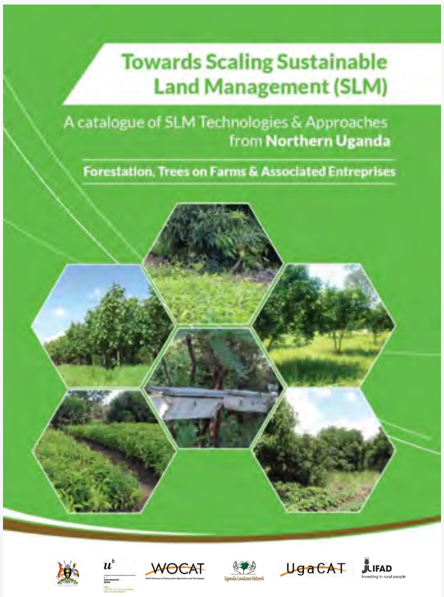
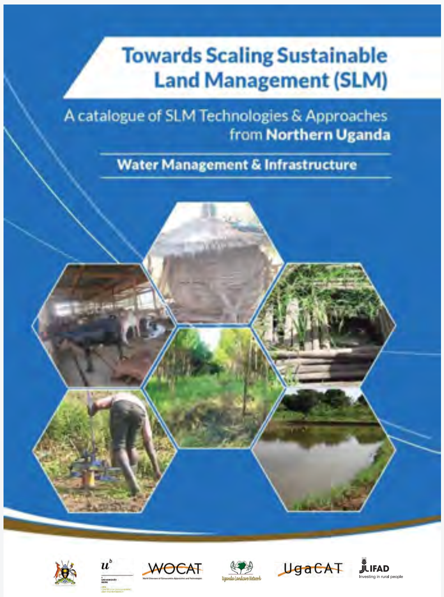
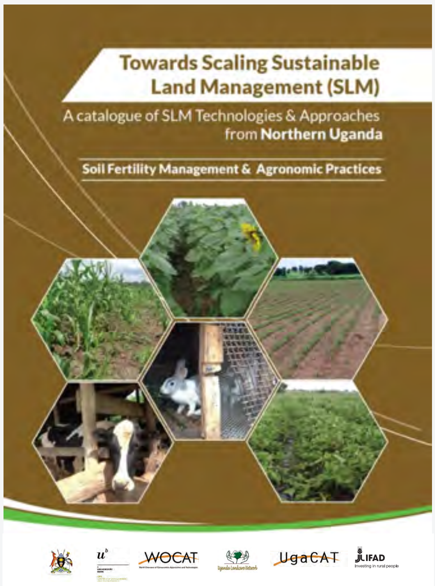
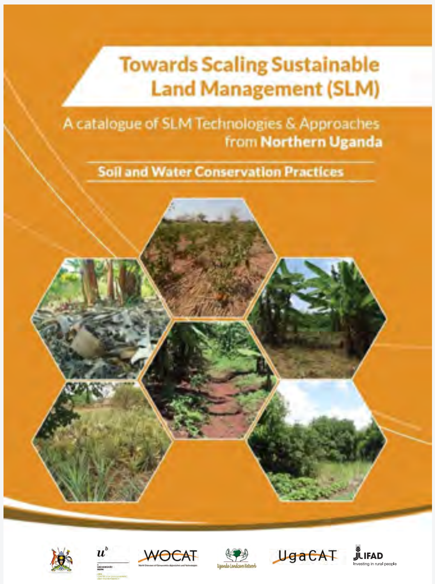
SCALING SUSTAINABLE LAND MANAGEMENT (SLM)

A collection of SLM Technologies and Approaches in Northern Uganda and beyond









2020

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WOCAT
World Overview of Conservation Approaches and Technologies
Uganda Landcare Network
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ACKNOWLEDGEMENT

Uganda Landcare Network (ULN) acknowledges a range of partners, institutions and individuals for their active participation in data collection and documentation. These include: Local government authorities of the nine districts (Lamwo, Adjumani, Amuru, Gulu, Nwoya, Agago, Kitgum, Pader plus a new district Omoro), Directorate of Extension under Ministry of Agriculture Animal Industry and Fisheries (MAAIF), National Agricultural Research Organisation (NARO), Project for Restoration of Livelihoods in Northern Uganda (PRELNOR) project implementation unit staff and various champion farmers. This documentation could only be realised with the support of the International Fund for Agriculture Development (IFAD) Uganda Country Office, the World Overview of Conservation Approaches and Technologies (WOCAT) secretariat, local compilers and reviewers and National Expert Group (NEG) members.

Caption: SLM stakeholders at the National Landcare Conference and Awards 2019 *(Photo by Issa Aligawesa)*

Caption: ULN secretariat at joint ULN-Uganda Forum for Agicultural Advisory Services (UFAAS) stakeholder's workshop on SLM integration into Agricultural Extension *(Photo by Issa Aligawesa)*

FOREWARD

Following the decision at the United Nations Conference on Environment and Development (UNCED) to elaborate a convention to combat desertification in 1992, Uganda was one of the countries that carried out studies to highlight different levels of vulnerability to drought and desertification. Consequently, the Government of Uganda (GoU) underscores interventions to reduce desertification and the effect of drought. At the national level, the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) spearhead the implementation of the United Nations Convention to Combat Desertification (UNCCD), which was signed on 21st November 1994 and ratified 25th June 1997 in close collaboration with the National Environment Management Authority (NEMA). An elaborated legal framework is in place to provide a dependable foundation on which the implementation of UNCCD is based including the constitution with laws and regulations to preserve the environment and prevent land degradation (Constitution of the Republic of Uganda, 1995 Article 245).

Considering the World Overview of Conservation Approaches and Technologies (WOCAT) global Sustainable Land Management (SLM) Database (www.wocat.net) is the primary recommended database by UNCCD for the reporting on good practices in SLM, Uganda spearheaded the compilation of a national SLM database hosted by the National Agricultural Research Organization (NARO), under the overall guidance of MAAIF and in partnership with the Uganda Landcare Network (ULN) in collaboration with the WOCAT secretariat. A selection of SLM practices is presented in the catalogue at hand. The aim of the database and catalogue is to increase awareness and motivation of planners and decision makers, agricultural extension agents, as well as farmers and other land users to take action against land degradation and scale up SLM solutions. SLM practices are documented and shared in a standardized format so the knowledge can be easily accessed and used by all stakeholders for evidence-based decision-making. Providing open access to SLM solutions on the ground and actively disseminating SLM knowledge will contribute to attaining land degradation neutrality (SDG 15.3).

Uganda's government through MAAIF remains committed to promote the building of a robust national database in collaboration with development partners and share the knowledge in different formats, such as this SLM catalogue. The commitment is propelled by GoU vision 2020 "A Transformed Ugandan Society from a Peasant to a Modern and Prosperous Country within 30 years". The vision illustrates specifically determination to fight desertification and droughts to enable economic growth including poverty eradication for local population as well as promoting a healthy environment for current and future generations.

Together towards Land Degradation Neutrality

Patience Rwamigisa Ph.D
Commissioner for Agricultural Extension
and Skills Management

SCALING-UP SUSTAINABLE LAND MANAGEMENT PRACTICES BY SMALL SCALE FARMERS

Introduction

This collection of Sustainable Land Management (SLM) practices was compiled as part of the International Fund for Agriculture Development (IFAD) funded project 'Scaling up SLM practices by smallholder farmers: working with agricultural extension services to identify, assess and disseminate SLM practices' implemented by the Centre for Development and Environment (CDE) of the University of Bern, Switzerland, hosting the World Overview of Conservation Approaches and Technologies (WOCAT) Secretariat, in partnership with Uganda Landcare Network (ULN) and close collaboration with the IFAD-supported loan investment in Uganda – the Programme for the Restoration of Livelihoods in the Northern Region (PRELNOR).

Caption: Agroforestry and Maize in Kitgum *(Photo by Issa Aligawesa)*

Target group

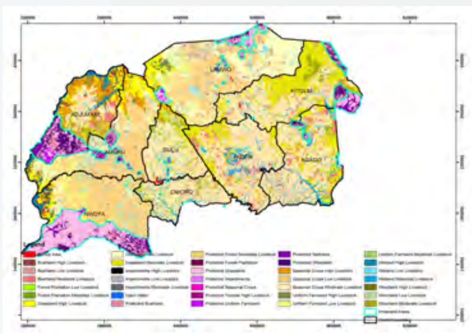
This collection of data and documentation of SLM Technologies (Ts) and Approaches (As) serves an invaluable technical tool for a range of stakeholders: extension agents, SLM planners, policy makers, private sector, and farmers. It includes relevant information on different SLM practices including implementation details, ecological and socio-economic benefits and disadvantages etc. to support informed decision making in SLM.

Caption: Apiary in Omoro *(Photo by Issa Aligawesa)*

Capacity building of extension

Prior to documentation of SLM Ts and As, a reconnaissance study in the project area in Northern Uganda was conducted to obtain an overview of SLM practices, the status of extension service and characterization of key landscapes. A Trainer of Trainers (ToT) was then conducted targeting Local Government officials, zonal centers under the National Agricultural Research Organisations (NARO), Directorate of Extension of Ministry of Agriculture Animal Industries and Fisheries (MAAIF), Champion farmers and project staff of PRELNOR and ULN. Documentation using standardised WOCAT tools was done by ULN staff together with field extension staff including NARO research scientists.

Caption: SLM stakeholders launching 'Scaling up SLM practices by smallerholder farmers' project, 2017 *(Photo by Hanspeter Liniger)*



Caption: Major land uses of Acholi sub-region including Adjumani *(Mapped by Grace Nangendo)*

WHAT IS SUSTAINABLE LAND MANAGEMENT (SLM)?

The wise use of land resources- including soils, water, vegetation, and animals to produce goods and provide services to meet changing human needs, while simultaneously ensuring the long-term productive potential of these resources and the maintenance of their environmental functions.

SLM Technology:

A physical practice on the land that controls land degradation enhances productivity, and / or other ecosystem services. A technology consists of one or more several measures such as agronomic, vegetative, structural and management measures.

SLM Approach:

An SLM Approach defines the ways and means used to implement one or several SLM Technologies. It includes technical and material support, as well as involvement and roles of different stakeholders, etc. An Approach can refer to a project/ programme or to activities initiated by land users themselves.

Source:
https://www.wocat.net/en/glossary

Caption: Mulching using grass on perenial cropland *(Photo by Issa Aligawesa)*

COLLECTION OF SUSTAINABLE LAND MANAGEMENT PRACTICES

Overview

This collection of SLM Technologies and Approaches was compiled as part of the project, 'Scaling - up Sustainable Land Management (SLM) practices by smallholder farmers: working with agricultural extension to identify, assess and disseminate SLM practices ' funded by the International Fund for Agriculture Development (IFAD).

SLM Categories

This collection captures four categories of SLM practices, namely:

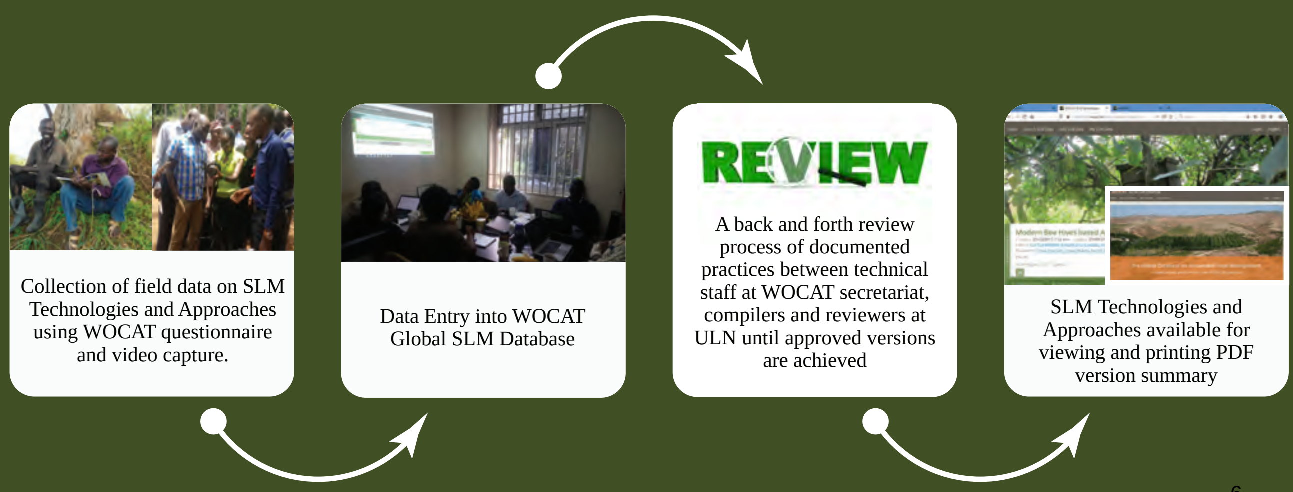
1. **Forestation, Trees on Farms & Associated Enterprises such as:**
   Fruit tree growing, orchard, integrated apiary, agroforestry
2. **Water Management & Infrastructures such as:**
   Ground water fed fish ponds, low cost irrigation with treadle pump
3. **Soil fertility management & agronomic practices such as:**
   Mulching, intercropping, crop rotation, manure use
4. **Soil and Water Conservation Practices such as:**
   Domestic roof and surface harvesting, contours, conservation basins

The collection captures details of SLM practices at farm level including practices selected by farmers themselves through a participatory process using a decision support tool. Some demonstrations examples are: Intercropping, Mulching, Agroforestry, Compost / manure, Cover crops, Apiary, Conservation basins, Aquaculture.

SLM Documentation process

Prior to the documentation of SLM Technologies and Approaches in the field, a series of trainings were conducted to introduce the methodology to be employed in the documentation process. The training focused on introduction of important tools, specifically the WOCAT Questionnaires on SLM Technologies and Approaches and related online WOCAT Database, to the target compilers (extension team, researchers as well as lead farmers).

The training was phased to include an SLM partner's workshop at national level to introduce the concept and create awareness as well as buy in and also ownership form high policy level. Elaborate Trainings of Trainers (ToTs) at project site level were conducted and involved hands on experience using the tools across Acholi subregion including Adjumani. The documentation at field level was steered by mainly extension agents, researchers under NARO and also field staff of ULN. The review of documented practices uploaded in the WOCAT Database (https://qcat.wocat.net) was done at two levels: in the country by local reviewers and with the WOCAT secretariat.



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SLM Technologies SLM Approaches

Forestation, Trees on Farms & Associated Entreprises

Integrated apiculture and forestry

Grevellia robusta (silk oak) boundary lines on a pineapple cropland

Modern beehives based apiculture

Multipurpose shrub species for supplementing animal pasture

Native tree species as windbreaks

Pine (*Pinus spp*) shielded mango (*Mangifera indica*) growing

WALA community tree planting approach

Pine (*Pinus spp*) wood lot

Fruit tree orchard of mangoes (*Mangifera indica*) and oranges (*Cytrus spp*) integrated with beans (*Phaseolus vulgaris*)


Photo showing Integrated Apiculture and Forestry technology in Northern Uganda (Rick Kamugisha)

Integrated Apiculture and Forestry (Uganda)

Penywii bee keepers association

DESCRIPTION

Maintaining colonies of honey bees within trees and shrubs for environmental conservation and household income.

Integrated apiculture and forestry technology is promoted and practiced by farmers with small, medium or large scale land holdings of 0.5 acres to 10 with an average of 5-28 local bee hives or more. The farmer may decide to increase the number of the beehives when he sells honey and he gets income.
The farmer (1) identifies the land with trees and shrubs where Local wooden bee hives made in rectangular shape are cited in a distance of not less than 5 -10 metres from one hive to the other (2) Clean the surrounding to reduce the weeds around the cited area (3) cite the beehives within the tree and shrubs (4) keep monitoring bush fires and thieves.
The necessary labour requirements for establishment of this technology include wooden beehives made locally and 4 people to install the bee hives who are paid on daily or monthly basis depending on request.
The benefits from this SLM technology are slightly negative due to the high costs of local bee hives at the time of establishment but positive in the long term of environmental conservation, honey provision and increased income from the sale of honey in addition to using local materials obtained locally associated with low costs.
Wild fires are a common threat during the dry seasons and in order to overcome this issue, it is needed to constantly keep monitoring and establish fire lines to guard against the wild fires

LOCATION

Location: Agago District, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 33.43499, 3.0976

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

In a permanently protected area?:

Date of implementation: 2013; 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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use

Forest/ woodlands Products and services: Fuelwood, Nature conservation/ protection

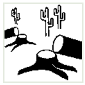
Water supply

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

Purpose related to land degradation

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

Degradation addressed

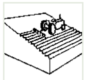


biological degradation - Bc: reduction of vegetation cover, Bh: loss of habitats, Bf: detrimental effects of fires, Bp: increase of pests/ diseases, loss of predators

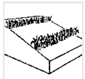
SLM group

- forest plantation management
- beekeeping, aquaculture, poultry, rabbit farming, silkworm farming, etc.

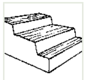
SLM measures



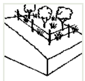
agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility



vegetative measures - V1: Tree and shrub cover, V3: Clearing of vegetation



structural measures - S9: Shelters for plants and animals

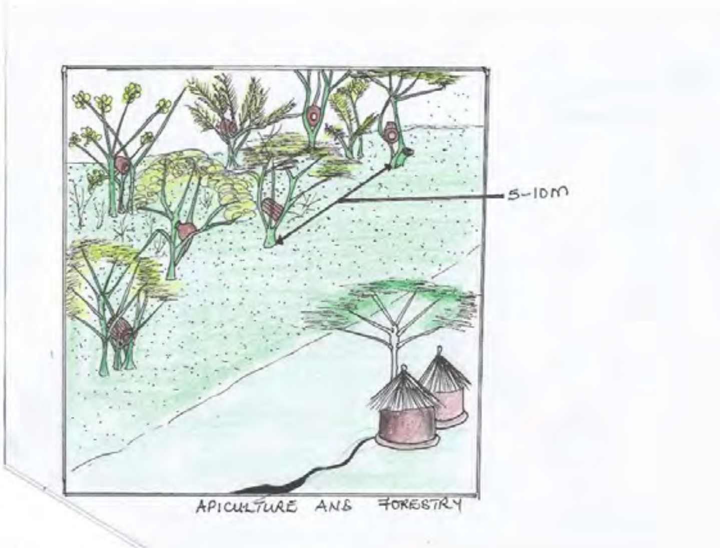


management measures - M1: Change of land use type

TECHNICAL DRAWING

Technical specifications

None



Author: Adora Phillip

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: 0.5 acres)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3400.0 UGX
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs
Purchase of bee hives.

Establishment activities
1. Site selection (location, distance) (Timing/ frequency: Once before establishment)
2. Look for labour to clear (Timing/ frequency: Once before estsblishment/ can be routine)
3. Clear the sorrounding (Timing/ frequency: During establishment/ Routine)
4. Buy the local wooden bee hives (Timing/ frequency: Once during establishment)
5. Installation of the beehives (Timing/ frequency: During establishment)

Establishment inputs and costs (per 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Persons days on monthly basis	persons	4.0	150000.0	600000.0	100.0
Equipment					
Bee hives	Pieces	25.0	75000.0	1875000.0	100.0
Other					
Transport for bee hives	Number	1.0	250000.0	250000.0	
					100.0
Total costs for establishment of the Technology				**2'725'000.0**	

Maintenance activities
1. Slashing (Timing/ frequency: Twice a year)
2. Making fireline to pevent fires (Timing/ frequency: Once a year but this requires maintanance)
3. Monitoring (Timing/ frequency: Daily)
4. Supervision (Timing/ frequency: Daily)

Maintenance inputs and costs (per 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Persons days for slashing, making fireline, monitoring	persons	4.0	150000.0	600000.0	100.0
Other					
Transport	1	1.0	250000.0	250000.0	100.0
Total costs for maintenance of the Technology				**850'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm

Agro-climatic zone
- [x] humid
- [ ] sub-humid

Specifications on climate
Average annual rainfall in mm: 1350.0
Two dry season and two wet season : Dry season June to August

- 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

- semi-arid
- arid

and January to February
Wet season: March to May and September to December

Slope
- flat (0-2%)
- ✓ 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- ✓ 501-1,000 m a.s.l.
- ✓ 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
- not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- ✓ excess
- good
- medium
- poor/ none

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

Water quality refers to:

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- ✓ subsistence (self-supply)
- ✓ mixed (subsistence/ commercial)
- commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ manual work
- ✓ animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- ✓ women
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household
- < 0.5 ha
- ✓ 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
- medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- ✓ open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- 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

Impact		Rating		Comment
land management	hindered	✓ (6/6)	simplified	Where the bee hives are installed, no cultivation and grazing activities are taking place.
expenses on agricultural inputs	increased	✓ (5/6)	decreased	Uses local wooden materials.
farm income	decreased	✓ (5/6)	increased	From the sale of honey.
diversity of income sources	decreased	✓ (5/6)	increased	Sale of honey and firewood.
workload	increased	✓ (2/6)	decreased	Required for Slashing , installation and carrying bee hives during establishment. This reduces over time.

Socio-cultural impacts

Impact		Rating		Comment
SLM/ land degradation knowledge	reduced	✓ (5/6)	improved	Installation and spacing the bee hives. Establishing fire line.

Ecological impacts

Impact		Rating		Comment
surface runoff	increased	✓ (5/6)	decreased	Presence of protected trees and shrubs.
soil cover	reduced	✓ (6/6)	improved	Presence of growing vegetation in the apiary.
soil loss	increased	✓ (6/6)	decreased	presence of rees and shrubs protect the soil from run off
soil organic matter/ below ground C	decreased	✓ (6/6)	increased	Decomposition of the leaves from the trees.
plant diversity	decreased	✓ (5/6)	increased	More trees and shrubs grow as result of protected apiary.
fire risk	increased	✓ (5/6)	decreased	Presence of fireline.

Off-site impacts

Impact		Rating		Comment
water availability (groundwater, springs)	decreased	✓ (5/6)	increased	Presence of a check dam where bees get water .

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Returns		Rating	
Short-term returns	very negative	✓ (3/7)	very positive
Long-term returns	very negative	✓ (5/7)	very positive

Benefits compared with maintenance costs

Returns		Rating	
Short-term returns	very negative	✓ (3/7)	very positive
Long-term returns	very negative	✓ (5/7)	very positive

High costs for buying beehives and paying labour compared to benefits which are rather low in the long term associated with obtaining income from the sale of honey.

CLIMATE CHANGE

Gradual climate change

Change		Rating		Comment
annual temperature decrease	not well at all	✓ (4/5)	very well	
seasonal temperature decrease	not well at all	✓ (4/5)	very well	Season: wet/ rainy season

Climate-related extremes (disasters)

Change		Rating	
forest fire	not well at all	✓ (3/5)	very well
insect/ worm infestation	not well at all	✓ (4/5)	very well

ADOPTION AND ADAPTATION

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

- ✓ single cases/ experimental
- 1-10%
- 11-50%
- > 50%

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

- 0-10%
- ✓ 11-50%
- 51-90%
- 91-100%

Number of households and/ or area covered

This is a demosntration for farmers learning.

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

- Yes

☑ No

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

- Helps control soil erosion because the land user does not dig where the bee hives are established.
- Provide income from the sale of honey.
- Can easily be replicated to other areas.
- Uses locally obtained materials.
- Easy to establish and maintain with minimum costs when the farmer has enough money.

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

- The technology uses materials which are locally obtained.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Requires technical knowledge on spacing and processing wax which is 20% of total honey produced. → Provide training to the land user on how to add value to the wax.
- The technology is liked by pests (obusinsibirizi) in the local language. → Training on how to control pests for increased production .
- Thieves like stealing the honey. The technology is a good attraction for thieves. → Facilitate formation of local level by-laws and enforcement of strong fines and bylaws.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Affected by Wild fires. → Promote firebreaks to guard against fires.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Stephanie Jaquet
Renate Fleiner
Nicole Harari
Drake Mubiru
Donia Jendoubi

Date of documentation: May 17, 2017

Last update: March 22, 2019

Resource persons
Phillip Odora - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2257/
Video: https://player.vimeo.com/video/325822100

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Grevillea Robusta provides shade to the pineapple fruits grown, dead leaves decompose to soil organic matter which makes the garden fertile. (Betty Adoch)

Grevillea Robusta (Silk Oak) Boundary Lines on a Pineapple Cropland (Uganda)

Yen ipoto

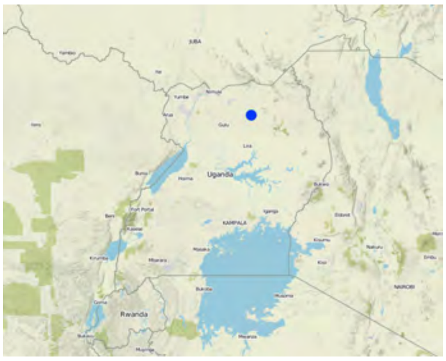
DESCRIPTION

Leguminous, fast growing grevillea robusta (silk oak) planted as boundary lines provides shade to a pineapple cropland, increases soil organic matter, provides fuel wood for domestic use and timber for construction after 5-8 years.

Grevillea Robusta (silk oak) is a leguminous, fast growing and evergreen tree planted in a natural environment with tropical savanna climate of Northern Uganda which receives rainfall of about 750-1000 mm per annum, established on a generally flat slope with an altitude of about 1000 meters above sea level. The soil type is moderately fertile with low moisture content that favours tree growth. These trees are planted as boundary lines for providing shade on a pineapple cropland, nitrogen fixation, increasing soil organic matter, providing fuel wood and as a source of timber for construction after 5-8 years. The tree species generally grows well under the mono-modal (one rainfall season) rainfall pattern of Northern Uganda.

Planting is normally done during the wet season at the onset of rain in early April and the inputs required for establishing this technology include Grevillea Robusta seedlings majorly provided by the District forestry officers, farmyard manure, hand hoes and spades. A hand hoe is used to dig pits about 0.5 m deep, 0.6 m wide and 3 to 5 m apart and 1 meter away from the pineapple crop. Farmyard manure is added to the pit to fill a depth of about 0.3 m, a layer of top soil is added to 0.2 m depth and the seedling is planted on top. The rest of the pit is filled with soil and watered to improve soil moisture content. Bamboo canes can be woven around the seedlings to protect them from destruction by livestock. Grevillea Robusta grows fast when the boundary line is well established within two years. The pruned branches provide fuel wood for domestic use like cooking and within 5 to 8 years the trees are harvested for timber. Establishment costs for this technology are normally higher compared to maintenance costs especially for the purchase of Grevillea seedlings, manures, farm equipment like hand hoes and pangas. The technology is easily and spontaneously adopted by average smallholder farmers with less than 2 acres and is useful for providing shade to the pineapple crop thus increasing the yield. What is not liked about this technology is that it forms a big canopy that limits photosynthesis. To maintain this technology, the land user has to constantly prune whenever the canopy grows big.

LOCATION



Location: Pader Town Council, Northern Uganda., Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 32.9923, 3.00843

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

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
- ☐ through projects/ external interventions

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
- [x] preserve/ improve biodiversity
- [ ] 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


Mixed (crops/ grazing/ trees), incl. agroforestry - Agroforestry
Main products/ services: Grevillea trees act as windbreak, provide shade and increase soil organic matter for pineapple crops.

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

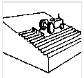
Number of growing seasons per year: 1
Land use before implementation of the Technology: The land was used for growing vegetables.
Livestock density: n.a.

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

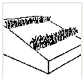
Degradation addressed


soil erosion by wind - Et: loss of topsoil, Ed: deflation and deposition

SLM group
- agroforestry
- windbreak/ shelterbelt
- integrated soil fertility management

SLM measures


agronomic measures - A5: Seed management, improved varieties

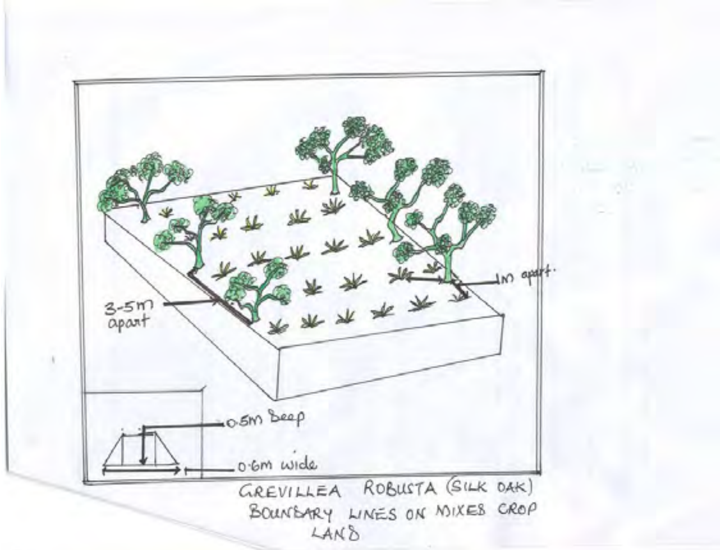


vegetative measures - V1: Tree and shrub cover

TECHNICAL DRAWING

Technical specifications

A hole is dug at a depth of 0.5 m, and 0.6 m wide. Farm yard manure added into the hole at a depth of 0.3 m and soil added to 0.2 m depth to fill up the hole in which tree seedlings are planted at a spacing of 3 or 5 meters apart since they do not form a huge canopy and 1 meter away from the pineapple crop.



Author: Betty Adoch.

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: 7 acres)
- Currency used for cost calculation: UGX
- Exchange rate (to USD): 1 USD = n.a UGX
- Average wage cost of hired labour per day: 3,000 shs

Most important factors affecting the costs
The Grevillea seedlings were distributed at a cost from the District. There is also high cost of hiring labour. However, family members can also help in maintaining the technology.

Establishment activities
1. Land clearing (Timing/ frequency: Late March)
2. Procurement of seedlings (Timing/ frequency: March)
3. Planting (Timing/ frequency: Early April at onset of rainfall)
4. Weeding (Timing/ frequency: May during wet season)
5. Pruning (Timing/ frequency: November in wet season)
6. Harvesting (Timing/ frequency: December during dry season for timber)

Establishment inputs and costs (per 7 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Hired labour	Day	30.0	3000.0	90000.0	100.0
Equipment					
Hoe	pieces	10.0	12000.0	120000.0	100.0
Panga	pieces	5.0	10000.0	50000.0	100.0
Plant material					
Grevillea seedlings	pieces	500.0	100.0	50000.0	100.0
Fertilizers and biocides					
Manure	Kgs	20.0	5000.0	100000.0	100.0
Construction material					
Bamboo reeds	pieces	100.0	1000.0	100000.0	100.0
Total costs for establishment of the Technology				**510'000.0**	

Maintenance activities
1. Pruning (Timing/ frequency: November)
2. Weeding (Timing/ frequency: May)

Maintenance inputs and costs (per 7 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
hired labour	days	5.0	3000.0	15000.0	100.0
Equipment					
hoes	pieces	10.0	12000.0	120000.0	100.0
pangas	pieces	5.0	10000.0	50000.0	100.0
Total costs for maintenance of the Technology				**185'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [x] 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
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
Average annual rainfall in mm: 1000.0
Moderate rain from April to October which supports the growth of the trees.
Name of the meteorological station: kitgum weather station
Tropical savanna climate

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
- [x] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [x] footslopes
- [ ] valley floors

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [x] 501-1,000 m a.s.l.
- [ ] 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
- [ ] 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
- [x] high (>3%)
- [ ] medium (1-3%)
- [ ] low (<1%)

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

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

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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

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

Level of mechanization
- [x] manual work
- [ ] 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
- [x] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [ ] 5-15 ha
- [x] 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
- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] 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	Quantity before SLM: low Quantity after SLM: high
wood production	decreased	□□□□□□✓	increased	Quantity before SLM: low Quantity after SLM: high
land management	hindered	□□□□□□✓	simplified	Quantity before SLM: low Quantity after SLM: high
energy generation (e.g. hydro, bio)	decreased	□□□□□□✓	increased	Quantity before SLM: low Quantity after SLM: high
farm income	decreased	□□□□□□✓	increased	Quantity before SLM: low Quantity after SLM: high
diversity of income sources	decreased	□□□□□□✓	increased	Quantity before SLM: low Quantity after SLM: high
Socio-cultural impacts				
SLM/ land degradation knowledge	reduced	□□□□□□✓	improved	Quantity before SLM: low Quantity after SLM: high
Ecological impacts				
soil moisture	decreased	□□□□□□✓	increased	Quantity before SLM: low Quantity after SLM: high
soil cover	reduced	□□□□□□✓	improved	Quantity before SLM: low Quantity after SLM: high
soil loss	increased	□□□□□□✓	decreased	Quantity before SLM: high Quantity after SLM: low the trees protect the soil from erosion
soil organic matter/ below ground C	decreased	□□□□□□✓	increased	Quantity before SLM: low Quantity after SLM: high
vegetation cover	decreased	□□□□□□✓	increased	Quantity before SLM: low Quantity after SLM: high
biomass/ above ground C	decreased	□□□□□□✓	increased	Quantity before SLM: low Quantity after SLM: high
plant diversity	decreased	□□□□□□✓	increased	Quantity before SLM: low Quantity after SLM: high
beneficial species (predators, earthworms, pollinators)	decreased	□□□□□□✓	increased	Quantity before SLM: low Quantity after SLM: high
habitat diversity	decreased	□□□□□□✓	increased	Quantity before SLM: low Quantity after SLM: high
wind velocity	increased	□□□□□□✓	decreased	Quantity before SLM: high Quantity after SLM: low trees protect the pineapple garden from strong wind
Off-site impacts				
buffering/ filtering capacity (by soil, vegetation, wetlands)	reduced	□□□□□□✓	improved	Quantity before SLM: Low Quantity after SLM: High Grevillea trees act as windbreak on a pineapple field

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: wet/ rainy season
Climate-related extremes (disasters)				
local rainstorm	not well at all	□□✓□□	very well	
local thunderstorm	not well at all	□□✓□□	very well	
local hailstorm	not well at all	□□✓□□	very well	
drought	not well at all	□□✓□□	very well	
forest fire	not well at all	□□✓□□	very well	

ADOPTION AND ADAPTATION

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

- ☐ single cases/ experimental
- ☑ 1-10%
- ☐ 10-50%
- ☐ more than 50%

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

- ☐ 0-10%
- ☐ 10-50%
- ☐ 50-90%
- ☑ 90-100%

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

- ☑ Yes
- ☐ No

To which changing conditions?

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

The grevillea robusta trees increase soil water retention after heavy rainfall episodes, and organic matter.

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Grevillea trees when mature provide timber for construction.
- Grevillea tree branches when pruned supply fuel wood.
- The dry tree leaves decompose and provide manure for the garden.

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

- Grevillea robusta provides many soil conservation benefits like nitrogen fixing and soil moisture retention among them.
- Young shoots from grevillea robusta provide animal fodder.
- The trees helps modify the microclimate.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Trees take up some of the cropland that should have been used to grow other crops. → Agroforestry
- Labour intensive in terms of pruning trees. → Family members to provide labour

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Grevillea provides shade to pineapple crops that obstructs the photosynthesis process. → Plant grevillea at a distance from the plant

REFERENCES

Compiler
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Reviewer
John Stephen Tenywa (johntenywa@gmail.com)
Nicole Harari (nicole.harari@cde.unibe.ch)
Renate Fleiner (renate.fleiner@cde.unibe.ch)

Date of documentation: June 7, 2017

Last update: July 16, 2019

Resource persons
Kilama George - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2778/
Video: https://player.vimeo.com/video/254826831

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- Uganda Landcare Network (ULN) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Links to relevant information which is available online
- None: https://www.gardenia.net/plant/Grevillea-robusta-Silky-Oak

Photo showing Modern Bee Hives based Apiculture in Northern Uganda (Rick Kamugisha)

Modern Bee Hives based Apiculture (Uganda)

Pito Kil

DESCRIPTION

Modern bee hives are installed on natural trees in order to conserve the environment and provide honey and income.

Apiculture is a non-problematic enterprise promoted by small-scale farmers. Beehives are hanged by the land user on trees for purposes of conservation and obtaining income from the sale of honey. The technology is located on a gentle slope (3-5%) of 3 acres of land with 150 bee hives installed. The trees produce flowers from which bees collect nectar to make honey. The activities involved in the establishment include making or acquiring improved beehives, installing the hives, and buying honey-harvesting equipment. In addition, there are maintenance activities which are; the inspection of the hives for damages, repair of damaged hives, periodic harvesting of honey, clearing overgrowth within the apiary and marketing the honey. The inputs required for establishing such a technology include labour for bush clearing, placing the beehives within trees and construction of fire lines. Other inputs are beehives, a bee suit, smoker, bucket, filtering materials and bottles. These inputs require a lot of money. The benefits from this SLM technology are slightly negative due to the high costs of labour at the time of establishment but positive in the long term due to environmental conservation, provision of honey and income from the sale of honey and to some extent reduction in land cover depletion since no cultivation takes place where the bee hives are installed. The bees also play an important role in the well being of the ecosystem through pollinating flowers of plants within their reach.
The technology is easy to manage once established, because it does not require routine activities like weeding, spraying and watering. For other land users who may need to adopt this technology, they need to seek advice from extension agents on how to install the beehives.

LOCATION

Location: Kitgum District, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 33.18444, 3.20355

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

Date of implementation: 2013; less than 10 years ago (recently)

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [x] reduce, prevent, restore land degradation
- [x] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] 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

Forest/ woodlands - (Semi-)natural forests/ woodlands: Dead wood/ prunings removal
Products and services: Other forest products
other (specify): Honey

Mixed (crops/ grazing/ trees), incl. agroforestry - Agroforestry

Water supply

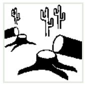
- [x] rainfed
- [ ] mixed rainfed-irrigated
- [ ] full irrigation

Number of growing seasons per year: 2
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

Purpose related to land degradation

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

Degradation addressed

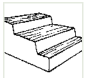


biological degradation - Bc: reduction of vegetation cover, Bh: loss of habitats, Bf: detrimental effects of fires

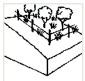
SLM group

- agroforestry
- beekeeping, aquaculture, poultry, rabbit farming, silkworm farming, etc.

SLM measures



structural measures - S11: Others

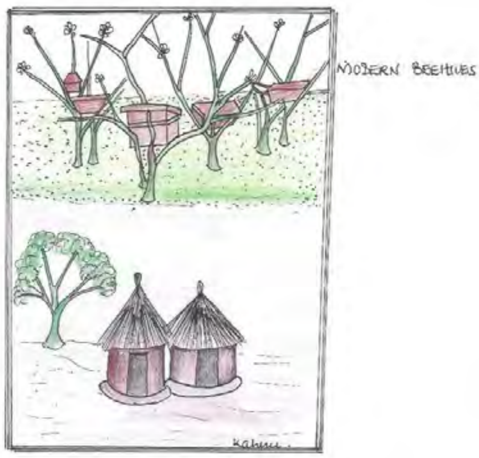


management measures - M2: Change of management/ intensity level, M3: Layout according to natural and human environment

TECHNICAL DRAWING

Technical specifications

The technology is installed on a gentle slope (3-5%) located on a 3 acres of land with 150 bee hives.



Author: Kaheru

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: 3 acres)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3400.0 UGX
- Average wage cost of hired labour per day: 5000 per person per day

Most important factors affecting the costs

Modern bee hives are the most expensive and the costs of labour.

Establishment activities

1. Installing bee hives location (Timing/ frequency: Once before establishment,)
2. Construction of hives (traditional and modern) (Timing/ frequency: Before establishment)
3. Place hives on forests or trees (Timing/ frequency: Before establishment)

Establishment inputs and costs (per 3 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Hired labour (installation)	persons	5.0	5000.0	25000.0	
Equipment					
Bee hives	Pieces	16.0	90000.0	1440000.0	
Other					
Transport	pick up	1.0	20000.0	20000.0	
Total costs for establishment of the Technology				**1'485'000.0**	

Maintenance activities

1. Clearing around the apiary (Timing/ frequency: Once a year)
2. Hive inspection (Timing/ frequency: After every two weeks)
3. Repair of damaged hives (Timing/ frequency: Once after 2 years)
4. Regular checking of hives (Timing/ frequency: Regularly)
5. Filter honey from curbs to seprate wax (Timing/ frequency: At the time of harvesting)

Maintenance inputs and costs (per 3 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Hired labour	persons	5.0	5000.0	25000.0	
Equipment					
Timber	Pieces	2.0	10000.0	20000.0	
Nails	kgs	2.0	7000.0	14000.0	
Wires	kgs	100.0	2000.0	200000.0	
buckets	Pieces	5.0	15000.0	75000.0	
Total costs for maintenance of the Technology				**334'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall

< 250 mm

Agro-climatic zone

humid

Specifications on climate

Average annual rainfall in mm: 1350.0

- [ ] 251-500 mm
- [ ] 501-750 mm
- [x] 751-1,000 mm
- [x] 1,001-1,500 mm
- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

- [x] sub-humid
- [ ] semi-arid
- [ ] arid

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

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

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [x] 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
- [x] concave situations
- [ ] 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)
- [x] fine/ heavy (clay)

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

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

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

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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

Off-farm income
- [x] less than 10% of all income
- [ ] 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
- [ ] animal traction
- [ ] mechanized/ motorized

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

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

Gender
- [ ] women
- [x] men

Age
- [ ] children
- [ ] youth
- [x] middle-aged
- [x] 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
- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] 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

None | poor ☑☐☐ good

IMPACTS

Socio-economic impacts

land management	hindered ☐☐☐☐☐☐☑ simplified		No roaming animals and the technology allows vegetation growth.
farm income	decreased ☐☑☐☐☐☐☐ increased		Decrease in the short run at the time of establishment and relaised in the long run at the time of harvest.
workload	increased ☐☐☐☐☐☑☐ decreased		

Socio-cultural impacts

Ecological impacts

soil moisture	decreased ☐☐☐☐☐☑☐ increased	
soil cover	reduced ☐☐☐☐☐☑☐ improved	Due to litter from the tree leaves.
soil loss	increased ☐☐☐☐☐☑☐ decreased	
vegetation cover	decreased ☐☐☐☐☐☑☐ increased	No cultivation taking place where the bee hives are cited.
plant diversity	decreased ☐☐☐☐☐☑☐ increased	
beneficial species (predators, earthworms, pollinators)	decreased ☐☐☐☐☐☑☐ increased	

Off-site impacts

damage on neighbours' fields	increased ☐☐☐☐☐☑☐ reduced	protected.

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

At start the costs of establishment are high and reduce with time instead reaps alot of profits from the sales.

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: wet/ rainy 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
- ☑ 1-10%
- ☐ 10-50%
- ☐ more than 50%

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

- ☑ 0-10%
- ☐ 10-50%
- ☐ 50-90%
- ☐ 90-100%

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

- ☑ Yes
- ☐ No

The land user started with local bee hives- later adopted use of modern bee hives from NAAD's.

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

- Source of income with good market locally.
- Its a source of employment for family members and those in

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- The apiary is near home stead and bees can bite people.

the community.
- Easy to manage once established. Does not have routine activities like weeding, spraying and watering. There for easy to manage.
- Can be easily replicated by other land users with less or similar size of land else where.

Strengths: compiler's or other key resource person's view
- The technology does not require alot of labour once established.

→ Relocating some bee hives which are too near.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome
- The technology is a long term benefit: The land user need to Integrate other SLM practices for quick income → promoting zero grazing for manure and other products.

REFERENCES

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Date of documentation: May 22, 2017

Last update: March 8, 2019

Resource persons
Oris OKeny (ocanbosco@yahoo.com) - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2327/
Video: https://player.vimeo.com/video/254824109

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

(Issa)

Multi purpose tree species for suplementing animal pasture (Uganda)

pito yat ma lee chamo

DESCRIPTION

Multipurpose tree species such as Calliandra are planted on farmstead to supplement animal pastures

Livestock keepers in Northern Uganda face challenges of obtaining pasture for their animals due to land fragmentation, conflicts and bush burning. Cattle keepers in Nwoya District now plant multipurpose trees to supplement grass as Livestock pasture.
Multipurpose trees seedlings or cuttings or seeds such as Calliandra calothursus are planted in natural pasture land at a spacing of about 8m x 8m, depending on the tree species, the spacing can be wider or narrower. The trees are caged during the first year of growth to prevent the animals from feeding on them and ensure proper establishment. The trees grow very first and in the following year after planting, they can be used for feeding the livestock. The tree leaves can be cut and carried to the livestock when or grazed depending on the age and height.
The trees produce nutritious leaves, among other products, used as livestock feed to supplement animal pasture. Furthermore, the trees provide shade for the animals during hot days. The leguminous trees bear vegetation rich in protein content, are ever green and produce leaves throughout the year, hence, serve as an important source of feed during dry season when grass is dry or burnt. Animals produce good quality manure that can be used for improving soil fertility. The availability of leguminous trees in the pasture land also prevents overgrazing on the grass and therefore an incidence of soil erosion is minimized.

LOCATION

Location: Gulu, Northern, Uganda

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 32.34512, 2.75856

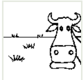
Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2008; less than 10 years ago (recently)

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

CLASSIFICATION OF THE TECHNOLOGY

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

Land use


Grazing land - other (specify): tethering domestic animals
Main animal species and products: cattle, goat, sheet

Water supply
- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Number of growing seasons per year: 2
Land use before implementation of the Technology: n.a.
Livestock density: 8/homestead

Purpose related to land degradation
- prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- ✓ adapt to land degradation
- not applicable

Degradation addressed


soil erosion by water - Wg: gully erosion/ gullying

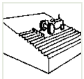
soil erosion by wind - Et: loss of topsoil

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

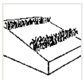
physical soil deterioration - Pc: compaction, Ps: subsidence of organic soils, settling of soil

biological degradation - Bc: reduction of vegetation cover, Bh: loss of habitats, Bq: quantity/ biomass decline

SLM group
- pastoralism and grazing land management
- integrated crop-livestock management

SLM measures


agronomic measures - A1: Vegetation/ soil cover

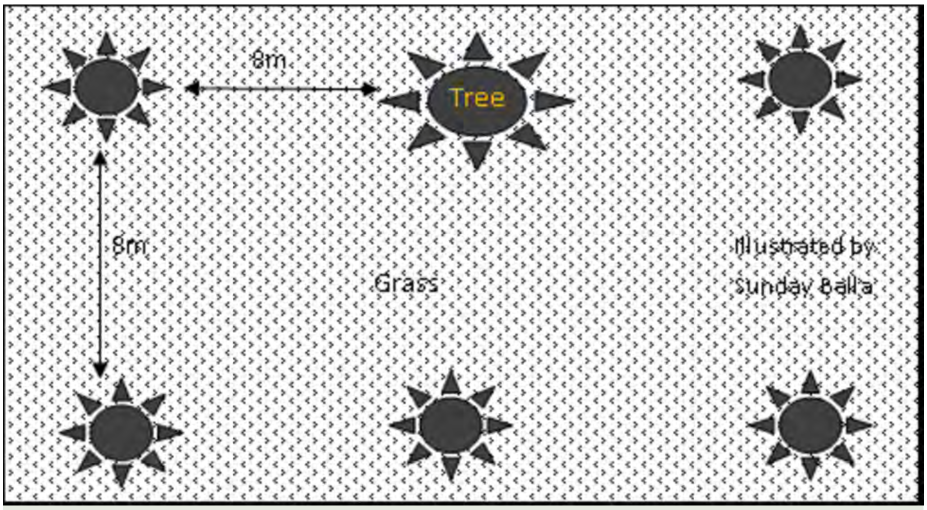


vegetative measures - V2: Grasses and perennial herbaceous plants

TECHNICAL DRAWING

Technical specifications

Trees are planted at a spacing of about 8m x 8m in the grazing land.



Author: Sunday Balla

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1 acreas of grazing land**)
- Currency used for cost calculation: **Uganda shillings**
- Exchange rate (to USD): 1 USD = 3600.0 Uganda shillings
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs
labour for planting

Establishment activities

1. Sourcing seed of multipurpose trees (Timing/ frequency: dry season)
2. digging the holes for planting (Timing/ frequency: onset of rains)
3. planting the seeds (Timing/ frequency: early rainy season)
4. protecting young trees from destruction (Timing/ frequency: during growth periods)

Establishment inputs and costs (per 1 acreas of grazing land)

Specify input	Unit	Quantity	Costs per Unit (Uganda shillings)	Total costs per input (Uganda shillings)	% of costs borne by land users
Labour					
personnel	persondays	4.0	5000.0	20000.0	100.0
Equipment					
hand hoe	pieces	1.0	10000.0	10000.0	100.0
tape measure	pieces	1.0	5000.0	5000.0	100.0
Plant material					
seed	kg	0.5	40000.0	20000.0	100.0
Total costs for establishment of the Technology				**55'000.0**	

Maintenance activities
n.a.

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 meteorological station

Slope
- flat (0-2%)
- ✓ 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- ✓ 501-1,000 m a.s.l.
- 1,001-1,500 m a.s.l.
- 1,501-2,000 m a.s.l.
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- 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
- ✓ not relevant

Soil depth
- [ ] very shallow (0-20 cm)
- [x] shallow (21-50 cm)
- [ ] 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
- [x] 5-50 m
- [ ] > 50 m

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

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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

Off-farm income
- [x] less than 10% of all income
- [ ] 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
- [x] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [x] 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
- [x] small-scale
- [ ] medium-scale
- [ ] large-scale

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

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

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

fodder production	decreased						✓		increased	animal have enough feed
fodder quality	decreased							✓	increased	leguminous multipurpose tree leaves have high protein content Quantity before SLM: 4 Quantity after SLM: 6
animal production	decreased						✓		increased	
wood production	decreased					✓			increased	the branches of trees used as firewood
risk of production failure	increased						✓		decreased	usually higher production
land management	hindered						✓		simplified	reduced erosion and trampling Quantity before SLM: 3litre/day Quantity after SLM: 5litre/day
farm income	decreased						✓		increased	

										higher milk propuction
workload	increased					✓		decreased		used to spend more time grazing animals

Socio-cultural impacts

food security/ self-sufficiency	reduced					✓		improved		adequate milk production
health situation	worsened				✓			improved		
land use/ water rights	worsened				✓			improved		
cultural opportunities (eg spiritual, aesthetic, others)	reduced			✓				improved		
community institutions	weakened			✓				strengthened		
national institutions	weakened				✓			strengthened		
SLM/ land degradation knowledge	reduced					✓		improved		
conflict mitigation	worsened						✓	improved		animals used to destroy other people's fields looking for pasture

Ecological impacts

soil crusting/ sealing	increased				✓			reduced		
soil compaction	increased					✓		reduced		
vegetation cover	decreased					✓		increased		
biomass/ above ground C	decreased				✓			increased		
plant diversity	decreased				✓			increased		grass and trees
beneficial species (predators, earthworms, pollinators)	decreased				✓			increased		multipurpose tree spp
drought impacts	increased					✓		decreased		trees are ever green even during dry periods when pasture are burnt or dried up
wind velocity	increased					✓		decreased		trees act as wind breaks
micro-climate	worsened					✓		improved		trees act as shade for livestock

Off-site impacts

groundwater/ river pollution	increased				✓			reduced		
damage on neighbours' fields	increased						✓	reduced		less movement and enough feeds
impact of greenhouse gases	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 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
- ✓ 1-10%
- 10-50%
- more than 50%

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

- ✓ 0-10%
- 10-50%
- 50-90%
- 90-100%

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

- Yes
- ✓ No

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

- It is cheap to establish
- does not require maintenance
- produce pasture throughout the year

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

- produce good quality pasture high in protein content
- animals produce good quality manure that can be applied in crop fields
- branches can be used as feed

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Trees take almost a year to grow and become ready for feeding animals

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

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Date of documentation: Dec. 19, 2017

Last update: Feb. 6, 2018

Resource persons
Sunday Balla Amale (sundayamale@gmail.com) - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_3328/

Linked SLM data
Approaches: In-situ pasture establishment demonstrations https://qcat.wocat.net/en/wocat/approaches/view/approaches_3285/
Approaches: On-farm pasture establishment demonstrations https://qcat.wocat.net/en/wocat/approaches/view/approaches_3285/
Approaches: On-farm indigenous pasture establishment demonstrations https://qcat.wocat.net/en/wocat/approaches/view/approaches_3285/
Approaches: On-farm indigenous pasture establishment demonstrations https://qcat.wocat.net/en/wocat/approaches/view/approaches_3285/

Documentation was faciliated by
Institution
- Makerere University (Makerere University) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Scattered native trees on-farm protect crops such as maize and bananas agaist strong winds (Otto Richard Kawawa)

Native trees as wind breaks (Uganda)

Gwokoyen Ma tye ki Kony

DESCRIPTION

Native tree scattered in the garden reduce wind speeds and lower chances of winds damaging crops

In relatively flat areas such as those in semi-arid parts of northern Uganda, strong winds can exacerbate damage to crops and animal structures in addition to increasing evaporation from watering troughs for animals. To reduce the risk of these occurrences, farmers maintain trees interspersed in the croplands or paddocks to intercept the strong winds.

Trees used for this purpose are generally native species because they grow large in diameter (> 60 cm dbh) and develop wide crowns (~20 m diameter). Some of the native tree species for this technology include Shea tree (Vitellaria paradoxa), and Tido (Khaya grandifoliola). The trees are not arranged in any specific pattern since they establish naturally, and are managed to grow and pruned appropriately to better reduce the impact of strong winds. The spacing between trees can range from 10 to 30 meters depending on the size but also on the location of target structures such as homestead and animal structures. By periodically pruning these trees, farmers also get wood for fuel while reducing the risk of injury from branches falling down as they deteriorate with age. The trees also provide shade in homesteads and in grazing lands. Pruning allows younger branches to emerge and ensures the health and longevity of the trees for several decades.

What farmers like about the technology is that the cost of establishment is generally very low as the care and pruning of trees does not require the purchase of any expensive equipment, planting materials are not required, and there is no labour required for planting. The technology does not take so much land since the trees are sparsely scattered in the crop or grazing land or along the boundaries. Also, the trees provide firewood when the branches are pruned. Sometimes farmers locate bee hives in these trees, thereby ensuring income diversification for the household.

Farmers dislike this technology because native tree species take long (15-20 years) to grow to appropriate sizes to effectively reduce the impact of strong winds and they are also in high demand for charcoal production. Furthermore, they can only be retained where they naturally grow, thus not being very effective as wind breaks as would be the case for those trees that are planted in preferred locations in the landscape. It is labour-intensive to prune these generally large trees with complex crowns, especially when they are fully grown. The trees also acts as hosts for birds, which are formidable pests to crops such as sorghum, simsim and maize in the gardens. The roots of trees extend to large areas within the gardens and can potentially reduce the yield of the nearby crops if root-pruning is not done. These trees also provide additional benefits such as shea from Vitellaria paradoxa that are useful as nutritional supplements. Timber from Khaya grandifoliola is highly valuable and earns additional income to the household.

LOCATION

Location: Latanya s/county Pader District, Northern, Uganda

No. of Technology sites analysed: 10-100 sites

Geo-reference of selected sites

- 33.434, 3.097

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

Date of implementation: 1950; more than 50 years ago (traditional)

Type of introduction

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use

Mixed (crops/ grazing/ trees), incl. agroforestry -
Agroforestry
Main products/ services: Maize, Simsim, Sorghum, Sweet potatoes

Water supply

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

Number of growing seasons per year: 2

Land use before implementation of the Technology: No change

Livestock density: Grazing is done during the dry season usually immediately after harvesting maize and sorghum

Purpose related to land degradation

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

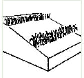
Degradation addressed

other -

SLM group

- agroforestry
- windbreak/ shelterbelt

SLM measures

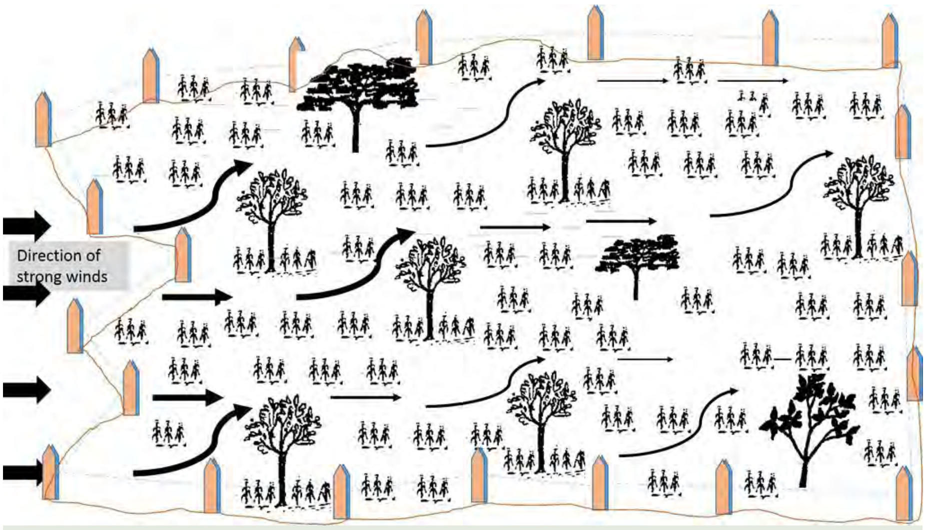


vegetative measures - V1: Tree and shrub cover

TECHNICAL DRAWING

Technical specifications

Trees randomly scattered within cropland
Spacing of trees ranges from 10 to 30 meters
Size of trees ranges from 10 to > 60 cm diameter and 5 to 30 meters in height



Author: Bernard Fungo

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology unit (unit: **Land management unit** volume, length: **6 acres**)
- 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
Pruning height of the trees. Higher and larger trees are more expensive to prune but also provide more firewood to the farmer

Establishment activities
1. Protection (Timing/ frequency: Always)
2. Pruning (Timing/ frequency: Once a year)

Establishment inputs and costs (per Land management unit)

Specify input	Unit	Quantity	Costs per Unit (Uganda Shilings)	Total costs per input (Uganda Shilings)	% of costs borne by land users
Labour					
Labor	1	40.0	2000.0	80000.0	100.0
Total costs for establishment of the Technology				**80'000.0**	

Maintenance activities
1. Pruning (Timing/ frequency: Once a year)

Maintenance inputs and costs (per Land management unit)

Specify input	Unit	Quantity	Costs per Unit (Uganda Shilings)	Total costs per input (Uganda Shilings)	% of costs borne by land users
Labour					
labor	1	40.0	2000.0	80000.0	100.0
Total costs for maintenance of the Technology				**80'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 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
- [x] 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%)

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

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.

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

- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

- [ ] footslopes
- [ ] valley floors

- [ ] 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.

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
- [x] 5-50 m
- [ ] > 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

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [x] 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

wood production	decreased						✓		increased
Time spent looking for firewood	None		✓						None

Socio-cultural impacts

Ecological impacts

wind velocity	increased						✓		decreased
micro-climate	worsened						✓		improved

Off-site impacts

wind transported sediments — increased / reduced: ✓ reduced

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative	✓ (positive)	very positive
Long-term returns	very negative	✓ (very positive)	very positive

Benefits compared with maintenance costs

Short-term returns	very negative	✓ (positive)	very positive
Long-term returns	very negative	✓ (very positive)	very positive

CLIMATE CHANGE

Climate-related extremes (disasters)

heatwave	not well at all	✓ (well)	very well
Strong winds	not well at all	✓ (very well)	very well

ADOPTION AND ADAPTATION

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

- [ ] single cases/ experimental
- [ ] 1-10%
- [x] 10-50%
- [ ] more than 50%

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

- [ ] 0-10%
- [ ] 10-50%
- [x] 50-90%
- [ ] 90-100%

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

- [ ] Yes
- [x] No

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

- Also provides fire wood for the household
- Trees also provide shade for the crops and livestock

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

- Fire wood can be obtained in addition to the environmental services that the trees provide

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Attracts wild animals e.g. snakes
- Only men are able to implement the technology because it is difficult

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- The trees sometimes attract wild animals such as snakes and squirrels.
- Protection from wild fire is sometimes required if the trees are close (< 10 meters)

REFERENCES

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Date of documentation: June 29, 2017

Last update: July 18, 2019

Resource persons
Richard Otim - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2871/
Video: https://player.vimeo.com/video/348382678

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- Uganda Landcare Network (ULN) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Key references

- N/a:

Links to relevant information which is available online

- Agroforestry system (intercropping beans/maize) with contour ditches, strips of Napier grass, manure and organic fertilizers. (Kenya): https://qcat.wocat.net/en/summary/2755/?as=html
- Dynamic agroforestry systems (Bolivia, Plurinational State of): https://qcat.wocat.net/en/summary/514/?as=html

Mango orchard (left) shiled against strong winds by a pine plantation (Right) (Issa Aliga)

Pine-shielded mango growing (Uganda)

Pito yen PIne Inget mayembe

DESCRIPTION

Pine-based shelter belt is used to protect an orchard of mangoes against strong winds in order to prevent abscission of generative organs such as flower buds, flowers, small fruits and ripened fruits

Falling of flower buds and young fruits are brought about by strong winds common in northern Uganda. This can significantly reduce the number of fruits harvested and therefore cause a reduction in income to the farmer.

Fruit trees (mainly mangoes and oranges) are protected from strong winds by establishing a pine plantation beside the orchard. The plantation of pine is established in the direction from where the strong winds come and the fruit trees are established on the opposite side so that the wind velocity is reduced by the pines before it damages the fruit trees. This is because pine trees generally grow taller than the fruit trees and thus provide a shield against strong winds. Individual plants of the fruit trees are planted at a spacing of 6 x 6 m within and between rows. The spacing between the fruit trees and pine trees is approximately 10 meters. Within five years, pine trees reach a size of about 8 meters high and a diameter of about 15 cm. The fruit trees and the pines are established at the same time and all management activities such as weeding, pruning and thinning are done in a manner similar to conventional management practice for individual orchards or pine plantations.

The most important inputs for this technology are the seedlings, labour for planting and periodic activities such as weeding, thinning and pruning. On average, a seedling of a fruit tree costs about UGX 3,000 while a pine tree costs UGX 500. Approximately 500 trees are planted in an acre of land in the ratio of 3:1 for fruit tree to pine tree, respectively. This technology is suitable for farmers who have extra land besides that for the orchards, in order to plant pine shelterbelts.

One great advantage of this technology to farmers is that it provides benefits from both pine plantation and from the orchard. According to the farmer, controlling wind speed using pine shelterbelts can improve the yield of the fruit trees by up to 50% which compensates for the number of fruit trees being reduced by 30%. Nonetheless, the return on investment is high, mainly due to the high price fetched for the fruits from the orchard. This technology is also a climate change adaptation strategy because it guards against extreme weather events such as strong winds, diversifies farmers income and mitigates climate change through carbon sequestration in pine plantation.

Despite the advantages, the farmer was abhorrent of the high establishment costs that are also relatively high compared to the costs a farmer has growing only orchards. The payback period is also fairly long, approaching 5 years for the orchard and 15-20 years for the timber from the pines. A further challenge is how to manage drought and heavy winds that are becoming more frequent and extreme.

Shielding orchards is done where the land is generally flat and the winds are strong such as in the plains of northern Uganda. It is suitable where both fruit trees and timber provide equally important products for the market.

LOCATION

Location: Northern, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.08786, 2.86487
- 32.09061, 2.86761

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

Date of implementation: 2013; less than 10 years ago (recently)

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [ ] improve production
- [x] 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
- [x] mitigate climate change and its impacts
- [x] create beneficial economic impact
- [ ] create beneficial social impact

Land use

Cropland - Perennial (non-woody) cropping

Forest/ woodlands - Products and services: Fruits and nuts

Water supply

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

Number of growing seasons per year: 2

Land use before implementation of the Technology: n.a.

Livestock density: n.a.

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

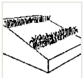
soil erosion by wind - Et: loss of topsoil, Ed: deflation and deposition, Eo: offsite degradation effects

other -

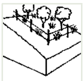
SLM group

- forest plantation management
- agroforestry
- windbreak/ shelterbelt

SLM measures



vegetative measures - V1: Tree and shrub cover

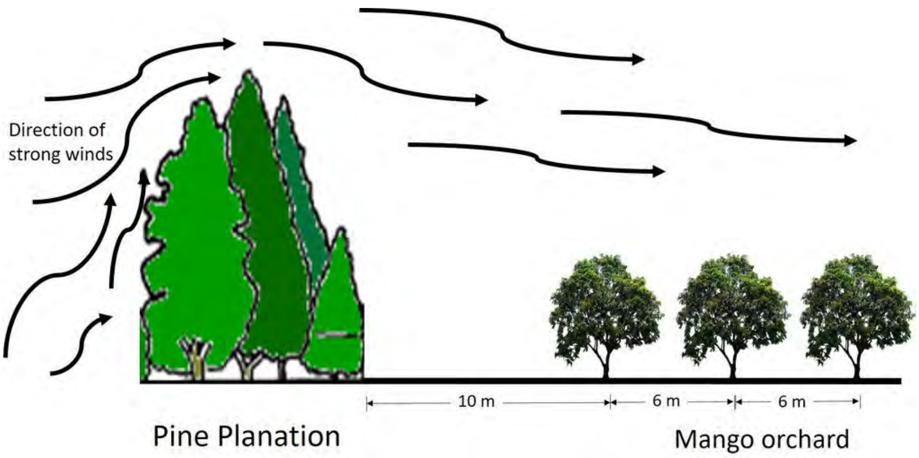


management measures - M5: Control/ change of species composition

TECHNICAL DRAWING

Technical specifications

Pine trees spaced at 3 x 3 meters throughout the plantation
Approximately 500 trees per acre
Mango trees planted 10 meters away from the Pine trees
spacing of mangoes is 6 x 6 meters



Author: Bernard Fungo

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **Acres**; conversion factor to one hectare: **1 ha = 0.4**)
- Currency used for cost calculation: **Uganda Shillings**
- Exchange rate (to USD): 1 USD = 3500.0 Uganda Shillings
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs

Land preparation and planting

Establishment activities

1. Clearing of land (Timing/ frequency: At the beginning of the season)
2. Planting (Timing/ frequency: Once at the start of the establishment)
3. Weeding (Timing/ frequency: None)
4. Thinning of pine plantation (Timing/ frequency: None)
5. Pruning of the pine plantation (Timing/ frequency: At age 3 and 7 years)

Establishment inputs and costs (per Acres)

Specify input	Unit	Quantity	Costs per Unit (Uganda Shillings)	Total costs per input (Uganda Shillings)	% of costs borne by land users
Labour					
Land preparation	Acre	1.0	200000.0	200000.0	100.0
Planting	Acre	1.0	100000.0	100000.0	100.0
Plant material					
Seedlings of Pine	Acre	500.0	500.0	250000.0	100.0
Seedlings of Mangoes	Acre	300.0	3000.0	900000.0	100.0
Total costs for establishment of the Technology				**1'450'000.0**	

Maintenance activities

1. Weeding (Timing/ frequency: Twice a year for the first year and once a year thereafter)
2. Pruning (Timing/ frequency: At age 3 and 7 years)
3. Thining (Timing/ frequency: At age 4 and 8 years)

Maintenance inputs and costs (per Acres)

Specify input	Unit	Quantity	Costs per Unit (Uganda Shillings)	Total costs per input (Uganda Shillings)	% of costs borne by land users
Labour					
Weeding	Acre	1.0	100000.0	100000.0	100.0
Pruning of Pine	Acre	1.0	20000.0	20000.0	100.0
Thinning of Pine	Acre	1.0	200000.0	200000.0	100.0
Plant material					
Seedlings for beating-up - Pine	Number	100.0	500.0	50000.0	100.0
Seedlings for beating-up - Mangoes	Number	50.0	3000.0	150000.0	100.0
Total costs for maintenance of the Technology				**520'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall

- ☐ < 250 mm
- ☐ 251-500 mm
- ☐ 501-750 mm

Agro-climatic zone

- ☐ humid
- ☑ sub-humid
- ☐ semi-arid

Specifications on climate

n.a.

- ✓ 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

- arid

Slope
- flat (0-2%)
- ✓ 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- 501-1,000 m a.s.l.
- ✓ 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
- ✓ not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- ✓ mixed (subsistence/ commercial
- commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ manual work
- animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- women
- ✓ men

Age
- children
- youth
- ✓ middle-aged
- elderly

Area used per household
- < 0.5 ha
- 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
- ✓ medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- 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

expenses on agricultural inputs	increased		✓						decreased
farm income	decreased							✓	increased
diversity of income sources	decreased							✓	increased

Socio-cultural impacts

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

Ecological impacts

soil moisture	decreased							✓	increased
drought impacts	increased					✓			decreased
wind velocity	increased							✓	decreased
micro-climate	worsened					✓			improved

Off-site impacts

wind transported sediments	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

Climate-related extremes (disasters)

Wind speed	not well at all			✓			very well

ADOPTION AND ADAPTATION

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

- ☑ single cases/ experimental
- ☐ 1-10%
- ☐ 10-50%
- ☐ more than 50%

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

- ☑ 0-10%
- ☐ 10-50%
- ☐ 50-90%
- ☐ 90-100%

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

- ☐ Yes
- ☑ No

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

- Improvement in income
- Increase production diversification
- Increased social security because trees provide benefits over long periods of time

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

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Very high cost of establishment, not affordable by many farmers → Do gradual planting instead of embarking on larger area than one can afford
- There is high risk of damage to young trees by grazing animals in the areas, especially during dry season → Fence-off the area, especially the orchard
- Pest and disease of mangoes result in severe damage to the orchard → Treat according to recommended schedule

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- The technology requires large areas of both orchard and pine plantation, which are not available among a majority of farmers in the area. → Joint land-use planning at community level to determine appropriate cropping mixtures in the landscape.
- Timing of establishment of the orchard has to be done after the pine has grown to a height of 3-4 meters (about 2 years). This is a fairly heavy investment for low-income farmers in a very short time before the actual benefits begin to accrue.

→ Sourcing for low-interest loans from commercial banks and other microfinance institutions

REFERENCES

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Resource persons
Robert Abok - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2880/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- Uganda Landcare Network (ULN) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Key references
- N/a:

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

WALA Community Tree Planting Approach

WALA Women Group Community Tree planting Approach (Uganda)

DESCRIPTION

A sustainable tree planting group approach involving thirty seven women to serve the most vulnerable community for sustainable development.

WALA community tree planting group is an association of 37 women initiated in 2005 and supported by Small Production Grants Scheme since 2006. The group was linked to Saw log production scheme Grant (SPGS) by National Forestry Authority (NFA) who have supported 37 women with tree seedlings, forest tools which include lining out ropes and cross head, pruning saws, thinning ropes, paint and paint brushes and tape measure to support tree planting. WALA, SPGS with partners first developed guidelines (constitution) spelling out the how to establish, manage tree plantations including marketing products for value addition which highlights that : (1) Prospective beneficiaries must be organised community groups or organizations of minimum of 37 members with a leadership committee (2) Should be located within the same Local Council 1 or village (3) Each member should own up a 0.20 ha and max 4 ha dedicated to tree planting, (4) Group must submit a letter expressing interest to access support for tree seedlings to the SPGS project manager with a copied to Food Agricultural Organization Representative in Uganda (5) A list of members with each member seedlings requirements per year must be endorsed by Local council 1 Chairman where proof of ownership of land may be attached with a legal entity with copies of legal documents attached and (6) The community should have willingness and ability to maintain the guidelines: https://www.yumpu.com/en/document/view/37755510/spgs-tree-planting-guidelines-for-Uganda-all-chapters-low. The executive committee organise community plantation planning meetings, trainings and exchange visits to empower them to mobilize resources for environmental conservation . Up to now the group has received 170,000 seedlings, 10 acres of land, 30 hoes and spades, 100 Lining up ropes (2) cross head (2) pruning saws (15) Paint (5 litre) Paint brushes (10) and Tape Measure (1) received by the group kept by the group treasurer. Benefits linked to this approach include presence of the leadership committee supported by the constitution to guide the group activities on site trainings, farmer-to-farmer learning, demonstration plots, access to information and decision support on commercial forest plantation establishment; sale of products as well as environmental services has enabled the group to extend its networks and partnerships beyond SPGS

LOCATION

Location: Northern Region,Uganda, Uganda

Geo-reference of selected sites
- 32.36583, 2.76556

Initiation date: 2005

Year of termination: n.a.

Type of Approach
- ☐ traditional/ indigenous
- ☐ recent local initiative/ innovative
- ☑ project/ programme based

APPROACH AIMS AND ENABLING ENVIRONMENT

Main aims / objectives of the approach
Environmental conservation through tree planting, improve sawlog production, sustainable land utilization, and income.

Conditions enabling the implementation of the Technology/ ies applied under the Approach
- **Social/ cultural/ religious norms and values**: Involvement of chiefs and local leaders.
- **Availability/ access to financial resources and services**: presence of women savings group.
- **Institutional setting**: Support by SPGS, Uganda Tree growers Association and NFA through seedlings provision, training's.
- **Collaboration/ coordination of actors**: Presence of memorandum of understanding and presence of other growers.
- **Legal framework (land tenure, land and water use rights)**: Land lease and existence of local level bylaws.
- **Policies**: Formulated using a bottom-top approach.
- **Land governance (decision-making, implementation and enforcement)**: Presence of bylaws.

- **Knowledge about SLM, access to technical support**: Have had training's in SLM.
- **Markets (to purchase inputs, sell products) and prices** : Increased demand for tree products (timber).
- **Workload, availability of manpower**: Trained by SPGS and other collaborators.

Conditions hindering the implementation of the Technology/ ies applied under the Approach
- **Institutional setting**: Poor enforcement of bylaws on free grazing.
- **Collaboration/ coordination of actors**: Short term period of collaboration.
- **Legal framework (land tenure, land and water use rights)**: Poor enforcement with low fines.
- **Land governance (decision-making, implementation and enforcement)**: Poor.
- **Knowledge about SLM, access to technical support**: Low adoption outside SPGS supported groups.
- **Markets (to purchase inputs, sell products) and prices** : Sell of raw products at low prices.
- **Workload, availability of manpower**: The groups members are old and those to inherit the group activities are not active.

PARTICIPATION AND ROLES OF STAKEHOLDERS INVOLVED

Stakeholders involved in the Approach and their roles

What stakeholders / implementing bodies were involved in the Approach?	Specify stakeholders	Describe roles of stakeholders
local land users/ local communities	Group members, Community	Implementation and use of the approach.
community-based organizations	Watemu Lapainat Agroforestry Association (WALA), Saving and Credit Organisation (SACCO).	Savings and Credit training's, loans.
SLM specialists/ agricultural advisers	Small Production Grants Scheme (SPGS) ,National Forestry Authority (NFA), Uganda Tree Growers Association (UTA)	Research
researchers	National Forestry Authority students.	Field work and data collection for publication.
teachers/ school children/ students	University students, primary and secondary teachers.	field work and support training's
NGO	Food and Agriculture Organisation (FAO), Uganda Timber Growers Association (UTGA)	Support training's.
local government	Councillors and Forestry officers.	Linkage to NGO's, training's and administrative guidance as well security.
national government (planners, decision-makers)	National Forestry Authority (NFA).	Planning and Commissioning.
international organization	Food Agriculture Organisation (FAO).	Funding.
Cultural leaders	Chiefs and church leaders.	Visits and pray with them.

Lead agency
Food and Agricultural Organisation (FAO), National Forestry Authority (NFA)

Involvement of local land users/ local communities in the different phases of the Approach

	none	passive	external support	interactive	self-mobilization	
initiation/ motivation		✓				Groups members were willing to participate in group activities.
planning		✓				Group members planning process- members were not very active at the beginning- Lobbying for land.
implementation				✓		Members participated in planting activities.
monitoring/ evaluation				✓		Members National Forestry Authority (NFA), Small Production Grants Scheme (SPGS) both do joint monitoring with the group members.

Flow chart

Decision-making on the selection of SLM Technology

Decisions were taken by
- [ ] land users alone (self-initiative)
- [ ] mainly land users, supported by SLM specialists
- [x] all relevant actors, as part of a participatory approach
- [ ] mainly SLM specialists, following consultation with land users
- [ ] SLM specialists alone
- [ ] politicians/ leaders

Decisions were made based on
- [x] evaluation of well-documented SLM knowledge (evidence-based decision-making)
- [ ] research findings
- [ ] personal experience and opinions (undocumented)

TECHNICAL SUPPORT, CAPACITY BUILDING, AND KNOWLEDGE MANAGEMENT

The following activities or services have been part of the approach
- [x] Capacity building/ training
- [x] Advisory service
- [x] Institution strengthening (organizational development)
- [x] Monitoring and evaluation
- [x] Research

Capacity building/ training

Training was provided to the following stakeholders
- ✓ land users
- field staff/ advisers

Form of training
- ✓ on-the-job
- ✓ farmer-to-farmer
- ✓ demonstration areas
- ✓ public meetings
- courses

Subjects covered

Saw log production, benefits of tree growing and how to Market logs.

Advisory service

Advisory service was provided
- ✓ on land users' fields
- at permanent centres

It is very useful because it reduces the costs of transport.
The training is hands on and practical.

Institution strengthening

Institutions have been strengthened / established
- no
- yes, a little
- yes, moderately
- ✓ yes, greatly

at the following level
- ✓ local
- regional
- national

Describe institution, roles and responsibilities, members, etc.

Type of support
- ✓ financial
- ✓ capacity building/ training
- ✓ equipment
- ✓ Seedlings

Further details

170,000 seedlings, 10 acres of land tools and materials: Lining up ropes (2) cross head (2) prunning saws (15) Paint (5 litre) Paint brushes (10) and Tape Measure (1).

Monitoring and evaluation

The monitoring is on going as the group activities are implemented.

Research

Research treated the following topics
- ✓ sociology
- ✓ economics / marketing
- ✓ ecology
- ✓ technology
- ✓ policy

University students, NFA and SPGS.

FINANCING AND EXTERNAL MATERIAL SUPPORT

Annual budget in USD for the SLM component
- ✓ < 2,000
- 2,000-10,000
- 10,000-100,000
- 100,000-1,000,000
- > 1,000,000

Precise annual budget: n.a.

FAO, SPGS

The following services or incentives have been provided to land users
- ✓ Financial/ material support provided to land users
- ✓ Subsidies for specific inputs
- ✓ Credit
- ✓ Other incentives or instruments

Financial/ material support provided to land users

Funds for thinning, Sawlog given to groups by SPGS.

	partly financed	fully financed
Seedlings		✓

Labour by land users was
- ✓ voluntary
- food-for-work
- paid in cash
- rewarded with other material support

Credit

Conditions: In form seedlings and equipment.
Credit providers: NFA.
Credit receivers: SPGS.

Other incentives or instruments

Formulation and implementation of bylaws. Training's. Exchange visits.

IMPACT ANALYSIS AND CONCLUDING STATEMENTS

Impacts of the Approach

	No	Yes, little	Yes, moderately	Yes, greatly
Did the Approach empower local land users, improve stakeholder participation? Capacities to work and make decisions in a group.				✓
Did the Approach enable evidence-based decision-making? Decisions made in groups on when to meet, plant, prune and thin.				✓
Did the Approach help land users to implement and maintain SLM Technologies? Incentives based (in form of trainings and seedlings).			✓	
Did the Approach improve coordination and cost-effective implementation of SLM? Coordinated by the leadership committee. Strengthened working as a group.				✓
Did the Approach mobilize/ improve access to financial resources for SLM implementation? Transformed them selves into a savings and Credit organisation (SACCO) group.			✓	
Did the Approach improve knowledge and capacities of land users to implement SLM? Access to technologies (seedlings), knowledge on planting, spacing and pruning and thinning.				✓
Did the Approach improve knowledge and capacities of other stakeholders? Especially farmers involved and partner's.			✓	
Did the Approach build/ strengthen institutions, collaboration between stakeholders? Different partners participated and contributed to implementing the approach. Community bylaws and functioning committee.				✓
Did the Approach mitigate conflicts? Conflicts between WALA women group leaders and livestock owners (Free grazing on trees). Conflicts resolved using the group committee.		✓		
Did the Approach empower socially and economically disadvantaged groups? Focus was not on well off women farmers but those who had interest in tree planting as a group.			✓	
Did the Approach improve gender equality and empower women and girls? Involved and empowered women who constituted 100% of the group members.			✓	
Did the Approach encourage young people/ the next generation of land users to engage in SLM? Those who belong to the households where members came from.			✓	
Did the Approach improve issues of land tenure/ user rights that hindered implementation of SLM Technologies? Focused more on training and production.		✓		
Did the Approach lead to improved food security/ improved nutrition? Income from the sale of tree products was used for buying food.		✓		
Did the Approach improve access to markets? Good quality tree products. Linkage done by SPGS.			✓	
Did the Approach lead to improved access to water and sanitation? Based near the plantation.	✓			
Did the Approach improve the capacity of the land users to adapt to climate changes/ extremes and mitigate climate related disasters? Carbon sequestration.			✓	

Main motivation of land users to implement SLM

- [x] increased production
- [x] increased profit(ability), improved cost-benefit-ratio
- [x] reduced land degradation
- [x] reduced risk of disasters
- [x] reduced workload
- [x] payments/ subsidies
- [x] rules and regulations (fines)/ enforcement
- [x] prestige, social pressure/ social cohesion
- [x] affiliation to movement/ project/ group/ networks
- [x] environmental consciousness
- [ ] customs and beliefs, morals
- [x] enhanced SLM knowledge and skills
- [ ] aesthetic improvement
- [x] conflict mitigation

Sustainability of Approach activities

Can the land users sustain what hat been implemented through the Approach (without external support)?

- [ ] no
- [x] yes
- [ ] uncertain

The group is involved in selling thinned trees and the income obtained is used to manage the forest activities like fireline, weeding etc. the presence of an organised leadership. With better management skills to manage, the group will keep working very closely with the group . The presence of the group constitution helps manage the group affairs.

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- The approach is inclusive and involves all group members.
- Income received from the thinned trees is used to facilitate group activities (meetings, workshops, stationery).
- The approach is appreciated by neighbours who are not members of the group.

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

- The approach is involving and allows full participation and

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- If not managed well, it can escalate conflicts through encroachment. → Need to put in place bylaws with strict punishments to encroaches. Strengthen bylaws.
- High costs of chemicals.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

equal decision making of all stakeholders.

- promoted only by women. → Involve men, youth and PWD's in implementing the approach.

REFERENCES

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Date of documentation: June 6, 2017

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Alice Orach - land user
Alice Orach - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/approaches/view/approaches_2767/
Video: https://player.vimeo.com/video/254847843

Linked SLM data
Technologies: Pine Woodlot https://qcat.wocat.net/en/wocat/technologies/view/technologies_2825/
Technologies: Pine Woodlot https://qcat.wocat.net/en/wocat/technologies/view/technologies_2825/
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Documentation was faciliated by
Institution
- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Links to relevant information which is available online
- SPGS Tree Planting Guidelines for Uganda: https://www.yumpu.com/en/document/view/37755510/spgs-tree-planting-guidelines-for-uganda-all-chapters-low-

Photo showing Pine Woodlot in Amuru District, Northern Uganda. (Rick Kamugisha)

Pine Woodlot (Uganda)

Pito Yen pine

DESCRIPTION

A Woodlot of Pine (Pinus caribaea) is a fast growing, tolerant tree based plantation established to address land cover depletion, soil fertility loss and soil erosion control.

To establish this technology, the farmer excavates a hole and wait for 4-6 days to allow air that can burn the seedlings first get out and then plant the seedlings. If the planting is done during the dry season, it is important that the farmer water the seedlings regularly to avoid drying.

The activities involved in establishing this technology include: (1) Looking for suitable land to establish the technology (2) Looking for labor, and appropriate seedlings and tools to use, (3) Identifying the expert/ trainer to train on how to plant and the right spacing (4) Digging the holes (30cm deep) and waiting for 4-6 days before planting. It is important that the farmer weeds the plantation if weeds develop.

Pinus caribaea is an important forest plantation tree that is fast growing, tolerant to poor soils which don't retain water and nutrients and often drains too well that may cause the roots to rot or fail to develop and its wood can be milled into timber, pulped or used as poles. The common inputs required for establishing such a technology include a hoe, a panga, a planting string, seedlings, and a trainer.

This technology is easy and cheap to maintain once established. It is good for timber, firewood and environmental conservation with the costs of buying seedlings and payment for labor being high at the time of establishment compared to the costs of recurrent maintenance activities.

What is not liked about this technology is that the benefits are realized after a long time. Secondly, pine is not a source of food until when it is sold and cash is used to buy food unlike fruit trees such as mangoes and oranges.

LOCATION

Location: Amuru District, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 32.13561, 2.9742

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

In a permanently protected area?:

Date of implementation: 2015; less than 10 years ago (recently)

Type of introduction

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

CLASSIFICATION OF THE TECHNOLOGY

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

Land use

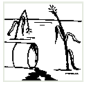
Forest/ woodlands Products and services: Timber, Fuelwood

Water supply
- rainfed
- ✓ mixed rainfed-irrigated
- full irrigation

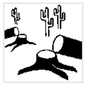
Purpose related to land degradation
- ✓ prevent land degradation
- reduce land degradation
- restore/ rehabilitate severely degraded land
- ✓ adapt to land degradation
- not applicable

Degradation addressed

soil erosion by wind - Et: loss of topsoil, Ed: deflation and deposition



chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

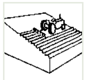


biological degradation - Bs: quality and species composition/ diversity decline

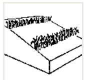
water degradation - Hp: decline of surface water quality

SLM group
- forest plantation management

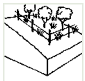
SLM measures



agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility, A3: Soil surface treatment, A4: Subsurface treatment, A5: Seed management, improved varieties



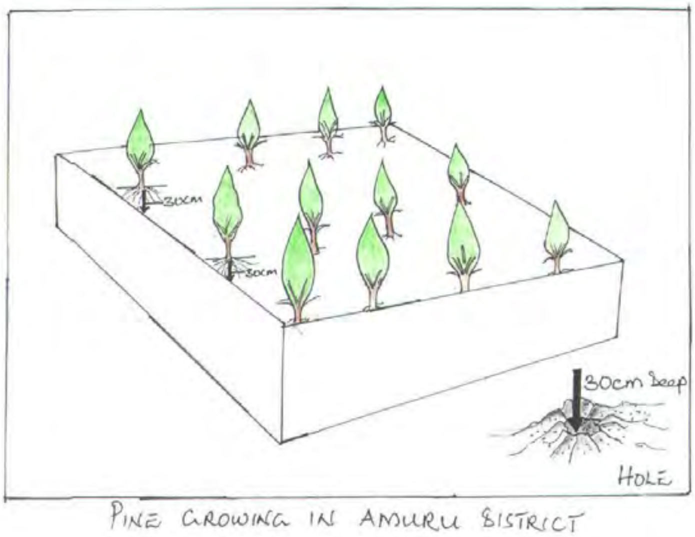
vegetative measures - V1: Tree and shrub cover



management measures - M1: Change of land use type, M2: Change of management/ intensity level, M3: Layout according to natural and human environment

TECHNICAL DRAWING

Technical specifications
2.5 metres within raws
3 metres between raws
10 metres between blocks
5-6 metres wide.



Author: Kaheru

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: 0.5 acres)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3400.0 UGX
- Average wage cost of hired labour per day: 5000 per person per day

Most important factors affecting the costs

Seedlings and labour takes most of the costs.

Establishment activities

1. lookling for suitable land (Timing/ frequency: Before planting)
2. Looking for tools, labour and seedlings (Timing/ frequency: Before planting)
3. Looking for expert/trainer (Timing/ frequency: Before planting)
4. Preparing land for planting (Timing/ frequency: At the time of planting)
5. Digging the holes (30-60cm) (Timing/ frequency: During planting)
6. Planting with spacing of 3m x3m (Timing/ frequency: During planting)
7. Watering: Dry season (Timing/ frequency: After planting)
8. Monitoring and security provision. (Timing/ frequency: After planting)

Establishment inputs and costs (per 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Labour	persons	10.0	5000.0	50000.0	100.0
Equipment					
Panga	Pieces	1.0	7000.0	7000.0	100.0
Hoe	Pieces	10.0	10000.0	100000.0	100.0
Panga	Pieces	3.0	7000.0	21000.0	100.0
Plant material					
Seedlings	Kgs	4000.0	2500.0	10000000.0	
Construction material					
Bamboo- bundles	Bundles	1.0	15000.0	15000.0	
Other					
watering can	Pieces	3.0	25000.0	75000.0	
Total costs for establishment of the Technology				**10'268'000.0**	
Total costs for establishment of the Technology in USD				*3'020.0*	

Maintenance activities

1. weeding/slashing (Timing/ frequency: Twice a year: when still young)
2. Watering (Timing/ frequency: During dry season: trees still young)
3. Prunning (Timing/ frequency: Twice a year)
4. Security and moniroring (Timing/ frequency: Daily)

Maintenance inputs and costs (per 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Labour on monthly basis	Persons	10.0	150000.0	1500000.0	100.0
Total costs for maintenance of the Technology				**1'500'000.0**	
Total costs for maintenance of the Technology in USD				*441.18*	

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
Average annual rainfall in mm: 1500.0

Slope
- ✓ flat (0-2%)
- ☐ 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
- ☐ footslopes
- ✓ valley floors

Altitude
- ☐ 0-100 m a.s.l.
- ☐ 101-500 m a.s.l.
- ☐ 501-1,000 m a.s.l.
- ✓ 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
- ☐ not relevant

Soil depth
- ☐ very shallow (0-20 cm)
- ✓ shallow (21-50 cm)
- ☐ moderately deep (51-80 cm)
- ☐ deep (81-120 cm)
- ☐ very deep (> 120 cm)

Soil texture (topsoil)
- ☐ coarse/ light (sandy)
- ✓ medium (loamy, silty)
- ☐ fine/ heavy (clay)

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

Topsoil organic matter content
- ☐ high (>3%)
- ✓ medium (1-3%)
- ☐ low (<1%)

Groundwater table
- ☐ on surface
- ✓ < 5 m
- ☐ 5-50 m
- ☐ > 50 m

Availability of surface water
- ☐ excess
- ☐ good
- ✓ medium
- ☐ poor/ none

Water quality (untreated)
- ☐ good drinking water
- ✓ poor drinking water (treatment required)
- ☐ for agricultural use only (irrigation)
- ☐ unusable

Water quality refers to:

Is salinity a problem?
- ☐ Yes
- ✓ No

Occurrence of flooding
- ☐ Yes
- ✓ No

Species diversity
- ☐ high
- ✓ medium
- ☐ low

Habitat diversity
- ☐ high
- ☐ medium
- ✓ low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- ☐ subsistence (self-supply)
- ✓ mixed (subsistence/ commercial)
- ☐ commercial/ market

Off-farm income
- ✓ less than 10% of all income
- ☐ 10-50% of all income
- ☐ > 50% of all income

Relative level of wealth
- ☐ very poor
- ✓ poor
- ☐ average
- ☐ rich
- ☐ very rich

Level of mechanization
- ✓ manual work
- ☐ animal traction
- ☐ mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- ☐ Semi-nomadic
- ☐ Nomadic

Individuals or groups
- ☐ individual/ household
- ✓ groups/ community
- ☐ cooperative
- ☐ employee (company, government)

Gender
- ✓ women
- ☐ men

Age
- ☐ children
- ✓ youth
- ✓ middle-aged
- ☐ elderly

Area used per household
- ✓ < 0.5 ha
- ☐ 0.5-1 ha
- ☐ 1-2 ha
- ☐ 2-5 ha
- ☐ 5-15 ha
- ☐ 15-50 ha
- ☐ 50-100 ha
- ☐ 100-500 ha

Scale
- ✓ small-scale
- ☐ medium-scale
- ☐ large-scale

Land ownership
- ☐ state
- ☐ company
- ☐ communal/ village
- ✓ group
- ✓ individual, not titled
- ☐ individual, titled

Land use rights
- ☐ open access (unorganized)
- ☐ communal (organized)
- ☐ leased
- ✓ individual

Water use rights
- ☐ open access (unorganized)
- ☐ communal (organized)

500-1,000 ha
1,000-10,000 ha
> 10,000 ha

leased
✓ 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

wood production	decreased						✓		increased	from the planted pine trees.
forest/ woodland quality	decreased							✓	increased	Due to prunning.
land management	hindered						✓		simplified	Slashing and weeding.
expenses on agricultural inputs	increased			✓					decreased	for labours.
farm income	decreased							✓	increased	From the sale of timber and fuel wood.
diversity of income sources	decreased						✓		increased	Timber and fuel wood.
workload	increased		✓						decreased	Planting, watering, thinning and pruning and harvesting.

Socio-cultural impacts

Ecological impacts

soil cover	reduced					✓			improved	Where the pine trees are planted.
soil loss	increased						✓		decreased	Due to planted trees.
soil organic matter/ below ground C	decreased					✓			increased	Especially where the trees are planted and was originally degraded.
invasive alien species	increased						✓		reduced	Causing serious problems to natural habitat.
habitat diversity	decreased		✓						increased	Due to Invasive species.
fire risk	increased					✓			decreased	If not protected with fireline.

Off-site impacts

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

Benefits are low in the short run and high in the long run.

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

ADOPTION AND ADAPTATION

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

single cases/ experimental
✓ 1-10%

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

✓ 0-10%
11-50%

- 11-50%
- > 50%
- 51-90%
- 91-100%

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

- Yes
- ✓ No

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

- Good at providing fire wood in the short run after prunning.
- The costs are low after establishment (prunning, monitoring).
- Easy to establish once the seedlings are available and can easily be replicated by other farmers.
- Suitable for both small scale and large farmers with similar or different land sizes.

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

- The land user is managing the technology well and is likely to reap long term benefits (income and Timber).
- The technology is easy to manage after establishment. Maintenance is not laborious.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- The technology is not very much appropriate for soil fertility improvement as compared to other agroforestry trees (callindra, Grivellea and Alnus). → The land user need to integrate other agroforestry and fruit trees in the technology.
- The technology is costly in terms of securing seedlings. The land user has to travel long distances 15km to buy the seedlings. → The land user can be trained on how to raise her own seedlings.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- The benefits of the technology are long term and may not help the land user to meet urgent needs (school fees, medical care etc) → The land user need to look at other alternative sources of income which are short term and multi-purpose e.g integrate tree planting with livestock for milk, manure and other benefits.
- The benefits of the technology are long term from 5 to 10 years. → Explore alternatives and integrate other sources of income which are short term and multi-purpose but also good at addressing land degradation problems e.g poultry keeping.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Stephanie Jaquet
Renate Fleiner
Nicole Harari
Drake Mubiru
Donia Jendoubi

Date of documentation: June 12, 2017

Last update: March 22, 2019

Resource persons
Alex Okecokon - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2825/
Video: https://player.vimeo.com/video/323401705

Linked SLM data
Approaches: WALA Women Group Community Tree planting Approach
https://qcat.wocat.net/en/wocat/approaches/view/approaches_2767/

Documentation was faciliated by
Institution

- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Fruit Tree orchard of mangoes and oranges integrated with beans (Kamugisha Rick)

Fruit Tree Orchard of Mangoes and Oranges Integrated with Beans (Uganda)

Mukungwa ki mayembe, muranga idyare

DESCRIPTION

Oranges (Citrus sinensis) and Mangoes (Mangifera indicate) integrated with beans are planted together in the same field to increase production and household income.

The technology is promoted by small scale farmers in Northern Uganda to address soil degradation including soil erosion, low crop productivity and low-income challenges both on farm and at household level. The farmer identified land with average size of 0.6 acres situated on a gentle sloping area (3-5%), measuring 45m wide x 95 m long planted with mangoes spaced 10m × 10m and oranges spaced 4m x 5m integrated with beans, NABE 14 and K20. The beans were planted using a line spacing of 10cm within a line and 30cm between lines with 2-3 seeds per hole. The selected bean varieties are high yielding and marketable. The following are the labour and input requirements for establishing this technology: a hoe, a tape measure, seedlings, 4 people and a panga.
Integration of beans into an already grown mango and orange field is a good and profitable practice because decomposition of the plant litter increases yields of the beans (nitrogen fixing) and the cost incurred, for example in weeding is less compared to the costs which would be incurred when the three enterprises (oranges, mangoes and beans) are planted separately on the same land.
Generally, benefits from implementing this technology are slightly positive ranging from improved soil fertility due to plant litter, reduced soil erosion with the fruit trees providing shade to the beans. After harvesting the beans, the farmer uses the bean waste/ residues as mulching material for the orchard which subsequently decomposes to provide manure. Also the beans cover reduces the moisture evaporation from the soil, thus keeping the soil moist
However, oranges, mangoes and beans are affected by pests and diseases and in case of this; the farmer is likely to suffer since they are planted in one field. The role of the extension worker is very critical at this stage in providing extension advisory services on how to spray the fruit trees when they get affected.

LOCATION

Location: Omolo district, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.37442, 2.69851

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

In a permanently protected area?:

Date of implementation: 2014; less than 10 years ago (recently)

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- [x] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] reduce risk of disasters
- [ ] 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

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

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

Degradation addressed


soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying, Wo: offsite degradation effects


soil erosion by wind - Et: loss of topsoil

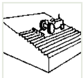

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

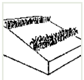

physical soil deterioration - Pu: loss of bio-productive function due to other activities

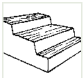

biological degradation - Bc: reduction of vegetation cover, Bh: loss of habitats, Bl: loss of soil life

SLM group
- agroforestry
- integrated crop-livestock management
- improved ground/ vegetation cover

SLM measures

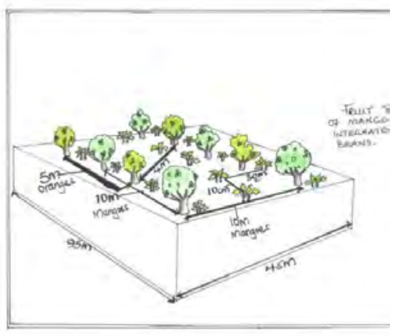

agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility, A5: Seed management, improved varieties


vegetative measures - V1: Tree and shrub cover


structural measures - S9: Shelters for plants and animals

TECHNICAL DRAWING

Technical specifications
None



Author: Kaheru

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **0.6 acres of land**)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3400.0 UGX
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs

Labour takes most of the cost during establishing. The farmer only buys a spraying pump for maintenance.

Establishment activities

1. site selection planted with Oragnes and Mangoes (Timing/ frequency: once before establishment)
2. Look for labour and required tools (Timing/ frequency: Before establishment)
3. Look for bean seeds (Timing/ frequency: Before establishment)
4. Digging holes (Timing/ frequency: During establishment)
5. Planting seeds (Timing/ frequency: During establishment)

Establishment inputs and costs (per 0.6 acres of land)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
persons days paid on monthly basis	persons	4.0	150000.0	600000.0	100.0
Equipment					
Hoe	pieces	4.0	10000.0	40000.0	100.0
Tape measure	pieces	1.0	7000.0	7000.0	100.0
Panga	pieces	2.0	7000.0	14000.0	100.0
Plant material					
Bean seeds	kgs	100.0	2000.0	200000.0	100.0
Fertilizers and biocides					
Pestcide	litres	2.0	25000.0	50000.0	100.0
Other					
Training	1	1.0	50000.0	50000.0	40.0
Total costs for establishment of the Technology				**961'000.0**	

Maintenance activities

1. Weeding (Timing/ frequency: Once in a season)
2. Spraying (Timing/ frequency: Once in a season)
3. Harvesting (Timing/ frequency: Once in a season)

Maintenance inputs and costs (per 0.6 acres of land)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
persons days on monthly basis	Persons	3.0	150000.0	450000.0	100.0
Equipment					
Spraying pump	Pieces	1.0	75000.0	75000.0	100.0
Total costs for maintenance of the Technology				**525'000.0**	

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
Average annual rainfall in mm: 1500.0
Nov- Dec and March -April.

Slope
- flat (0-2%)
- ✓ 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- ✓ 501-1,000 m a.s.l.
- ✓ 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
- not relevant

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

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

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

Topsoil organic matter content
- ✓ high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Water quality refers to:

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- medium
- ✓ low

Habitat diversity
- high
- medium
- ✓ low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- ✓ mixed (subsistence/ commercial)
- commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ manual work
- animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- ✓ women
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household
- ✓ < 0.5 ha
- 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
- medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- 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

production area (new land under cultivation/ use)	decreased						✓		increased	Increased due to use of the intercropping space.
land management	hindered						✓		simplified	Due to litter.
diversity of income sources	decreased						✓		increased	Fruits (oranges and mangoes) and beans.
workload	increased		✓						decreased	Weeding and harvesting.

Socio-cultural impacts

SLM/ land degradation knowledge	reduced						✓		improved	Spacing.

Ecological impacts

soil cover	reduced						✓		improved	Due to litter and mulching using bean residues.
soil loss	increased							✓	decreased	
soil organic matter/ below ground C	decreased							✓	increased	Due to litter and mulching using bean residues.
vegetation cover	decreased						✓		increased	Mulching using bean residues.

Off-site impacts

water availability (groundwater, springs)	decreased						✓		increased	Exposure to rainfall.

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

High costs for paying for labour and buying seed during establishment.

CLIMATE CHANGE

Gradual climate change

annual rainfall increase	not well at all				✓		very well	
seasonal rainfall increase	not well at all			✓			very well	Season: wet/ rainy season

Climate-related extremes (disasters)

epidemic diseases	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?

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

Number of households and/ or area covered

5

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

- [x] Yes
- [ ] No

Put in place a tree nursery.

To which changing conditions?

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

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Oranges provide shade for beans during sunshine.
- Oranges provide staking materials for beans.
- Easy to manage and improves fertility of the soil.
- High yield with integration/ one crop as an alternative in case of crop failure.

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

- Bean residues act as mulching material and its decomposition increases fertility and moisture of the soil.
- Can be replicated elsewhere with other farmers.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Labour intensive: planting, wedding, watering and harvesting. → Work in groups.
  use family labour in addition to hired labour.
- Easily affected by pests and diseases. → Spray early enough before attack.
  Seek guidance from the extension services on how to manage pests and diseases.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- High costs for purchase of seeds and labours. → Join small savings groups.
  Training on how farmers can have their own seeds and do it as a business.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Renate Fleiner
Nicole Harari
Drake Mubiru
Donia Jendoubi

Date of documentation: June 7, 2017

Last update: March 22, 2019

Resource persons
Peterson Tusubira - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2787/
Video: https://player.vimeo.com/video/325822618

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Water Management & Infrastructure

Ground water fed fish ponds
Underground water abstraction for livestock production
Energy-saving ground stoves
Low cost irrigation with treadle pump
Wooden water reservor for rain harvesting

Photo showing Ground water fish fed ponds in Nothern Uganda. (Kamugisha Rick Nelson)

Ground water fed fish ponds (Uganda)

Pii it Pi Gwooko Rec

DESCRIPTION

Fish farming supported by availability of water is considered as profitable enterprise in Northern Uganda. Farmers use areas with either high water tables or swamps to locate the ground water recharged fish ponds and water for fish production and crop irrigation during the dry season.

Fish farming is a sustainable land management agricultural practice promoted by farmers on medium sized farms in Northern Uganda, where ground water supply in wetland is used to recharge at least three adjacent fish ponds for fish production during the wet and dry season with each pond established measuring 50 m long x 20 m wide and 1.5 m depth with the following inputs hoes, spades, panga, wheel barrow, feeds and labour. The sides of the ponds are grown with grassy vegetation to stabilize soil, as well as feed the fish. It is, therefore imperative that farmers who want to invest in such sustainable land management practice first seek professional advice from extension agents or from other experienced farmers, on post-harvest fish handling and preservation. In Northern Uganda, fish theft and poisoning are also rampant, especially where ponds are not properly guarded or fenced. The most costly aspects of pond fish farming include pond excavation, laboratory testing of water and surrounding soil properties; procurement of fries especially tilapia, fencing and procurement of fish feeds. The average cost of establishing each pond is approximately US$428; while putting fish firies establishment goes for an average of US$ 71 per pond.
It is important to note that at the beginning the capital investments are high; these include paying for construction and buying fish fries to put in the ponds. However, in the long term the benefits exceed the costs. This is because fish farming is a high value enterprise with potential to provide household food, nutrition and income security.

LOCATION

Location: Lamwo District, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.7544, 3.49514

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?:

Date of implementation: 2000; 10-50 years ago

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use

Cropland

- Annual cropping: cereals - maize

Number of growing seasons per year: 2

Grazing land

Animal type: cattle - non-dairy beef, cows, fish: Nile perch, tilapia and wild fish

Species	Count
goats	5
cattle - non-dairy beef	4

Waterways, waterbodies, wetlands - Swamps, wetlands

Main products/ services: Fish fingers

Water supply

- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation

- prevent land degradation
- reduce land degradation
- ✓ restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

biological degradation - Bh: loss of habitats, Bp: increase of pests/ diseases, loss of predators

water degradation - Hs: change in quantity of surface water, Hp: decline of surface water quality

other -

SLM group

- surface water management (spring, river, lakes, sea)
- beekeeping, aquaculture, poultry, rabbit farming, silkworm farming, etc.

SLM measures

agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility

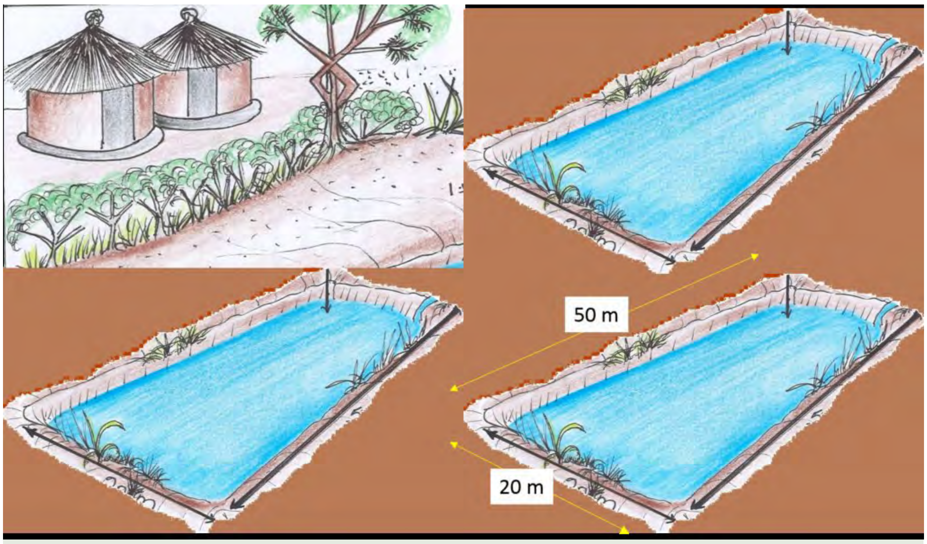
vegetative measures - V2: Grasses and perennial herbaceous plants, V3: Clearing of vegetation

structural measures - S5: Dams, pans, ponds

management measures - M1: Change of land use type

TECHNICAL DRAWING

Technical specifications
Using 6 people paid on daily basis the farmer digs a three adjacent fish ponds either in a wetland on an average land size of less than 0.5 acres each water fed fish pond measuring 50 m long x 20 m wide dug to a depth of not more than 1.5 m. to allow water passively replenishes the pond, The Species kept are Nile perch, tilapia and wild fish.



Author: Kaheru

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: 0.5 acres)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3500.0 UGX
- Average wage cost of hired labour per day: 5000 per person per day

Most important factors affecting the costs
Labour for establishing and maintaining the pond.

Establishment activities
1. Excavation of soil for ponds (Timing/ frequency: During the dry season)
2. Soil testing (Timing/ frequency: During the dry season)
3. Water testing (Timing/ frequency: Routine, dry and wet season)
4. Buying fries (Timing/ frequency: Dry and wet season)
5. Stocking the fish (Timing/ frequency: Wet season and dry season)
6. Feeding (Timing/ frequency: Dry and wet season)
7. Planting around the pond (Timing/ frequency: Dry and wet season)

Establishment inputs and costs (per 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Monthly persons days	persons	6.0	150000.0	900000.0	1000.0
Equipment					
Hoes	pieces	6.0	10000.0	60000.0	100.0
Spade	peices	3.0	10000.0	30000.0	100.0
panga	pieces	3.0	10000.0	30000.0	100.0
Wheel barrow	piece	2.0	250000.0	500000.0	
Other					
Fish fries for 3 ponds	fries	3000.0	1000.0	3000000.0	100.0
Soil tests	1	2.0	350000.0	700000.0	1000.0
water tests	1	2.0	380000.0	760000.0	100.0
Total costs for establishment of the Technology				**5'980'000.0**	
Total costs for establishment of the Technology in USD				*1'708.57*	

Maintenance activities
1. Slashing (Timing/ frequency: twice a year)
2. Feeding (Timing/ frequency: Routine)

Maintenance inputs and costs (per 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Persons days for feeding and slashing/ monthly	Persons	1.0	150000.0	150000.0	100.0
Other					
Feeds monthly	Kilograms	15.0	4000.0	60000.0	
Total costs for maintenance of the Technology				**210'000.0**	
Total costs for maintenance of the Technology in USD				*60.0*	

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
Average annual rainfall in mm: 1250.0
Two rainy season and two dry season- Bi modal.

Slope
- ✓ flat (0-2%)
- 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- ✓ 101-500 m a.s.l.
- ✓ 501-1,000 m a.s.l.
- 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
- not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- ✓ < 5 m
- 5-50 m
- > 50 m

Availability of surface water
- excess
- ✓ good
- medium
- poor/ none

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

Water quality refers to:

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- ✓ mixed (subsistence/ commercial)
- commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- ✓ poor
- average
- rich
- very rich

Level of mechanization
- ✓ manual work
- animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- individual/ household
- ✓ groups/ community
- cooperative
- employee (company, government)

Gender
- ✓ women
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household
- < 0.5 ha
- 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
- ✓ medium-scale
- large-scale

Land ownership
- state
- company
- ✓ communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- ✓ 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

risk of production failure	increased						✓		decreased	Well managed with constant feeding.
product diversity	decreased						✓		increased	Promoting different fish fries on the fish ponds. Quantity before SLM: 0 Quantity after SLM: 3
production area (new land under cultivation/ use)	decreased							✓	increased	Started with one fish pond and increased to three adjacent fish ponds.
land management	hindered							✓	simplified	Vegetation planted/ allowed to grow around the ponds to act as fodder and stabilizer
demand for irrigation water	increased						✓		decreased	for fish production.
expenses on agricultural inputs	increased		✓						decreased	Purchase of feeds.
farm income	decreased							✓	increased	High due to sale of fish.
diversity of income sources	decreased					✓			increased	Sale of fish.
economic disparities	increased		✓						decreased	Between those who have fish ponds and those who don't have.
workload	increased		✓						decreased	Increased workload at establishment for digging ponds, feeding the fish fries compared to maintenance.

Socio-cultural impacts

food security/ self-sufficiency	reduced							✓	improved	Relies on fish from the pond.
recreational opportunities	reduced						✓		improved	Other farmers coming to learn from the technology.
SLM/ land degradation knowledge	reduced						✓		improved	Training by the extension worker on feeding and management.

Ecological impacts

water quantity	decreased		✓						increased	Water re-charged from underground.
harvesting/ collection of water (runoff, dew, snow, etc)	reduced						✓		improved	Underground harvesting and kept in the pond for fish production during the dry season.
vegetation cover	decreased						✓		increased	Vegetation allowed to grow on the ponds as stabilizer and feeds.
beneficial species (predators, earthworms, pollinators)	decreased						✓		increased	More fish fries varieties stocked by the farmer in the ponds :3 different species.
pest/ disease control	decreased		✓						increased	Training by the extension agent on how to control.
drought impacts	increased						✓		decreased	under ground water harvesting water to be favour fish survival during the dry season.
fire risk	increased						✓		decreased	located in the wetland.

Off-site impacts

water availability (groundwater, springs)	decreased						✓		increased	re-charged from under ground,

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

slightly negative at the time of establishment with purchase of labour, purchase of fish fries and lab testing but positive when workload reduces and its associated costs with the farmer harvesting and selling fish for income.

CLIMATE CHANGE

Gradual climate change

annual temperature decrease	not well at all [ ][ ][ ][✓][ ] very well	
seasonal temperature decrease	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: wet/ rainy season

Climate-related extremes (disasters)

drought	not well at all [ ][ ][ ][ ][✓] very well	
land fire	not well at all [ ][ ][ ][✓][ ] very well	
epidemic diseases	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?
- [ ] 0-10%
- [x] 11-50%
- [ ] 51-90%
- [ ] 91-100%

Number of households and/ or area covered
Mostly those with some capital

Has the Technology been modified recently to adapt to changing conditions?
- [ ] Yes
- [x] No

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
- Provides high benefits (income) in the short run.
- Its replicable elsewhere by both small scale and large scale land users.
- Uses recharged from under ground which is available all year round.

Strengths: compiler's or other key resource person's view
- Good and sustainable technology. Does not require constant labour once its established. Low costs of labour required for routine and maintenance activities.
- Can survive on planted vegetation to supplement fish feeds.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome
- Requires high level sophisticated skills in water and soil testing / high costs. → Testing using local indicators.
- Not fenced. Possibility of poisong the fish. → Fencing the fish pond and if possible employ a local secuirty guard.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome
- Labour and capital intentive at the time of establishment/ Appropriate to the rich. → Link farmers to Agricultural loans and pay after selling fish.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Alexandra Gavilano
Stephanie Jaquet
Renate Fleiner
Nicole Harari
John Stephen Tenywa
Donia Jendoubi

Date of documentation: June 8, 2017

Last update: Aug. 10, 2019

Resource persons
Parikinson Okot - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2796/
Video: https://player.vimeo.com/video/254825002

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Photo showing underground water abstraction hole in the ground in Northern Uganda (Issa Aiga)

Under ground water abstraction for livestock production (Uganda)

IET

DESCRIPTION

Waterhole is excavated for abstracting underground water for watering livestock as well as irrigating crops during the dry season.

Underground water abstraction is done by excavating a pit hole in the ground fixed and protected against collapse to reach water underground . A hole measuring 2-6 m deep , 2 m wide and 3 m long is manually dug in the ground/ soil and established far distant from the homes and near the streams to allow water to collect and come up . The hole is shaped in such a way that water does not flow out, and the top is covered to keep the water in the hole protected from contamination. The opening is covered with local materials like poles, bamboo stems (Bamboo aridinarifolia), etc. Water flows into the hole through various methods of groundwater recharge such as open wells, soak pits, and recharge shaft/ trench.

The activities involved in establishing such a underground water hole include (1) identifying suitable site for digging the hole, (2) looking for trainer or expert to advise on how to dig and cover the hole, (3) looking for labor, and tools (e.g. hoes, spades, poles, etc.), (4) digging the hole to a depth of about 2-6 m, de-pending on the level of water table, (5) protect the hole with bamboo or wood to ensure hygiene and from people falling in.

The returns derived from this technology include: an effective alternative water source during the dry season which is used for crop irrigation (e.g. maize – Zea mays; cabbage - Brassica oleracea) and for livestock production/ watering.
This technology is most preferred because it is cheap, affordable and easy to maintain. The only costs are at the establishment phase. Its main challenge is that it can be contaminated when managed poorly if animals are allowed to close to the hole. To ensure this, the farmer needs to keep in contact with the extension agent to ensure maximum proper management of the hole to minimize contamination.

In terms of impacts, the technology provides an effective alternative water source during the dry season, which is used majorly for livestock and irrigating crops.

Because the technology is promoted as a supplementary water source for the dry season, during the wet season grass may grow on top of the protected hole. Before its use in the dry season the land user removes the grass before abstracting the well water for crop production and 5 heads of livestock kept in distance of 50 m-100 m from the well.

LOCATION

Location: Lamwo, Nothern Region, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.7544, 3.49514

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?:

Date of implementation: 2016; less than 10 years ago (recently)

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

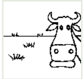
CLASSIFICATION OF THE TECHNOLOGY

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

Land use

Cropland
- Annual cropping

Number of growing seasons per year: 2



Grazing land
- Cut-and-carry/ zero grazing

Water supply
- rainfed
- ✓ mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation
- ✓ prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying, Wm: mass movements/ landslides, Wo: offsite degradation effects

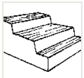
soil erosion by wind -

physical soil deterioration -

water degradation - Hs: change in quantity of surface water, Hg: change in groundwater/aquifer level, Hp: decline of surface water quality, Hq: decline of groundwater quality

SLM group
- integrated crop-livestock management
- water harvesting
- irrigation management (incl. water supply, drainage)

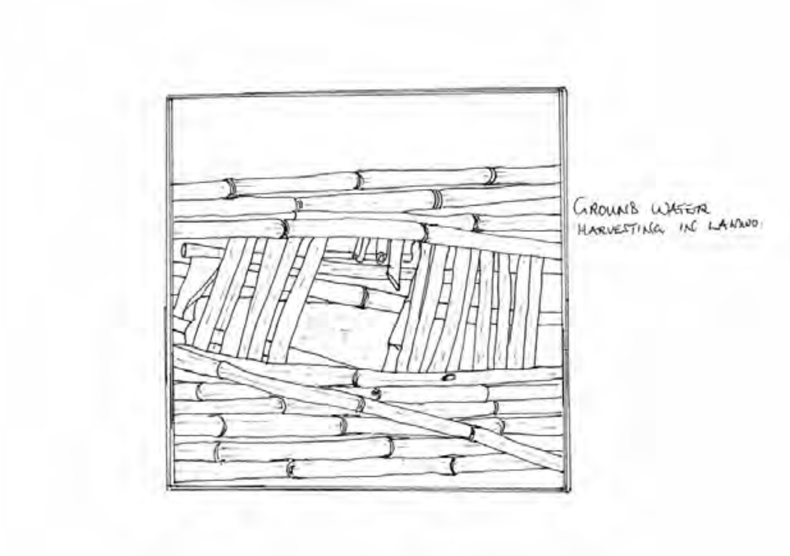
SLM measures



structural measures - S7: Water harvesting/ supply/ irrigation equipment, S9: Shelters for plants and animals

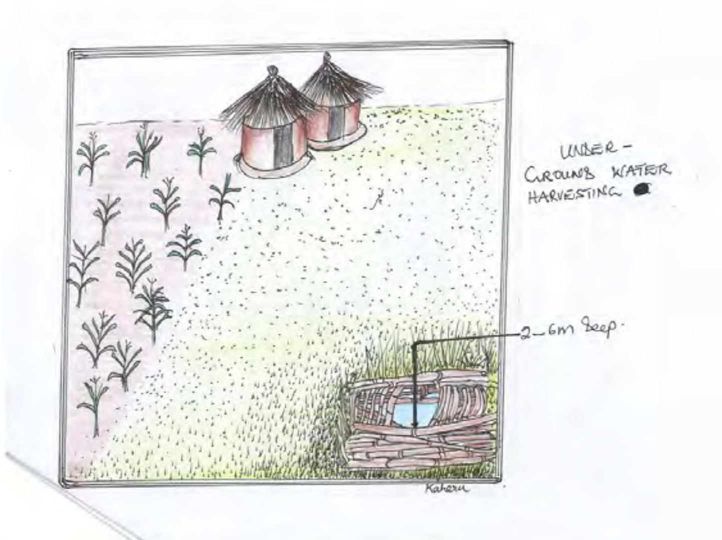
TECHNICAL DRAWING

Technical specifications
None



Author: Kaheru

None



Author: Kaheru Prossy

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **0.5 acres**)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3350.0 UGX
- Average wage cost of hired labour per day: 5000 per person per day

Most important factors affecting the costs
Hygiene inspection.

Establishment activities
1. Identify site (Timing/ frequency: Once before establishment)
2. Look for expert to train on how to dig the hole (Timing/ frequency: Once before establishment)
3. Look for labour to dig the hole (Timing/ frequency: During the dry season)
4. Buy inputs required (hoes, spades, poles and bamboo) (Timing/ frequency: Before establishment)
5. Sinking the hole (Timing/ frequency: During establishment)
6. Protect the hole with Bamboo (Timing/ frequency: After establishment)
7. Livestock keeping (Timing/ frequency: Before and after establishment)
8. Carrying water for the livestock (Timing/ frequency: During the dry season)

Establishment inputs and costs (per 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Labour for digging the hole	Persons	5.0	5000.0	25000.0	100.0
Equipment					
Hoe	Pieces	1.0	10000.0	10000.0	100.0
Spade	Pieces	1.0	10000.0	10000.0	100.0
Poles for protecting the hole	Pieces	100.0	200.0	20000.0	100.0
Plant material					
Bamboo for protecting the hole	Pieces	1.0	10000.0	10000.0	100.0
Total costs for establishment of the Technology				75'000.0	
Total costs for establishment of the Technology in USD				*22.39*	

Maintenance activities
1. Slashing of plants and grass grown on top of the hole (Timing/ frequency: After establishment)
2. Hygiene Inspection (Timing/ frequency: Daily)
3. Transporting water for livestock and crop production (Timing/ frequency: Dry season)

Maintenance inputs and costs (per 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Labour for slashing of grown plants and grass	Persons	2.0	5000.0	10000.0	100.0
Labour for transporting water for livestock	Persons	2.0	5000.0	10000.0	100.0
Labour for Hygiene inspection (monthly)	Persons	3.0	2000.0	6000.0	100.0
Equipment					
Test kit	Pieces	1.0	100000.0	100000.0	100.0
Other					
Pesticides (monthly)	litres	3.0	12000.0	36000.0	100.0
Total costs for maintenance of the Technology				162'000.0	
Total costs for maintenance of the Technology in USD				*48.36*	

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
Fair rainfall in the months of April to October and dry spell from Nov-March.

Slope
- flat (0-2%)
- ✓ 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
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- convex situations
- ✓ concave situations
- not relevant

Soil depth
- very shallow (0-20 cm)
- shallow (21-50 cm)
- ✓ moderately deep (51-80 cm)
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- ✓ medium (loamy, silty)
- fine/ heavy (clay)

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- on surface
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- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
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- ✓ medium
- poor/ none

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

Water quality refers to:

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high

Habitat diversity
- high

✓ medium	✓ medium
low	low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- ✓ mixed (subsistence/ commercial)
- commercial/ market

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- rich
- very rich

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- animal traction
- mechanized/ motorized

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- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- individual/ household
- ✓ groups/ community
- cooperative
- employee (company, government)

Gender
- ✓ women
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household
- < 0.5 ha
- 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
- ✓ medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Access to services and infrastructure

Service	Rating (poor – good)
health	✓ 2/3
education	✓ 3/3 (good)
technical assistance	✓ 1/3 (poor)
employment (e.g. off-farm)	✓ 1/3 (poor)
markets	✓ 2/3
energy	✓ 2/3
roads and transport	✓ 1/3 (poor)
drinking water and sanitation	✓ 2/3
financial services	✓ 1/3 (poor)

IMPACTS

Socio-economic impacts

Impact	Rating (decreased – increased)	Comment
Crop production	✓ 7/7	Due to irrigation water
animal production	✓ 6/7	Quantity before SLM: 0 Quantity after SLM: None More milk produced and sold from 0 to 10 litres per day each litre sold at 0.35 USD
water availability for livestock	✓ 6/7	water is available for livestock during dry spells
water quality for livestock	✓ 5/7	underground water clean. not poluted
irrigation water availability	✓ 6/7	water available for irrigating crops in the dry season
irrigation water quality	✓ 5/7	underground water is not poluted
farm income	✓ 6/7	extented crop cultivation and increased production during dry seasons

Socio-cultural impacts

Ecological impacts

Off-site impacts

Impact	Rating	Comment
water availability (groundwater, springs)	decreased – increased: ✓ 5/7	Especially during the dry season for livestock and crop production
reliable and stable stream flows in dry season (incl. low flows)	reduced – increased: ✓ 5/7	Kept to be used in the dry season for livestock and crop prouduction

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

The difference is only with the hygiene inspection costs. low at establishment but high at hygiene inspection which is routine.

CLIMATE CHANGE

Gradual climate change

annual temperature decrease	not well at all	✓					very well	
seasonal temperature decrease	not well at all	✓					very well	Season: winter

ADOPTION AND ADAPTATION

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

- ✓ single cases/ experimental
- 1-10%
- 11-50%
- > 50%

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

- ✓ 0-10%
- 11-50%
- 51-90%
- 91-100%

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

- ✓ Yes
- No

To which changing conditions?

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

The technology allows vegetation growth around the bamboo and poles.

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- The technology provides constant water supply for livestock and crop production to be used during the dry season when there is shortage of water.
- Its cheap and easy to maintain once established.
- It can be replicated and used by other farmers in other areas.

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

- The technology is effective in minimising water wastage and enhancing water access during the dry season but is established over along distance 1 km from the homestead where the cows are kept.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- The technology requires routine labour for inspection and technical know how. → Training on hygiene inspection.
- Dangerous to roaming animals and people when they fall in. → Protection using a berbed wire fence or using local local materials (wood).

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Not fenced. The fence was removed. → Fencing to protect animals .
- Need strong bylaw on under groundwater management. → Facilitate formulation and implementation of bylaw on under groundwater management.

REFERENCES

Compiler
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Date of documentation: May 18, 2017

Last update: Aug. 11, 2019

Resource persons
Churchill Obita - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2304/
Video: https://player.vimeo.com/video/325826449

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- Centre Ecologique Albert Schweitzer (CEAS) - Switzerland

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

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

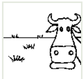
CLASSIFICATION OF THE TECHNOLOGY

Main purpose
- ✓ improve production
- reduce, prevent, restore land degradation
- conserve ecosystem
- protect a watershed/ downstream areas – in combination with other Technologies
- preserve/ improve biodiversity
- ✓ reduce risk of disasters
- ✓ adapt to climate change/ extremes and its impacts
- mitigate climate change and its impacts
- ✓ 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
- ✓ mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation
- prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- ✓ adapt to land degradation
- not applicable

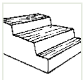
Degradation addressed

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

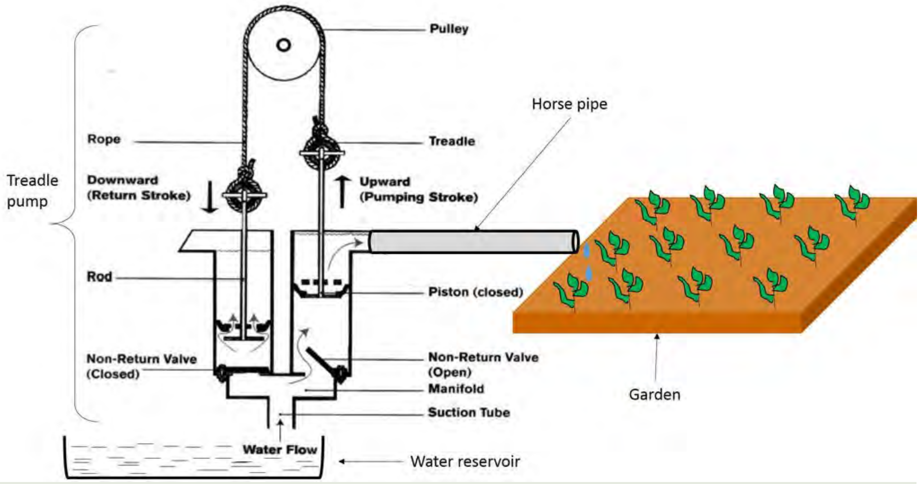


structural measures - S7: Water harvesting/ supply/ irrigation equipment

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.



Author: Bernard Fungo

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

Agro-climatic zone
- ☐ humid
- ☑ sub-humid
- ☐ semi-arid
- ☐ arid

Specifications on climate
Name of the meteorological station: Gulu, Uganda

- 1,001-1,500 mm
- 1,501-2,000 mm
- 2,001-3,000 mm
- 3,001-4,000 mm
- > 4,000 mm

Slope
- flat (0-2%)
- ✓ 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
- ✓ footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- 501-1,000 m a.s.l.
- ✓ 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
- ✓ not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- < 5 m
- 5-50 m
- ✓ > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Water quality refers to:

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- ✓ mixed (subsistence/ commercial)
- commercial/ market

Off-farm income
- less than 10% of all income
- ✓ 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ manual work
- ✓ animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- women
- ✓ men

Age
- children
- youth
- ✓ middle-aged
- elderly

Area used per household
- < 0.5 ha
- ✓ 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
- ✓ medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ 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?

- [ ] Yes
- [x] No

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 view → how 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 view → how 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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Stephanie Jaquet
Renate Fleiner
Nicole Harari
John Stephen Tenywa
Donia Jendoubi

Date of documentation: June 7, 2017

Last update: Aug. 11, 2019

Resource persons
Charles Malingu - land user

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

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Key references
- N/a:

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

Wife of Odoch George preparing to boil water using ground stove. (Amale Balla Sunday)

Energy-saving ground stoves (Uganda)

keno di-ot (keno di-kal)

DESCRIPTION

Energy-saving stove is a hole dug in the floor of a hut or in the compound. It helps to reduce the quantity of firewood used for cooking by reducing heat loss and ensuring firewood burning for longer time.

The rate at which forests are disappearing in northern Uganda is so frightening that strategic ameliorative innovations such as reduced wastage of biomass energy need to be envisioned. As such, the technology known as "energy-saving ground stove or energy-efficient ground stove" is being promoted in the region. This technology ensures that (i) smoke is eliminated in the kitchen, thus achieving a healthy environment, (ii) cooking is done faster while the stove retains beat for longer periods, (iii) up to 60% of firewood used with traditional cooking stoves is saved, and (iv) accidents from open fires are prevented.The energy-saving ground stove is constructed by digging a hole inside the kitchen or in the compound. For domestic food preparation, the hole is usually 1 square meter and 15 cm deep. The end where firewood is inserted is about 20 cm wide; while the opposite end where the fire burns is about 30 cm wide. Sometimes, the ground hole is lined with a layer of clay on the floor and walls. During construction, the common wind direction should be noted, especially when the hole is constructed outside the house. Constructing this ground hole does not require much technical skill although making a good one requires some experience. A hand hoe is commonly used for digging the hole, but any ground excavating tool can be used. This technology helps to preserve heat in the soil for further cooking; thus reducing household demand for firewood considerably. Ultimately, this reduces the pressure on deforestation. It also substantially saves women farmers' precious time, otherwise spent looking for firewood. This technology is particularly important for people who use firewood for cooking, because most energy-saving stoves available in the markets are expensive and require charcoal. Other locally made portable stoves also require charcoal. The challenge with the ground-stove technology is that it is not portable, hence, cannot be moved from one point to another. When constructed outside the kitchen, it becomes filled with water during rainy season, a factor that constrains its sustained use.

LOCATION

Location: Anaka, Nwoya, Uganda

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 32.10307, 2.73687

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?:

Date of implementation: 10-50 years ago

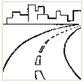
Type of introduction
- ☐ through land users' innovation
- ☑ as part of a traditional system (> 50 years)
- ☐ during experiments/ research
- ☐ through projects/ external interventions

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use



Settlements, infrastructure - Settlements, buildings
Remarks: Applied at cooking points or inside kitchen.

Water supply

- [x] rainfed
- [ ] 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

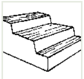
biological degradation - Bc: reduction of vegetation cover

other -

SLM group

- energy efficiency technologies

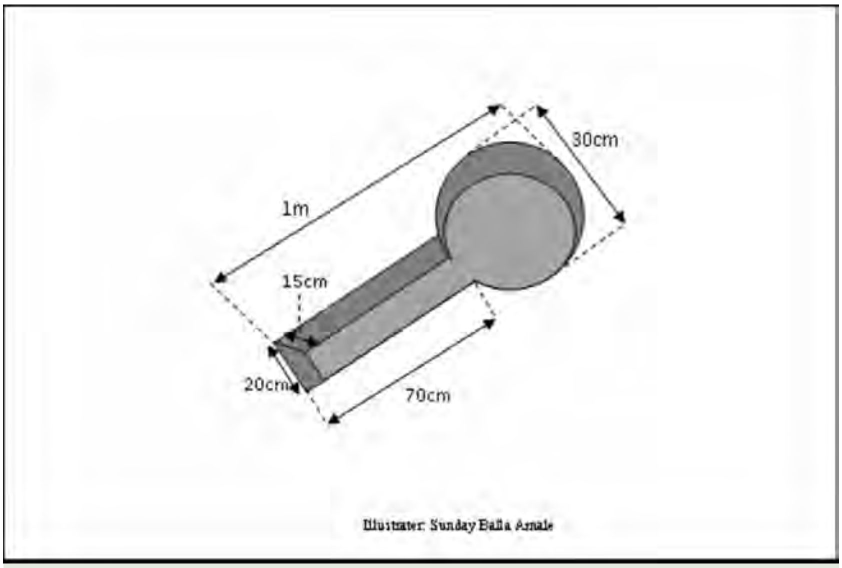
SLM measures



structural measures - S10: Energy saving measures

TECHNICAL DRAWING

Technical specifications
length 1m
burning end : round with diameter 30cm (depends on the purpose and sauce pan commonly used)
firewood input end 20cm (also depends on the purpose)
depth 15cm deep (depends on purpose)



Author: Amale Balla Sunday

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology unit (unit: **hole** volume, length: **not applicable**)
- Currency used for cost calculation: **Uganda shillings**
- Exchange rate (to USD): 1 USD = 3600.0 Uganda shillings
- Average wage cost of hired labour per day: 5000 per day

Most important factors affecting the costs
price of the hoe

Establishment activities
1. Identifying a suitable space (Timing/ frequency: anytime)
2. Marking lot (Timing/ frequency: anytime)
3. digging holes (Timing/ frequency: anytime)

Establishment inputs and costs (per hole)

Specify input	Unit	Quantity	Costs per Unit (Uganda shillings)	Total costs per input (Uganda shillings)	% of costs borne by land users
Labour					
persons	person hours	1.0	2000.0	2000.0	100.0
Equipment					
hand hoe	piece	1.0	10000.0	10000.0	100.0
Total costs for establishment of the Technology				**12'000.0**	
Total costs for establishment of the Technology in USD				*3.33*	

Maintenance activities
1. removing the ash (Timing/ frequency: once per week)
2. shaping the corners (Timing/ frequency: once a year)

Maintenance inputs and costs (per hole)

Specify input	Unit	Quantity	Costs per Unit (Uganda shillings)	Total costs per input (Uganda shillings)	% of costs borne by land users
Labour					
personnel	person hours	1.0	2000.0	2000.0	100.0
Total costs for maintenance of the Technology				**2'000.0**	
Total costs for maintenance of the Technology in USD				*0.56*	

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

Agro-climatic zone
- humid
- ✓ sub-humid
- semi-arid
- arid

Specifications on climate
two rainy seasons separated by short dry spell between june and july. dry season between december to march
Name of the meteorological station: Gulu

- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

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

Landforms
- [x] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [ ] 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)
- [x] shallow (21-50 cm)
- [ ] 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)
- [ ] medium (loamy, silty)
- [x] fine/ heavy (clay)

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

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

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

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

Water quality refers to:

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

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

Level of mechanization
- [x] manual work
- [ ] 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
- [x] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [x] 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
- [x] small-scale
- [ ] medium-scale
- [ ] large-scale

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

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

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

Access to services and infrastructure

	poor				good
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

energy generation (e.g. hydro,	decreased						✓		increased	Quantity before SLM: collect fire wood once a week

bio)

Quantity after SLM: collect firewood after every fortnight
after SLM, little wood is required for their cooking activities

farm income	decreased [rating scale: ✓ at centre] increased		increased since time spent in collecting firewood is put in farming

Socio-cultural impacts

Ecological impacts

Off-site impacts

impact of greenhouse gases	increased [rating scale: ✓ at second from right] reduced	efficient energy utilization

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative [rating scale: ✓ at second from right] very positive	
Long-term returns	very negative [rating scale: ✓ at far right] very positive	

Benefits compared with maintenance costs

Short-term returns	very negative [rating scale: ✓ at second from right] very positive	
Long-term returns	very negative [rating scale: ✓ at far right] very positive	

CLIMATE CHANGE

-

ADOPTION AND ADAPTATION

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

- ☐ single cases/ experimental
- ☐ 1-10%
- ☑ 11-50%
- ☐ > 50%

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

- ☐ 0-10%
- ☐ 11-50%
- ☐ 51-90%
- ☑ 91-100%

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

- ☐ Yes
- ☑ No

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

- Less time needed for collecting firewood since wood demand is reduced.
- Reduced cutting down of trees since demand for firewood is reduced.
- Heat stored in the ground makes food cook very fast.
- After cooking, the heat in the soil is used to roast sweet potatoes or cassava.

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

- The technology is cheap and does not require technical skills.
- It can easily be scaled up to highly populated areas since it takes up a very small space.
- The technology is cheaper than any portable energy saving stoves available in the market.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Cannot be moved from one point to another.
- If in the compound, rainwater clogs inside it. → Cover it with carpet during rain.

Weaknesses/ disadvantages/ risks: compiler’s or other key resource person’s view → how to overcome

- Corners need shaping over time. → Use clay to stabilise corners of the ground hole.

REFERENCES

Compiler
Sunday Balla Amale

Reviewer
John Stephen Tenywa
Nicole Harari
Alexandra Gavilano

Date of documentation: Dec. 18, 2017

Last update: Aug. 11, 2019

Resource persons
Margret Ayamo - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_3324/
Video: https://player.vimeo.com/video/469

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- Uganda Landcare Network (ULN) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Front view of the rain water harvest reservoir structure and the home roof top. (Aine Amon)

Wooden water reservoir for rain water harvesting. (Uganda)

Okutagila amizi aha ibati

DESCRIPTION

A gutter system constructed on the farmer's house-roof collects rainwater and directs it into a constructed reservoir raised off the ground with interior walls lined with water-proof tarpaulin. The reservoir has a maximum capacity of 8,000 liters of water; clean enough for irrigation, livestock and domestic use during seasons of scarcity. The reservoir is raised off of ground to minimize contamination and any possible accidents.

The wooden water reservoir system was introduced to the farmer by staff of the area's local government as a demonstration site to educate others on how to cheaply harvest and store rainwater in a relatively clean form for domestic, livestock and irrigation use. The farmer's house was fitted with gutters to tap rainwater and direct it into the water reservoir. The water collected is used to buffer the water scarcity during the dry season, which normally stresses livestock and crops in the area. The water can be stored for as long as three months, depending on the size of the water reservoir and the use of the water.

The establishment of the technology requires a clean roof for collecting rainwater, gutters, poles, iron sheets, tarpaulin, hose pipe, jerry can and nails. Further equipment required include; a hammer, hoe and panga (large knife for weeding and forest works). At the farm in Kyegegwa, the reservoir is constructed 3 meters away from the farmer's main house located at the top of a gently sloping hill. The establishment process involves: leveling of the site on which the technology is planned and constructing a water reservoir supported by a wooden structure. The support structure is constructed using four poles made in such a way that the two front poles are taller (5m) while the two poles behind are shorter (3m). This will give the roof a slight slope to prevent rainwater from stagnating on the roof. A raised rectangular floor supported by the poles is then established at a height of 0.5m above ground. The rectangular reservoir base dimensions are 1m×4m×2m (h×l×w) and is divided into 4 compartment. Each of these, lined with water-tight tarpaulin, can hold 2000 litres of water. The water so collected in the reservoir can be extracted under gravity through a 1.5cm diameter hose pipe into a jerry can placed below the reservoir.

The cost of establishment and durability of this rainwater harvesting system is mainly dependent on the type of materials and gutters used. In Kyegegwa District, wood for construction of the system is locally available valued at US$ 67.99 for the construction of the reservoir system. The iron sheets, gutters and nails are acquired from Kyegegwa Town where they are valued at US$ 127.28. The labor required is also locally available where it takes four men to establish the structure at a total cost of US$ 17.95 in three days.

The water reservoir is semi-permanent and can last for about 1.5 years depending on the quality of materials used. The maintenance activities include cleaning of the reservoir every month and repairing of the worn out parts at the end of the wet season. The farmer strongly recommends the technology since most of the materials and labour used are relatively cheap and locally available. The reservoir is raised off the ground to reduce contamination and minimize possible accidents with children and livestock. Despite the open space above the water level and the roof, the farmer has observed that the reservoir does not breed obnoxious vectors like mosquitoes. The water collected is

LOCATION

Location: Kyeggegwa, Western, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 31.016, 0.466

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2015

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

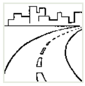
relatively clean and the farmer uses it for irrigation of home gardens and for watering of livestock. When properly filtered it is as well used for domestic purposes. The technology can be improved by using treated poles, stronger wood material and tarpaulin of improved quality.

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use



Settlements, infrastructure - Settlements, buildings
Remarks: The farmer's house roof top is used as the rain water catchment area.

Water supply

- ☐ rainfed
- ✓ mixed rainfed-irrigated
- ☐ full irrigation

Number of growing seasons per year: 2
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

Purpose related to land degradation

- ✓ prevent land degradation
- ☐ reduce land degradation
- ☐ restore/ rehabilitate severely degraded land
- ✓ adapt to land degradation
- ☐ not applicable

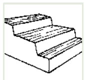
Degradation addressed

water degradation - Ha: aridification

SLM group

- water harvesting

SLM measures



structural measures - S6: Walls, barriers, palisades, fences, S7: Water harvesting/ supply/ irrigation equipment

TECHNICAL DRAWING

Technical specifications

The support structure is constructed using four poles made in such a way that the two front poles are taller (5 m) while the two poles behind are shorter (3 m), giving the roof a slight slope to prevent rainwater from stagnating on the roof. A raised rectangular floor supported by the poles is then established at a height of 0.5 m above ground. A cuboid reservoir of dimensions 1 m×4 m×2 m (h×l×w) is constructed with wooden panels; divided into four compartments and placed on the rectangular floor. Each compartment, to hold 2,000 liter of water, is lined with water-tight tarpaulin. Water from the reservoir can be extracted under gravity through a 1.5 cm diameter hose pipe into a jerry can placed below the reservoir.

Author: Aine Amon

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology unit (unit: **Water Reservior** volume, length: **Capacity 8000 liters, segregated into 4 compartments**)
- Currency used for cost calculation: **Uganda shillings**
- Exchange rate (to USD): 1 USD = 3638.35 Uganda shillings
- Average wage cost of hired labour per day: 20000

Most important factors affecting the costs

The nature of material used for example wood or metal and the labor hired to construct the system.

Establishment activities

1. Site selection (Timing/ frequency: Before onset of rain)
2. Clearing and leveling (Timing/ frequency: Before onset of rain)
3. Erection of poles (Timing/ frequency: Before onset of rain)
4. Establishment of floor, walls and roofing (Timing/ frequency: Before onset of rain)
5. Establishment of taupline and gutters (Timing/ frequency: Before onset of rain)

Establishment inputs and costs (per Water Reservior)

Specify input	Unit	Quantity	Costs per Unit (Uganda shillings)	Total costs per input (Uganda shillings)	% of costs borne by land users
Labour					
Builders	Man day	8.0	22500.0	180000.0	100.0
Equipment					
Hammer	pieces	30000.0	1.0	30000.0	100.0
Panga	pieces	9000.0	1.0	9000.0	100.0
Dibber	pieces	15000.0	1.0	15000.0	100.0
Hoe	pieces	10000.0	1.0	10000.0	100.0
Plant material					
Spade	pieces	15000.0			
Poles	pieces	12.0	3000.0	36000.0	100.0
Timber	pieces	12.0	10000.0	120000.0	100.0
Wood	pieces	8.0	1500.0	12000.0	100.0
Construction material					
Tarpaulin	peices	1.0	45000.0	45000.0	
Iron sheet	peices	6.0	25000.0	150000.0	
Nails	Kg	4.0	6000.0	24000.0	
Hose pipe	Meters	3.0	3000.0	9000.0	
Wood and poles	Pieces	50.0	4900.0	245000.0	
Total costs for establishment of the Technology				**885'000.0**	

Maintenance activities

1. Cleaning the reservoir/ tarpaulin and unblocking gutters (Timing/ frequency: Twice in the wet season)
2. Renovation of the structure (Timing/ frequency: Once a year)
3. Replacement of the taupline (Timing/ frequency: Once a year)

Maintenance inputs and costs (per Water Reservior)

Specify input	Unit	Quantity	Costs per Unit (Uganda shillings)	Total costs per input (Uganda shillings)	% of costs borne by land users
Labour					
Men		2.0	20000.0	40000.0	100.0
Equipment					
Hose pipe	meters	3.0	2000.0	6000.0	100.0
Jerrycans	20litres	2.0	9000.0	18000.0	100.0
Construction material					
Poles	pieces	6.0	3000.0	18000.0	100.0
Timber	pieces	6.0	10000.0	60000.0	100.0
Wood	pieces	5.0	1500.0	7500.0	100.0
Total costs for maintenance of the Technology				149'500.0	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [x] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

Agro-climatic zone
- [x] humid
- [ ] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
The rain seasons run from March-May and Sept-Nov.

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

Landforms
- [ ] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [x] hill slopes
- [ ] 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)
- [x] shallow (21-50 cm)
- [ ] 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
- [x] poor drinking water (treatment required)
- [ ] for agricultural use only (irrigation)
- [ ] unusable

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- [x] subsistence (self-supply)
- [ ] 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
- [ ] 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
- [ ] middle-aged
- [x] elderly

Area used per household
- [ ] < 0.5 ha

Scale
- [ ] small-scale

Land ownership
- [ ] state

Land use rights
- [ ] open access (unorganized)

- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [x] 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

- [x] medium-scale
- [ ] large-scale

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

- [ ] communal (organized)
- [ ] leased
- [x] individual

Water use rights

- [ ] open access (unorganized)
- [x] 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	
fodder production	decreased					✓			increased	
fodder quality	decreased					✓			increased	
animal production	decreased					✓			increased	
wood production	decreased				✓				increased	
forest/ woodland quality	decreased				✓				increased	
non-wood forest production	decreased				✓				increased	
risk of production failure	increased						✓		decreased	
product diversity	decreased						✓		increased	
production area (new land under cultivation/ use)	decreased						✓		increased	
land management	hindered				✓				simplified	
drinking water availability	decreased						✓		increased	Quantity before SLM: None Quantity after SLM: 80000 litres in storage by end of the wet season
drinking water quality	decreased					✓			increased	The water stored in the tank is relatively clean compared to that harvested previously using the run off harvest system.
water availability for livestock	decreased					✓			increased	
water quality for livestock	decreased						✓		increased	
irrigation water availability	decreased						✓		increased	
irrigation water quality	decreased						✓		increased	
expenses on agricultural inputs	increased				✓				decreased	Costs on irrigation and income from extended growing seasons
farm income	decreased						✓		increased	
diversity of income sources	decreased						✓		increased	
economic disparities	increased				✓				decreased	
workload	increased						✓		decreased	

Socio-cultural impacts

food security/ self-sufficiency	reduced						✓		improved	
health situation	worsened					✓			improved	Improved nutrition since the irrigation water supports growth of vegetables
cultural opportunities (eg spiritual, aesthetic, others)	reduced					✓			improved	
recreational opportunities	reduced				✓				improved	
community institutions	weakened					✓			strengthened	

Ecological impacts

harvesting/ collection of water (runoff, dew, snow, etc)	reduced			✓					improved	
surface runoff	increased					✓			decreased	
excess water drainage	reduced					✓			improved	
soil moisture	decreased						✓		increased	Through irrigation in the dry season
nutrient cycling/ recharge	decreased					✓			increased	The water facilitates dissolution of nutrients
soil organic matter/ below ground C	decreased					✓			increased	

		1	2	3	4	5	6	7	
acidity	increased				✓				reduced
vegetation cover	decreased					✓			increased
biomass/ above ground C	decreased					✓			increased
plant diversity	decreased					✓			increased
invasive alien species	increased				✓				reduced
animal diversity	decreased					✓			increased
drought impacts	increased						✓		decreased

Off-site impacts

		1	2	3	4	5	6	7	
water availability (groundwater, springs)	decreased				✓				increased
buffering/ filtering capacity (by soil, vegetation, wetlands)	reduced					✓			improved

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

		1	2	3	4	5	6	7	
Short-term returns	very negative						✓		very positive
Long-term returns	very negative						✓		very positive

Benefits compared with maintenance costs

		1	2	3	4	5	6	7	
Short-term returns	very negative							✓	very positive
Long-term returns	very negative							✓	very positive

CLIMATE CHANGE

Climate-related extremes (disasters)

		1	2	3	4	5	
drought	not well at all				✓		very well

Other climate-related consequences

		1	2	3	4	5	
extended growing period	not well at all				✓		very well
Livestock and domestic water	not well at all				✓		very well

ADOPTION AND ADAPTATION

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

- ☐ single cases/ experimental
- ☑ 1-10%
- ☐ 10-50%
- ☐ more than 50%

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

- ☐ 0-10%
- ☐ 10-50%
- ☑ 50-90%
- ☐ 90-100%

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

- ☑ Yes
- ☐ No

To which changing conditions?

- ☐ climatic change/ extremes
- ☐ changing markets
- ☐ labour availability (e.g. due to migration)
- ☑ Limited finances

The farmer improvised iron sheets as gutters to collect water from the roof into the reservoir.

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Most of the materials are cheap and locally available.
- The establishment process is not so complex and can easily be learnt by the local workers.
- The tarpaulin used is relatively cheap and long lasting.

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

- The farmer easily benefits from 2 annual rainy seasons.
- The system is raised off ground which minimizes contamination and accidents.
- The water is kept in a relatively clean status for livestock, irrigation and domestic use.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- The water system is open to contamination. → Need to construct a wall net to protect the water from contamination
- The materials (wood) used are prone to destruction by insects which increases maintenance costs. → Use of metallic or concrete poles

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- The taupline is a temporally reservoir that needs routine replacement. → Use of plastic materials or construction of concrete walls.
- In case of infestation with insects like termites, the poles will suffer damage. → Use treated wood poles or metal poles.

REFERENCES

Compiler
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Nicole Harari (nicole.harari@cde.unibe.ch)

Date of documentation: Dec. 5, 2017

Last update: Dec. 13, 2019

Resource persons
Deo Kabanda - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_3301/
Video: https://player.vimeo.com/video/261443480

Linked SLM data
Approaches: water harvesting https://qcat.wocat.net/en/wocat/approaches/view/approaches_2356/

Documentation was faciliated by
Institution
- National Agricultural Research Organisation (NARO) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Key references

- Rain Water Harvesting Handbook, Ministry of Water and Environment: https://www.mwe.go.ug/sites/default/files/library/Rain%20Water%20Harvesting%20Handbook.pdf

Links to relevant information which is available online
- Rainwater Reservoirs above Ground Structures for Roof Catchment: http://www.itacanet.org/doc-archive-eng/water/Rainwater_reservoirs_GTZ.pdf

Soil Fertility Management & Agronomic Practices

Stall feeding of Fresian cow by cut and carry for livestock management

Small ruminants management for manure production (goats)

Row planting of annual crops

Rotational grazing of goats for pasture conservation and improvement

Reducing tillage by slashing

Peer farmers as village resource person for scaling climate -Smart Agriculture (CSA) practices

Mulching using banana (***Musa spp***) leaves

Mulching using grass on perennial cropland

Modern intensive livestock management

Intercropping maize (***Zea mays***) and soya (***Glycine max***)

Growing cover crops for weed control

Animal manure use in a citrus orchard

Intensive pig farming for soil fertility improvement and household income

Controlled livestock grazing for soil fertility improvement

Orchard of mangoes (***Mangifera indica***) and oranges (***Cytrus spp***) for soil fertility improvement

Dairy cattle fed with supplementary feeds

Reclamation of indigenous pastures for dairy farming

Domestic biogas plant for fuel and organic fertilizer

Barley (***Hordeum vulgare***) fodder management for livestock among smallholder farmers

Photo Showing Stall Feeding of Friesian Cow to facilitate collecting manure for soil fertility improvement. (Issa Aiga)

Stall feeding of Friesian cow by cut and carry for livestock management (Uganda)

Gokwo dyang

DESCRIPTION

Zero grazing by cut and carry feeding. The cows do not graze but are confined inside the stall, feed and water is provided for the animals.

Due to land fragmentation and conflicts, traditional grazing systems where animals are reared in open grasslands is no longer feasible and sustainable since grassland is limited and stray animals would destroy neighboring crops. Now small holders with limited land but diversified livelihoods have to utilize the available land in full capacity and sustainable ways. For dairy farmers, stall feeding is an innovative and promising system. In this practice, a Friesian cow and its calf are confined inside the built stall. The stall has four partitions. A Calf room, milking pallor, feeding and drinking area and sleeping room. Within the feeding area is placed a wooden box of width 0.5m, length 1.5m and height 0.3m; into which feed is put for the animal. A half drum that can hold 80 liters of water is also put inside the feeding area. Both the wooden feeder and half drum are raised to a height of 0.5 m above the ground surface to prevent contamination of the feed with dung and urine; and also ensure efficient feed intake.
The farmer cultivated 1 acre of Napier grass (elephant grass), which provides adequate feed for the demands of the cow (75-100 kg of fresh grass per day). The Napier grass is cut, chopped and put inside the wooden box, while water is fetched from the stream and put into the half drum.
Through this method, the animal movement is restricted. This reduces the exposure to parasites such as ticks, and contagious diseases such as East Coast Fever. This practice also reduces land conflicts that would be caused by stray animals destroying crops of neighbors. The animal does not waste energy to look for pasture and water, hence milk productivity is enhanced. Manure is also deposited within the feeding area and thus easy to collect, decompose and apply in both farmers' crop and pasture fields. Animals do not need to be attended to, hence farmer has more time to rest and carry out other activities.
However, a lot of labor is required for cutting and chopping the grass, and carrying the feeds and water especially during the dry season. Treatment of animals and maintenance of the stall is costly and if management is poor, parasites and diseases can also build up within the stall. Stall feeding requires feed preservation in the form of fermented pasture (silage) and/or dried pasture (hay); stored and to be used for feeding the animals during dry seasons when pasture is dry and of poor quality.
To sustain this technology, the land users can supplement the feed through cultivating multipurpose tree species (Calliandra spp and Grivellia spp), leguminous forages such as lablab spp and macuna beans. Non-conventional feeds such as kitchen wastes (cassava, sweet potato and banana peelings) can also supplement the cut and carried Napier grass.

LOCATION

Location: Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 32.18691, 2.61938

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

In a permanently protected area?:

Date of implementation: 2014; less than 10 years ago (recently)

Type of introduction

- ☐ through land users' innovation
- ☐ as part of a traditional system (> 50 years)
- ☐ during experiments/ research
- ☑ through projects/ external interventions

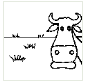
CLASSIFICATION OF THE TECHNOLOGY

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

Land use

Cropland
- Annual cropping
- Tree and shrub cropping

Number of growing seasons per year: 2



Grazing land
- Cut-and-carry/ zero grazing

Animal type: cattle - dairy, cow =1 . calf =1

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

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

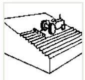
Degradation addressed

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

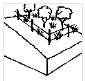
physical soil deterioration - Pc: compaction, Pu: loss of bio-productive function due to other activities

SLM group
- integrated crop-livestock management
- integrated soil fertility management
- Stall feeding

SLM measures



agronomic measures - A2: Organic matter/ soil fertility



management measures - M1: Change of land use type, M2: Change of management/ intensity level

other measures

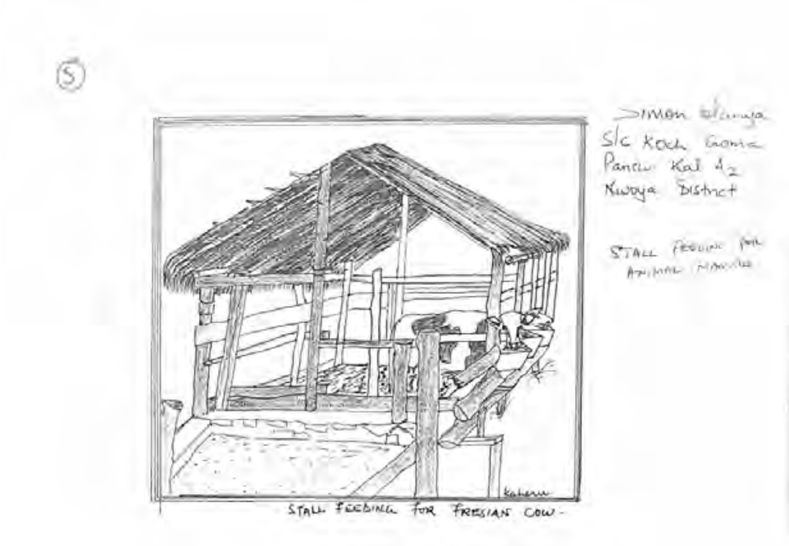
TECHNICAL DRAWING

Technical specifications

The stall should be 3 m tall, approximately with 4 rooms 1st floor for calf, second one for milking 3rd for sleeping and the 4th for feeding and drinking water.

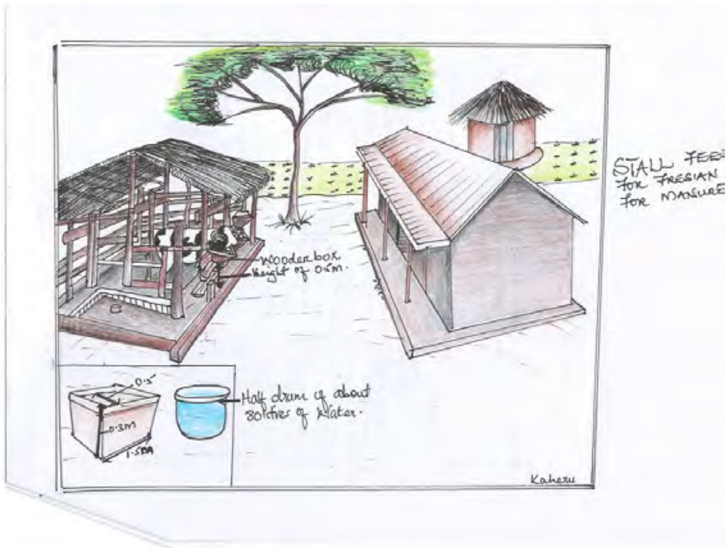
The Inputs required for this technology include: concrete wall built with cement, , wood (makonko), grass or iron roof, wooden box of about 1.5x0.5 m, half drum of about 80 litres both raised at 50cm above the floor, rake , tauplin and polythene paper.

Slope: Gentle slope.



Author: Kaheru

None



Author: Kaheru Prossy

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **1.5 acres**)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3803.0 UGX
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs
Labour costs for establishing and maintaining the technology.

Establishment activities
1. looking for land where to plant pasture (Timing/ frequency: During the first rainy season)
2. Looking for labour to clear the land, planting (Timing/ frequency: Once in a year(April-June))
3. Looking for seed (Timing/ frequency: once before establsihment)
4. Planting the pasture (Timing/ frequency: Daily after establishment)
5. Initial construction of the stall (Timing/ frequency: Once before establishment)
6. Initial construction of of feeding and drinking troughs (Timing/ frequency: Once before establishment)
7. Putting the cow/s in the stall (Timing/ frequency: Once after establishment)
8. Feeding and watering (Timing/ frequency: Daily)

Establishment inputs and costs (per 1.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
labour for transporting wood and cement	Persons	25.0	5000.0	125000.0	70.0
Labour for preparing and planting fields	Persons	45.0	5000.0	225000.0	30.0
Labour for constructing stall	persons	12.0			
Equipment					
Hoe	Pieces	2.0	10000.0	20000.0	100.0
Panga	Pieces	1.0	7000.0	7000.0	100.0
Spranger	Pieces	1.0	10000.0	10000.0	100.0
Plant material					
Elephant grass	bundles	5.0	100000.0	500000.0	100.0
lab lab	Pieces	4.0	5000.0	20000.0	100.0
Mucuna	Pieces	1.0	20000.0	20000.0	100.0
Construction material					
Timber	Pieces	40.0	3000.0	120000.0	100.0
Cement	bags	10.0	30000.0	300000.0	100.0
Logs	Pieces	60.0	3000.0	180000.0	100.0
Nails	kgs	10.0	3500.0	35000.0	100.0
Other					
Grass to thatch the stall	bundles	24.0	2000.0	48000.0	100.0
Total costs for establishment of the Technology				**1'610'000.0**	
Total costs for establishment of the Technology in USD				*423.35*	

Maintenance activities
1. Weeding pasture (Timing/ frequency: Three times per year)
2. Repairing of stall (Timing/ frequency: once after establishment and when need)
3. Treatment of cow (Timing/ frequency: When need arises(sick))
4. Insemination (Timing/ frequency: Once in two years)
5. Spraying (Timing/ frequency: Twice per week)
6. Reseeding (Timing/ frequency: During the rainy season)
7. Replanting of pasture (Timing/ frequency: During the rainy season)
8. Cutting and carrying the grass to the animal (Timing/ frequency: Daily after establishment)
9. Collection of manure (Timing/ frequency: Daily)
10. Applying manure to the garden (Timing/ frequency: Daily)
11. Making silage and hay (Timing/ frequency: During the wet season)

Maintenance inputs and costs (per 1.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Labour on daily basis	Persons	3.0	5000.0	15000.0	70.0
Hired labour on monthly basis	Persons	2.0	150000.0	300000.0	30.0
Equipment					
Hoe	Pieces	10.0	10000.0	100000.0	100.0
Rake	Pieces	2.0	7000.0	14000.0	100.0
Tauplin	Pieces	1.0	35000.0	35000.0	100.0
Polythene	Rolls	1.0	25000.0	25000.0	100.0
Plant material					
pasture for planting	Bundles	43.0	10000.0	430000.0	100.0
Other					
Pesticides (monthly)	litres	2.0	12000.0	24000.0	100.0
Total costs for maintenance of the Technology				**943'000.0**	
Total costs for maintenance of the Technology in USD				*247.96*	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 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
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
Average annual rainfall in mm: 1500.0
Two rainy season separated by about two weeks and dry spell and dry season of 4 weeks.

Slope
- [x] flat (0-2%)
- [ ] gentle (3-5%)
- [ ] moderate (6-10%)
- [ ] rolling (11-15%)

Landforms
- [ ] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [ ] hill slopes

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.

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

- [ ] hilly (16-30%)
- [ ] steep (31-60%)
- [ ] very steep (>60%)

- [ ] footslopes
- [x] valley floors

- [ ] 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.

Soil depth
- [ ] very shallow (0-20 cm)
- [x] shallow (21-50 cm)
- [ ] 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)
- [ ] medium (loamy, silty)
- [x] fine/ heavy (clay)

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

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

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

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

Water quality refers to:

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

Off-farm income
- [x] less than 10% of all income
- [ ] 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
- [ ] 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
- [x] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [x] 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)
- [x] communal (organized)
- [ ] leased
- [ ] individual

Access to services and infrastructure

	poor				good
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	The area which is under pasture.
fodder production	decreased							✓	increased	0.5 acre improved pasture but lack management.
animal production	decreased						✓		increased	Quantity before SLM: 3 litres of milk per day Quantity after SLM: 10litres of milk per day Increased milk production.
production area (new land under cultivation/ use)	decreased							✓	increased	Additional fodder.

land management	hindered	□□□□□□✓	simplified	Trees hold soils , are perennial as compared to annuals that need to be planted every year and need less maintenance.
water quality for livestock	decreased	□□□□✓□□	increased	But it has no much effect.
expenses on agricultural inputs	increased	□□✓□□□□	decreased	Planting material.
farm income	decreased	□□□□□✓□	increased	Sale of milk.
diversity of income sources	decreased	□□□□□✓□	increased	More products for sale (grass, milk, manure).
workload	increased	□✓□□□□□	decreased	Feeding animal.

Socio-cultural impacts

food security/ self-sufficiency	reduced	□□□□□□✓	improved	Income received from sale of milk is used for buying food.
community institutions	weakened	□□□□□□✓	strengthened	Especially in savings and credit (SACCO).

Ecological impacts

soil loss	increased	□□□□□□✓	decreased	Restricted movements of cattle since the ve is only cut and carried to where the animal is fed.
soil compaction	increased	□□□□□□✓	reduced	Less tampering with the soil.
soil organic matter/ below ground C	decreased	□□□□□□✓	increased	Due to application of manure.

Off-site impacts

damage on neighbours' fields	increased	□□□□□✓□	reduced	No zero grazing.
impact of greenhouse gases	increased	□□✓□□□□	reduced	No bio gas production.

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

Once established the farmer needs only to pay for labour to cut and carry grass and make silage and hay only.

CLIMATE CHANGE

Gradual climate change

annual temperature increase	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?

- [x] Yes
- [ ] No

To which changing conditions?

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

During the dry season, the land user seeks fodder from the swamps.

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- The technology is good at providing income for household needs.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- High costs of treatment. → Reduce risk of infection and

- The technology is replicable in other areas and helps diversify income source because of the many products derived from the technology.
- Does not require labour to attend to it for 12 hours in a day unlike those technologies that concern cultivation. This means the farmer has more time to do other activities in a day.

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

- Appropriate for low maintenance costs.
- The technology does not promote conflicts among land users.

infestation.

- Veterinary services expensive and not easily available. → Training of local trainers to support extension.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- The technology is not sustainable if not well manged by the land user. → Improve management of the technology.
- Requires day to day monitoring of diseases. → Engage household labour to keep alternating.
- The land user require skills on how to make concentrates. → Train the land user on how to make concentrates.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Alexandra Gavilano
Donia Jendoubi
John Stephen Tenywa
Nicole Harari
Renate Fleiner
Stephanie Jaquet
Rima Mekdaschi Studer

Date of documentation: June 10, 2017

Last update: Aug. 22, 2019

Resource persons
Simon Olanya - land user
- None

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2816/
Video: https://player.vimeo.com/video/325826709

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Goats tethered for animal manure (Issa Aiga)

Small ruminant management for manure production (goats) (Uganda)

Gwooko dyel pi kelo moc cam

DESCRIPTION

Local goat breeds housed in a shed to generate manure for annual and perennial cropland.

Small ruminants (goats) produce significant quantities of nutrient rich manure, which is useful for replenishing soil fertility for crop production. In Northern Uganda, this technology involves several goats, raised in a shade constructed often of wooden materials. An average shade covers about 10 m by 2.5 m, and raised up to 0.5 m off the ground to protect the ruminants from vermin such as snakes and rats, as well as rainwater flooding. The ground floor may be cemented so that the droppings are kept free from mixing with other pesticides and various chemicals used to control external parasites that may contaminate the manure. The droppings generated by the animals are collected from underneath the shade and heaped in a pit for composting. The pit is covered for about two weeks using a grass and soil or polythene paper. After this period, the compost manure is mature and is ready for application in the fields to increase production. Because this technology involves goats, it is relatively easier and cheaper to maintain than the case of cattle in terms of feeding and maintenance. Besides, it is more efficient in providing manure for soil fertility improvement since the droppings generated by the animals are collected from underneath the shade and heaped in a pit for composting and collected over time. Moreover, the demand for goat meat is often high, thus its price remains steadily high during the year. To be able to manage this technology and to achieve desired benefits, the farmer must keep in contact with the extension worker for veterinary services because goat diseases are rampant in the region and vary from simple skin ailments, diarrhoea to severe conditions causing, loss of weight, abortion and death. The most common infections include; Scours that are more common in young goats and dirty pens caused by bacteria, coccidia, worms or even showing the following signs; loss of appetite, diarrhoea (yellow to red discoloration), pasting of faeces under and around the tail, loss of weight and high temperature. Goats are well known for their strength and resilience to diseases. However, this does not necessarily mean that they are never affected. This often accounts for a substantial part of the cost of production.

LOCATION

Location: Town, Western Uganda Region, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 33.07907, 3.11806

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?:

Date of implementation: 2015; less than 10 years ago (recently)

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

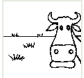
CLASSIFICATION OF THE TECHNOLOGY

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

Land use

Cropland
- Annual cropping

Number of growing seasons per year: 2


Grazing land
- Cut-and-carry/ zero grazing

Water supply
- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation
- ✓ prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

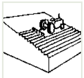
Degradation addressed

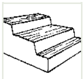
chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion), Ca: acidification

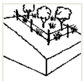

physical soil deterioration - Ps: subsidence of organic soils, settling of soil


biological degradation - Bq: quantity/ biomass decline, Bl: loss of soil life

SLM group
- integrated crop-livestock management
- integrated soil fertility management

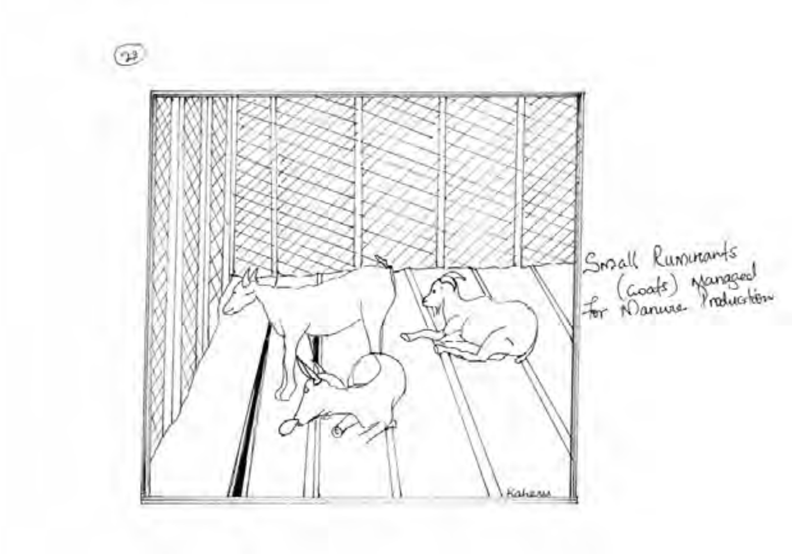
SLM measures

agronomic measures - A3: Soil surface treatment


structural measures - S9: Shelters for plants and animals


management measures - M6: Waste management (recycling, re-use or reduce)

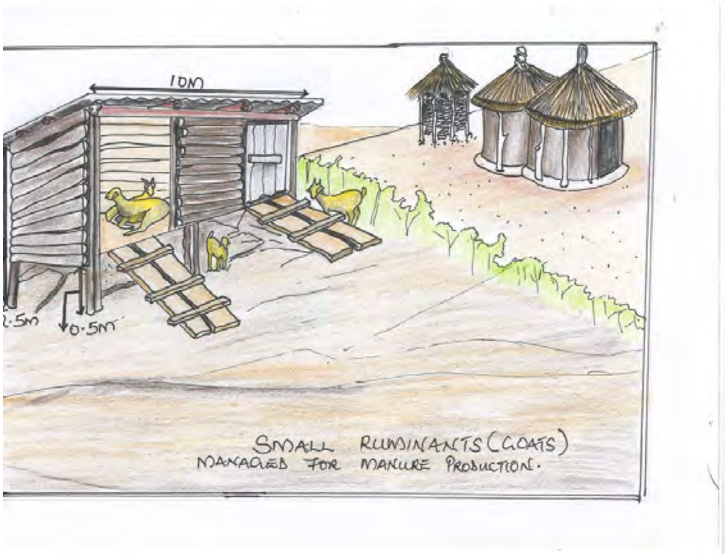
TECHNICAL DRAWING

Technical specifications
None



Author: Kaheru

None



ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **Less than 0.5 acres**)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3500.0 UGX
- Average wage cost of hired labour per day: 5000 per person per day

Most important factors affecting the costs

Labour takes most of the costs.

Establishment activities

1. Drawing structural plan (Timing/ frequency: Once before establishment)
2. Purchasing and assembling material (Timing/ frequency: once before estabslishment)
3. Measuring and laying out plan/pitting (Timing/ frequency: Once during establishment)
4. Contsruction of the struture (Timing/ frequency: During establishment)
5. Manure collection and composting (Timing/ frequency: Routine)

Establishment inputs and costs (per Less than 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Labour for construction on daily basis	persons	3.0	5000.0	15000.0	100.0
Construction material					
poles	Pieces	20.0	3000.0	60000.0	100.0
iron sheets	Pieces	5.0	20000.0	100000.0	100.0
Nails	kgs	5.0	3000.0	15000.0	100.0
wire mesh	kgs	20.0	50000.0	1000000.0	100.0
Total costs for establishment of the Technology				**1'190'000.0**	

Maintenance activities
1. Manure collection and composting (Timing/ frequency: daily)
2. Manure application to gardens (Timing/ frequency: monthly)

Maintenance inputs and costs (per Less than 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
labour on daily basis	persons	3.0	5000.0	15000.0	100.0
Total costs for maintenance of the Technology				15'000.0	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 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
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
Average annual rainfall in mm: 1400.0

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
- [x] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [ ] 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%)
- [ ] medium (1-3%)
- [x] low (<1%)

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

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

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

Water quality refers to:

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [x] Yes
- [ ] No

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
- [x] poor
- [ ] average
- [ ] rich
- [ ] very rich

Level of mechanization
- [x] manual work
- [ ] 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

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

Land ownership
- [ ] state
- [ ] company
- [ ] communal/ village
- [ ] group

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

- [ ] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

- [x] individual, not titled
- [ ] individual, titled

Water use rights
- [ ] open access (unorganized)
- [x] communal (organized)
- [ ] leased
- [ ] 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	Due to application of manure.
farm income	decreased ✓ increased	Income increased from the sale of goats and the sale of maize.
diversity of income sources	decreased ✓ increased	From goats, sheep, and maize.

Socio-cultural impacts

Ecological impacts

soil organic matter/ below ground C	decreased ✓ increased	Due to application of animal manure.

Off-site impacts

damage on neighbours' fields	increased ✓ reduced	Due to controlled grazing.

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

Balanced at the time of establishment and positive within 1-2 years and more.

CLIMATE CHANGE

Gradual climate change

annual rainfall decrease — not well at all ✓ very well

Climate-related extremes (disasters)

epidemic diseases — not well at all ✓ very well

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology
- [x] single cases/ experimental
- [ ] 1-10%
- [ ] 11-50%
- [ ] > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?
- [ ] 0-10%
- [x] 11-50%
- [ ] 51-90%
- [ ] 91-100%

Has the Technology been modified recently to adapt to changing conditions?
- [ ] Yes
- [x] No

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

- Relatively cheap because it uses locally available materials and labour.
- Does not require expensive maintenance costs in terms of labour.
- Special skills are required for management and maintenance. The land user can even use family labour.

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

- Goats are on demand and income is guaranteed once the farmer has his ruminants ready for sale each goes to 100,000-200,000 UGX equivalent to 26.5- 57 Unites states dollars depending on the size.
- Small ruminant manure is good at improving soil fertility and is nutritious and increase crop yields significantly.
- Small ruminant requires medical/ veterinary attention which are readily available at sub-county level.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Susceptible to thieves. → Provide security to guard against thieves.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- The technology is susceptible to diseases if not managed well. This may result to deaths. → Attend to the technology on a daily basis by cleaning the house shade and treating diseases.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Stephanie Jaquet
Renate Fleiner
Nicole Harari
John Stephen Tenywa
Donia Jendoubi

Date of documentation: June 7, 2017

Last update: March 13, 2019

Resource persons
Alex Nyeko - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2784/
Video: https://player.vimeo.com/video/323398214

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Photo showing Row Planting of anuual crops in Northern Uganda (Issa Aiga)

Row planting of annual crops (Uganda)

Pito kodi iline

DESCRIPTION

In row planting, crops are planted according to the recommended agronomic spacing to ease management and obtain maximum yields per unit area.

In this practice, the farmer planted sunflower (Helianthus) seeds at a spacing recommended for the particular variety. Sunflower variety PAN7033 and AGISUN was cultivated on 1 acre of land at a spacing of 15cm within row and 30cm between rows.
To plant crops in a row, the farmer has to ensure that the field is finely prepared. During planting, pegs are fitted at a spacing corresponding to spaces between the rows (30cm), along the width of the field. Ropes are then tied on the pegs along the length of the field. The rope guides the person who will be digging the planting holes, while another person would be dropping the seeds in the holes. After digging the holes in a row, the rope is transferred to the next set of pegs and the process is repeated. These activities require a minimum of 10 people to be working on the farm in order to plant 1 acre of sunflower in a day.
In this way; high yield is obtained from the crop. Activities like weeding, spraying, fertilizer application, harvesting becomes easy hence labor demand is reduced.
Although there are elaborate gardening pegs and ropes in the market, the rope and pegs can be made from locally available materials hence reducing costs. Crop planted in rows may reduce surface runoff by planting in a homogenous way and improve maintain a consistent soil cover.

LOCATION

Location: Amuru District, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.1347, 2.95231

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?:

Date of implementation: 2015; 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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use

Cropland

- Annual cropping

Number of growing seasons per year: 2

Water supply

- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation

- prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

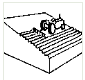
soil erosion by water - Wt: loss of topsoil/ surface erosion

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

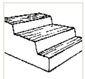
SLM group

- rotational systems (crop rotation, fallows, shifting cultivation)
- improved ground/ vegetation cover

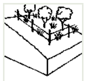
SLM measures



agronomic measures - A1: Vegetation/ soil cover, A7: Others



structural measures - S11: Others

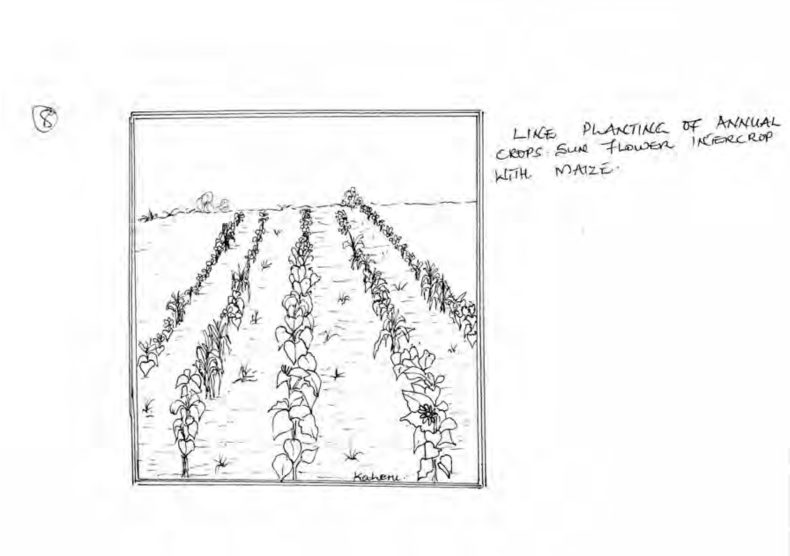


management measures - M2: Change of management/ intensity level

TECHNICAL DRAWING

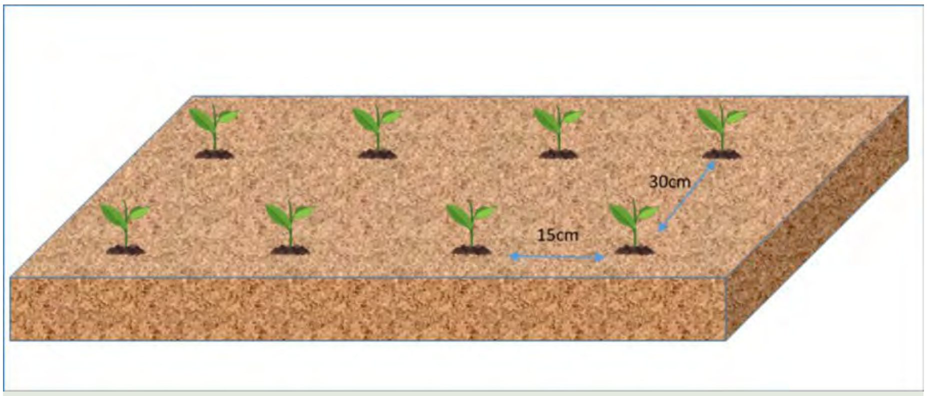
Technical specifications

None



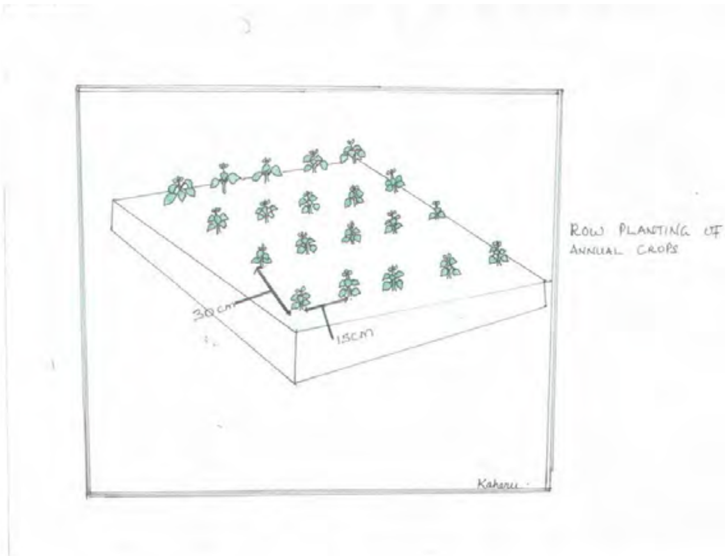
Author: Kaheru

None



Author: Amale Balla Sunday

None



Author: Kaheru prossy

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1 acre**)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3600.0 UGX
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs
Labour for planting, weeding and harvesting takes the most of costs.

Establishment activities

1. Land opening (Clearing the bush before planting) (Timing/ frequency: Once before establishment)
2. 2 degrees tillage (Timing/ frequency: Once before establishment)

3. Marking line (Timing/ frequency: During establishment)
4. Digging (Timing/ frequency: During establishment)
5. Seeding (Timing/ frequency: During establishment)
6. Weeding (Timing/ frequency: After establishment)
7. Harvesting (Timing/ frequency: After establishment)

Establishment inputs and costs (per 1 acre)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Labour for planting	Persons	10.0	5000.0	50000.0	100.0
Equipment					
Hoes	Pieces	3.0	10000.0	30000.0	100.0
pegs	Pieces	6.0	2000.0	12000.0	100.0
ropes	Rolls	1.0	10000.0	10000.0	100.0
Plant material					
Seeds	Kgs	30.0	5000.0	150000.0	100.0
Total costs for establishment of the Technology				252'000.0	

Maintenance activities
1. Monitoring (Timing/ frequency: Once a year)
2. Harvesting (Timing/ frequency: once a year)

Maintenance inputs and costs (per 1 acre)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Labour for harvesting and monitoring.	persons	5.0	5000.0	25000.0	100.0
Total costs for maintenance of the Technology				25'000.0	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 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
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
n.a.

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
- [ ] footslopes
- [x] valley floors

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [x] 501-1,000 m a.s.l.
- [ ] 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)
- [x] shallow (21-50 cm)
- [ ] 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
- [x] 5-50 m
- [ ] > 50 m

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

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

Water quality refers to:

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

Relative level of wealth
- [ ] very poor
- [x] poor
- [ ] 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
- [x] women
- [x] men

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

Area used per household
- [ ] < 0.5 ha
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [x] 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
- [x] small-scale
- [ ] 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)
- [x] leased
- [x] individual

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

Access to services and infrastructure

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

(Scale: poor – good, 3 levels; ✓ marks the selected level: health 2, education 1, technical assistance 2, employment 1, markets 2, energy 1, roads and transport 3, drinking water and sanitation 3, financial services 1.)

IMPACTS

Socio-economic impacts

Impact	Scale (7 levels)	Selected level	Comment
Crop production	decreased – increased	6	High yield and pod filling.
land management	hindered – simplified	2	Row planting technique.
expenses on agricultural inputs	increased – decreased	2	Especially on labour.
farm income	decreased – increased	6	From the sale of harvests (soya and sunflower).

Socio-cultural impacts

Ecological impacts

Impact	Scale (7 levels)	Selected level	Comment
nutrient cycling/ recharge	decreased – increased	7	Use of the soya bean residues.
soil organic matter/ below ground C	decreased – increased	7	Soil organic matter increased due to application of soya residues.

Off-site impacts

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

	Scale (7 levels)	Selected level
Short-term returns	very negative – very positive	5
Long-term returns	very negative – very positive	6

Benefits compared with maintenance costs

	Scale (7 levels)	Selected level
Short-term returns	very negative – very positive	5
Long-term returns	very negative – very positive	6

CLIMATE CHANGE

Gradual climate change

	Scale (5 levels)	Selected level
annual temperature increase	not well at all – very well	4

seasonal temperature increase — not well at all / very well (rated: moderately) — Season: wet/ rainy season

ADOPTION AND ADAPTATION

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

- ☐ single cases/ experimental
- ☑ 1-10%
- ☐ 11-50%
- ☐ > 50%

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

- ☑ 0-10%
- ☐ 11-50%
- ☐ 51-90%
- ☐ 91-100%

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

- ☐ Yes
- ☑ No

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

- Easy to establish using a rope which is cheap.
- Easy to establish and manage with minimum costs.
- Good at controlling soil and water runoffs
- The technology can easily be replicated and used by both small scale and large scale farmers.

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

- Yield potential is high and realized when the spacing is done well by the land user according to recommended spacing.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Labour intensive at the time of establishment. → Use group labour.
- Time consuming during establishment. → Use group labour to save on time.
- Requires technical knowledge especially on the spacing. → Provide information early enough to the land user on the required spacing.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- The land user does not Incorporate Integrated Soil Fertility Management (ISFM) yet has livestock manure. → Advice to integrate animal manure in row planting.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Stephanie Jaquet
Renate Fleiner
Nicole Harari
John Stephen Tenywa
Donia Jendoubi

Date of documentation: June 10, 2017

Last update: March 13, 2019

Resource persons
David Obwona - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2814/
Video: https://player.vimeo.com/video/323400163

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Goats grazing (Betty Adoch)

Rotational grazing of goats for pasture conservation and improvement. (Uganda)

Gwoko Dyel

DESCRIPTION

Rotational grazing by improved goats variety enhances/ increases soil fertility, biodiversity and production of pastures and generates farmyard manure applied on cropland.

Rotational grazing is the shifting of livestock to different units of a pasture or range in regular sequence to permit the recovery and regrowth of the pasture plants after grazing, which increased forage production. Forage that are over-grazed or are less healthy from being grazed every few days have smaller root mass, which leads to less soil organic matter. Northern Uganda has tropical savannah climate characterized by moderate rainfall of 750-1000mm per annum. This region also experiences prolonged dry spells from June to July and also November to March characterised by wild fire outbreaks which retards pasture growth. Because of this, land user has to conserve pastures through rotational grazing in a paddock system. The land is gently sloping with moderate soil humus that has also supported the growth of pastures. The land user is a subsistence farmer who graze goat in a paddock system for pasture conservations, manure generation for cropland, and goats for home consumptions and sale. About 90% of his income is from on farm activities.

A well-managed controlled grazing program can increase quality forage production by 30-70% each year. Much of this increase in forage production is accomplished by minimizing overgrazing. In this technology, six paddocks were created measuring 40x50meters on a five acres' piece of land. Goats are shifted from one paddock to another in an interval of one month and later shifted to another section. The water tank is also moved as the goats are shifted to another paddocks. The shifting is to reduce on overgrazing. The land user has 40 goats. Two paddocks are grazed at the same time with each having a carrying capacity of 20goats to minimize on overcrowding and congestion at the water point. controlled grazing is practiced in order to protect the area from the damages of grazing that is digging up roots and everything in the field since this will de-grass an area and make it susceptible for erosion. By limiting graze time, fields can produce all year round instead of being a one-time harvest. Goats are not allowed to graze a paddock until it is at least 10 to 12 inches in height. If grazed any shorter, this compromises root recovery, energy storage in the roots, and grass' ability to depend on photosynthesis alone. This is why the land user preferred rotational grazing to prevent overgrazing, and allow the forage plenty of time to recover.

The inputs needed for the establishment of this technology are pangas, hand hoes, slashers, poles, and labour force to carry out the work of paddock constructions. To main the technology, the over grown grass is slashed to a height of 10 to 12 inches in height which is consumable by goats, water point is cleaned every two weeks to avoid contamination, paddocks repaired and goats constantly checked for treatment

The technology provides beneficial impacts like improvement of organic matter content and pasture soil fertility as a result of spreading manure around the whole pasture while grazing and browsing. Grazing goats typically return to the water tanks or a single favourite shade tree. The manure deposited around water tanks/tree shade is collected and used as farmyard manure for the seasonal crop production like cereals, vegetables, and legumes.

The technology is disliked because it is tedious to look after so many goats, wild animal

LOCATION

Location: Omoro District., Northern Uganda., Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.33574, 2.55368

Spread of the Technology: evenly spread over an area (approx. 0.1-1 km2)

In a permanently protected area?:

Date of implementation: 2003; 10-50 years ago

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

attacks and drought affects water supply and pasture growth for the goats.

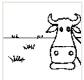
CLASSIFICATION OF THE TECHNOLOGY

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

Land use


Cropland
- Annual cropping: cereals - maize, cereals - sorghum, simsim

Number of growing seasons per year: 2



Grazing land
- Improved pastures
- Rotational grazing

Animal type: cattle - non-dairy beef, goats, poultry

Species	Count
cattle - non-dairy beef	8
goats	40
poultry	50

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

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

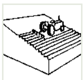
Degradation addressed


soil erosion by water - Wt: loss of topsoil/ surface erosion

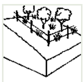
physical soil deterioration - Pc: compaction

biological degradation - Bc: reduction of vegetation cover, Bs: quality and species composition/ diversity decline

SLM group
- rotational systems (crop rotation, fallows, shifting cultivation)
- integrated crop-livestock management

SLM measures


agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility



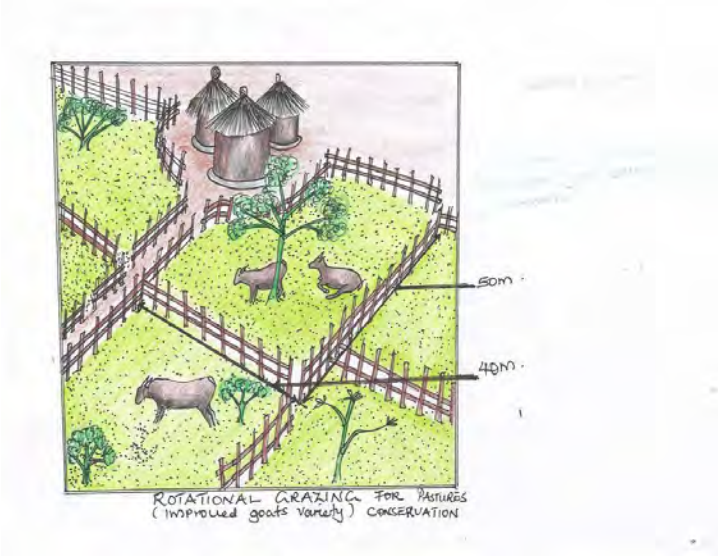
management measures - M1: Change of land use type, M2: Change of management/ intensity level, M3: Layout according to natural and human environment

other measures

TECHNICAL DRAWING

Technical specifications
Five acres of land under paddock system of rotational grazing. The paddocks measures 40x50meter. Poles of about 1meter high are

used to fenced the paddocks.



Author: Betty Adoch

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: 5acres)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3718.0 UGX
- Average wage cost of hired labour per day: 1000shs

Most important factors affecting the costs
The labour costs for fencing the paddocks, and the high costs of fencing materials.

Establishment activities
1. Clearning the bush through digging and slashing (Timing/ frequency: Dry season.)
2. Marking the paddocks and planting poles (Timing/ frequency: Dry season)
3. Fencing the area (Timing/ frequency: Dry season)
4. Installing the water tank (Timing/ frequency: Dry season)
5. Introducing the goats into the paddock (Timing/ frequency: Rainy season)

Maintenance activities
1. Slashing the over grown grass (Timing/ frequency: wet season)
2. cleaning the water tank (Timing/ frequency: wet and dry season)
3. Refilling the water tank (Timing/ frequency: wet and dry season)
4. Repairing the paddock (Timing/ frequency: Dry season)
5. Creating firelines (Timing/ frequency: dry season)

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
The rainfall is moderate and unreliable.
Name of the meteorological station: Gulu meterological station.
Climate is suitable for pasture growth.

Slope
- ✓ flat (0-2%)
- 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- 501-1,000 m a.s.l.
- ✓ 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
- not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table

Availability of surface water

Water quality (untreated)

Is salinity a problem?

- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

- excess
- ✓ good
- medium
- poor/ none

- ✓ good drinking water
- poor drinking water (treatment required)
- for agricultural use only (irrigation)
- unusable

Water quality refers to:

- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- ✓ high
- medium
- low

Habitat diversity
- high
- medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- ✓ mixed (subsistence/ commercial)
- commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- manual work
- ✓ animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- women
- ✓ men

Age
- children
- youth
- ✓ middle-aged
- elderly

Area used per household
- < 0.5 ha
- 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
- medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- individual, not titled
- ✓ individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- individual

Access to services and infrastructure

	poor				good
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

fodder production	decreased						✓		increased	Quantity before SLM: negative Quantity after SLM: positive Due to conserved pastures.
drinking water availability	decreased						✓		increased	Quantity before SLM: negative Quantity after SLM: positive Source of water is secured by the land user.
water availability for livestock	decreased							✓	increased	Quantity before SLM: slightly negative Quantity after SLM: very positive Water filled in a tank for goats consumption.
water quality for livestock	decreased							✓	increased	Quantity before SLM: negative Quantity after SLM: positive Goats fenced off which avoid water contamination.
farm income	decreased							✓	increased	Quantity before SLM: negative Quantity after SLM: positive Rotational grazing has saved the land user from purchasing animal feeds which would be very expensive.

Socio-cultural impacts

SLM/ land degradation knowledge	reduced							✓	improved	Quantity before SLM: negative Quantity after SLM: very positive Land user is aware of climate smart agriculture which has a lots of site benefits in terms of increased animal productions.

Ecological impacts

Impact		Rating		Comments
evaporation	increased	✓ (very positive)	decreased	Quantity before SLM: very positive Quantity after SLM: very negative Grass cover the soil from effects of evaporation.
soil moisture	decreased	✓ (positive)	increased	Quantity before SLM: negative Quantity after SLM: positive Grass covers the soil from erosion.
soil cover	reduced	✓ (very positive)	improved	Quantity before SLM: slightly negative Quantity after SLM: very positive Grass covers the soil from being exposed to agents of erosion.
soil loss	increased	✓ (very positive)	decreased	Quantity before SLM: very positive Quantity after SLM: very negative The grass covers the soil from erosion.
soil compaction	increased	✓ (very positive)	reduced	Quantity before SLM: very positive Quantity after SLM: very negative Grazing goats loosen the soil particles which helps in fertile soil formation.
biomass/ above ground C	decreased	✓ (very positive)	increased	Quantity before SLM: negative Quantity after SLM: very positive Dry grass decompose to form humus.
plant diversity	decreased	✓ (very positive)	increased	Quantity before SLM: negative Quantity after SLM: positive Different vegetation covers exist in the grazing fields.
fire risk	increased	✓ (very positive)	decreased	Quantity before SLM: very positive Quantity after SLM: very negative Fire lines are created during dry seasons to prevent wildfire spread to the grazing fields.

Off-site impacts

Impact		Rating		Comments
buffering/ filtering capacity (by soil, vegetation, wetlands)	reduced	✓ (positive)	improved	Quantity before SLM: negative Quantity after SLM: positive Grass roots filters and purifies the surface water.
damage on neighbours' fields	increased	✓ (very positive)	reduced	Quantity before SLM: positive Quantity after SLM: negative Goats are fenced off from crop land reducing unnecessary destruction.

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

		Rating	
Short-term returns	very negative	✓ (slightly positive)	very positive
Long-term returns	very negative	✓ (positive)	very positive

Benefits compared with maintenance costs

		Rating	
Short-term returns	very negative	✓ (slightly positive)	very positive
Long-term returns	very negative	✓ (positive)	very positive

The farmer has been able to generate income to improve his standard of living.

CLIMATE CHANGE

-

ADOPTION AND ADAPTATION

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

- ☐ single cases/ experimental
- ☑ 1-10%
- ☐ 11-50%
- ☐ > 50%

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

- ☑ 0-10%
- ☐ 11-50%
- ☐ 51-90%
- ☐ 91-100%

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

- ☑ Yes
- ☐ No

indegineous pastures are conserved for the goats.

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

- Conserve indegineous pastures.
- The vegetation roots filters the surface water.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Limited capital to establish the paddocks. → Extenal support

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

- Availability of pastures for the goats through out the year.
- The paddocks protects the land from land wrangles.

from doners.

- Prolonged dry spells that retards pastures growth. → Practice climate smart agriculture like rotational grazing.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Limited labour force to look after the goats. → Employing farm workers.
- Pests and diseases that disturb the goats. → Technical services from the extension workers.

REFERENCES

Compiler
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Reviewer
Alexandra Gavilano
Rima Mekdaschi Studer
Stephanie Jaquet
Renate Fleiner
Nicole Harari
Drake Mubiru

Date of documentation: May 3, 2017

Last update: Aug. 10, 2019

Resource persons
Abel Mwaka - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2147/
Video: https://player.vimeo.com/video/254983316

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Key references

- Mixed crop-livestock farming - FAO: www.fao.org/docrep/004/Y0501E/y0501e03.htm

Links to relevant information which is available online

- Mixed farming | ClimateTechWiki: www.climatetechwiki.org/content/mixed-farming

(Amale Balla Sunday)

Reducing tillage by slashing (Uganda)

lum ajwera

DESCRIPTION

A minimum tillage technology where the garden is cleared by slashing and crops are planted without opening the land.Only the spot where the seed is dropped is dug, The rest of the land is left undisturbed.

Tillage, which is practice traditionally used to prepare fine seedbeds and control weeds, bears several undesirable side effects that have forced land users to rethink and develop other sustainable management strategies such as reduced tillage or no-till (see Figure below). Tillage as a practice damages soil and leaves it exposed to erosion, particularly by wind and water. Yet weeding using tillage methods is often laborious and costly.

In parts of northern Uganda, minimum or reduced tillage is used to ease land preparation. Labor is an important factor that determines the size of gardens that the farmers can prepare and work on. With this technology, immediately after crop harvest, the field is cleared by slashing residues (weeds and crop residues) present in the field. It is a good practice to cut the vegetation before they produce seeds to ensure that few weed seeds germinate. After slashing down crop residues, planting holes for the subsequent crop are dug following given recommendations for a target crop.

This practice ensures that the residues provide mulch, which in turn reduces surface runoff and soil erosion. The decomposing residues provide humus and replenish nutrients into the soil. Plants can also escape harsh weather conditions since they can be planted in time. This technology is still new among the farming communities in northern Uganda, thus its proper use requires extension advisory support.

LOCATION

Location: Nwoya district, Nothern, Uganda

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites

- 32.2054, 2.52852
- 31.99282, 2.57852
- 31.87527, 2.53772

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2015; less than 10 years ago (recently)

Type of introduction

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

CLASSIFICATION OF THE TECHNOLOGY

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

Land use

Cropland - Annual cropping

Water supply
- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Number of growing seasons per year: 2
Land use before implementation of the Technology: n.a.
Livestock density: not relevant

Purpose related to land degradation
- prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- ✓ adapt to land degradation
- not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion

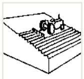
soil erosion by wind - Et: loss of topsoil

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

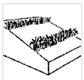
biological degradation - Bh: loss of habitats, Bq: quantity/ biomass decline, Bl: loss of soil life

SLM group
- improved ground/ vegetation cover
- minimal soil disturbance

SLM measures



agronomic measures - A1: Vegetation/ soil cover



vegetative measures - V2: Grasses and perennial herbaceous plants

TECHNICAL DRAWING

Technical specifications
Grasses are slashed to ground surface

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology unit (unit: acre acre volume, length: 300x160m2)

Most important factors affecting the costs
Farm Labour; although this technology reduces the labour demand

- Currency used for cost calculation: **uganda shillings**
- Exchange rate (to USD): 1 USD = 3600.0 uganda shillings
- Average wage cost of hired labour per day: 5000

Establishment activities

1. slashing (Timing/ frequency: dry season)

Establishment inputs and costs (per acre)

Specify input	Unit	Quantity	Costs per Unit (uganda shillings)	Total costs per input (uganda shillings)	% of costs borne by land users
Labour					
personnel	persondays	9.0	5000.0	45000.0	100.0
Equipment					
slashes	pieces	3.0	6000.0	18000.0	100.0
Total costs for establishment of the Technology				63'000.0	

Maintenance activities

n.a.

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

two rainy seasons in a year, dry season between december and march

Name of the meteorological station: gulu meteorological station

Slope
- flat (0-2%)
- ✓ 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- ✓ 501-1,000 m a.s.l.
- 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
- ✓ not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- ✓ subsistence (self-supply)
- mixed (subsistence/ commercial
- commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- ✓ poor
- average
- rich
- very rich

Level of mechanization
- ✓ manual work
- animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative

Gender
- ✓ women
- men

Age
- children
- ✓ youth
- ✓ middle-aged

☐ employee (company, government)

☐ elderly

Area used per household
- ☐ < 0.5 ha
- ☑ 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
- ☐ medium-scale
- ☐ large-scale

Land ownership
- ☐ state
- ☐ company
- ☐ communal/ village
- ☐ group
- ☑ individual, not titled
- ☐ individual, titled

Land use rights
- ☐ open access (unorganized)
- ☐ communal (organized)
- ☐ leased
- ☑ individual

Water use rights
- ☐ open access (unorganized)
- ☑ communal (organized)
- ☐ leased
- ☐ 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	more land can be opened
crop quality	decreased					✓			increased	better crop growth
land management	hindered					✓			simplified	reduced erosion
expenses on agricultural inputs	increased						✓		decreased	less expenses on land opening
workload	increased						✓		decreased	primary and secondary tillage reduced to just slashing

Socio-cultural impacts

Ecological impacts

Off-site impacts

water availability (groundwater, springs)	decreased					✓			increased	grass retain more water

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

in real sense, its not maintained, its done each and every season for annual crops for land clearence

CLIMATE CHANGE

Gradual climate change

annual rainfall decrease	not well at all					✓	very well	
seasonal rainfall decrease	not well at all				✓		very well	Season: wet/ rainy season

Climate-related extremes (disasters)

drought	not well at all					✓	very well
insect/ worm infestation	not well at all			✓			very well

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology
- ☐ single cases/ experimental
- ☑ 1-10%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?
- ☐ 0-10%
- ☐ 10-50%

- [ ] 10-50%
- [ ] more than 50%
- [x] 50-90%
- [ ] 90-100%

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

- [x] Yes
- [ ] No

To which changing conditions?

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

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- reduce labour demands
- more land can be cleared
- less farm activities

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

- reduce soil disturbance hence increase soil life

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- hard soil → prepare before land dries up completely
- more weeds → proper control of weeds, before they produce seeds

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- leached nutrients are not brought to surface → plant deep rooted crops
- my limit soil aeration → stop of planting should be well dug

REFERENCES

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Date of documentation: Dec. 19, 2017

Last update: June 27, 2018

Resource persons
Everline Aryemo - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_3329/

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- Makerere University (Makerere University) - Uganda

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

A peer farmer explaining a technology to fellow farmers (Amale Balla Sunday)

Peer farmers as a village resource person for scaling Climate-Smart Agriculture (CSA) Practices (Uganda)

Lawang Lupur (Rwot Kweri)

DESCRIPTION

A prosocial behavior approach, where a peer farmer identified by other local farmers is trained on a technology and then used as a trainer for the fellow farmers (farmer group or neighbors).

Adoption of sustainable agricultural practices requires an in-depth understanding of the implementation, sustainability and the opportunity cost involved. Empowered local resource persons known as peer farmers are used by the International Center for Tropical Agriculture (CIAT) and International Institute of Tropical Agriculture (IITA) in Northern Uganda as channels to ensure that farmers understand the importance and implementation of Climate Smart Agricultural (CSA) Practices such as using conservation farming (CF) permanent basins.

A peer farmer in this case is a local community member whom the farmers identify as a potential trainer, very cooperative and, if trained would be willing to share the knowledge with other farmers in that community. After training the peer farmers, an incentive is promised to them based on their performance over time. This incentive is a commodity that is very cheap, but valuable, and not usually a farm input. In this case weighing scale was used as an incentive.

The peer farmer then uses all available methods and channels to pass on to the knowledge to other folks. The acquired knowledge and skills are usually shared through community meetings, religious gatherings, market places and so on.

The process of implementing this approach includes: Identifying the place of implementation, working with the farmers to identify a potential peer farmer, training the peer farmer, the peer farmer training other farmers over time and monitoring the progress of knowledge spill over. Stakeholders involved: Field staff - Work with farmers to identify and train peers, monitor activities; local leaders - organize community members; peer farmer - attend training, train other farmers.

This method is cheap, farmers identify someone with fairly good pro-social behavior, and farmers would be willing to learn from their own village member.

LOCATION

Location: Alero Sub-county, Nwoya District, Uganda

Geo-reference of selected sites
- 31.99964, 2.63475
- 32.00125, 2.63325
- 32.22205, 2.58247
- 32.22202, 2.58249

Initiation date: 2015

Year of termination: n.a.

Type of Approach
- [ ] traditional/ indigenous
- [ ] recent local initiative/ innovative
- [x] project/ programme based

APPROACH AIMS AND ENABLING ENVIRONMENT

Main aims / objectives of the approach
Promoting adoption of Climate-Smart Agriculture through prosocial behaviour

Conditions enabling the implementation of the Technology/ ies applied under the Approach
- **Social/ cultural/ religious norms and values** : traditional relations among local communities
- **Institutional setting** : Agricultural Advisory services in the country, more NGOs operating in the agricultural sector
- **Collaboration/ coordination of actors** : Participatory involvement of all the stakeholders in the agricultural sector
- **Policies** : PMA-Plan for Modernisation of Agriculture, a Government policy aimed at ensuring adoption of modern farming technologies. Policy Action on climate change adaptation Vision 2040 - A government policy aims at transforming Uganda's agriculture from subsistence to commercial farming.
- **Knowledge about SLM, access to technical support** : Trainings from different agencies
- **Markets (to purchase inputs, sell products) and prices** : high demands for food produce and favorable market prices with good roads
- **Workload, availability of manpower** : use local people at their own times

Conditions hindering the implementation of the Technology/ ies applied under the Approach
- **Social/ cultural/ religious norms and values** : limited cooperation among some communities
- **Knowledge about SLM, access to technical support** : costs to fund the training of peer farmers
- **Markets (to purchase inputs, sell products) and prices** : middle men cheat poor farmers
- **Workload, availability of manpower** : illiteracy

PARTICIPATION AND ROLES OF STAKEHOLDERS INVOLVED

Stakeholders involved in the Approach and their roles

What stakeholders / implementing bodies were involved in the Approach?	Specify stakeholders	Describe roles of stakeholders
local land users/ local communities	farmers and local leaders	implement the technology
community-based organizations	farmer groups	used as a channel
SLM specialists/ agricultural advisers	extension workers	train on the SLM technologies
researchers	CIAT/IITA	Assess the degree of resilience
international organization	CIAT/IITA	funding research activities

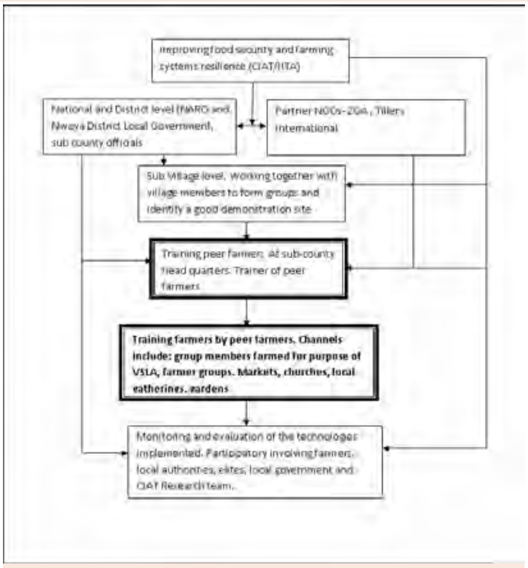
Lead agency
CIAT

Involvement of local land users/ local communities in the different phases of the Approach

	none	passive	external support	interactive	self-mobilization	
initiation/ motivation			✓			CIAT project promoting food security and farming systems resilience in East Africa through wide-scale adoption of climate smart agriculture. The project is implemented in Nwoya district, designed by CIAT and funded by IFAD.
planning			✓			CIAT/IITA: IITA became partner organisation for the project. Staffing was done through IITA, implemented in collaboration with IITA Uganda.
implementation				✓		CIAT, IITA, Local government, National Agricultural Research Organisation, ZOA, Farmers, Extension agents
monitoring/ evaluation				✓		Participatory monitoring and evaluation involving all parties through farmers field days

Flow chart

detailed chart showing the different planyers in the approach



Author: Amale Balla Sunday

Decision-making on the selection of SLM Technology

Decisions were taken by
- land users alone (self-initiative)
- mainly land users, supported by SLM specialists
- ✓ all relevant actors, as part of a participatory approach
- mainly SLM specialists, following consultation with land users
- SLM specialists alone
- politicians/ leaders

Decisions were made based on
- ✓ evaluation of well-documented SLM knowledge (evidence-based decision-making)
- ✓ research findings
- personal experience and opinions (undocumented)

TECHNICAL SUPPORT, CAPACITY BUILDING, AND KNOWLEDGE MANAGEMENT

The following activities or services have been part of the approach
- ✓ Capacity building/ training
- ✓ Advisory service
- ✓ Institution strengthening (organizational development)
- ✓ Monitoring and evaluation
- ✓ Research

Capacity building/ training

Training was provided to the following stakeholders
- ✓ land users
- field staff/ advisers

Form of training
- on-the-job
- farmer-to-farmer
- demonstration areas
- ✓ public meetings
- courses

Subjects covered

Advisory service

Advisory service was provided
- ✓ on land users' fields
- at permanent centres

planned visits to peer farmers fields to observe what they are doing and advising them accordingly.

Institution strengthening

Institutions have been strengthened / established

- [ ] no
- [x] yes, a little
- [ ] yes, moderately
- [ ] yes, greatly

at the following level

- [x] local
- [ ] regional
- [ ] national

Describe institution, roles and responsibilities, members, etc.

local farmer groups

Type of support

- [ ] financial
- [x] capacity building/ training
- [ ] equipment

Further details

Monitoring and evaluation

Research

Research treated the following topics

- [x] sociology
- [x] economics / marketing
- [ ] ecology
- [ ] technology

CIAT/IITA Research in Northern Uganda under the project; Promoting food security and farming systems resilience in East Africa through wide scale adoption of climate smart Agriculture (CSA)

FINANCING AND EXTERNAL MATERIAL SUPPORT

Annual budget in USD for the SLM component

- [ ] < 2,000
- [x] 2,000-10,000
- [ ] 10,000-100,000
- [ ] 100,000-1,000,000
- [ ] > 1,000,000

Precise annual budget: n.a.

The following services or incentives have been provided to land users

- [ ] Financial/ material support provided to land users
- [ ] Subsidies for specific inputs
- [ ] Credit
- [x] Other incentives or instruments

Other incentives or instruments

weighing scale for best performers

IMPACT ANALYSIS AND CONCLUDING STATEMENTS

Impacts of the Approach

	No	Yes, little	Yes, moderately	Yes, greatly
Did the Approach empower local land users, improve stakeholder participation? yes, improved group work			✓	
Did the Approach enable evidence-based decision-making? decision made by community members				✓
Did the Approach help land users to implement and maintain SLM Technologies? incentive driven			✓	
Did the Approach improve coordination and cost-effective implementation of SLM? farmers working with each other			✓	
Did the Approach mobilize/ improve access to financial resources for SLM implementation? promoted group work but directed towards technology transfer		✓		
Did the Approach improve knowledge and capacities of land users to implement SLM? new technologies				✓
Did the Approach improve knowledge and capacities of other stakeholders? mostly farmers involved			✓	
Did the Approach build/ strengthen institutions, collaboration between stakeholders? different stakeholders participated			✓	
Did the Approach mitigate conflicts? improved social relations		✓		
Did the Approach empower socially and economically disadvantaged groups? did not focus on well off farmers, just anyone whom the community thinks has the potential to train local members			✓	
Did the Approach improve gender equality and empower women and girls? 50% of trainers were women and at the end they performed better than the men trainers			✓	
Did the Approach encourage young people/ the next generation of land users to engage in SLM? ensure transfer to local people		✓		
Did the Approach improve issues of land tenure/ user rights that hindered implementation of SLM Technologies?	✓			
Did the Approach lead to improved food security/ improved nutrition? much higher increase in production				✓

Did the Approach improve access to markets?
good quality products

Did the Approach lead to improved access to water and sanitation?
farm based

Did the Approach lead to more sustainable use/ sources of energy?
farm based

Did the Approach improve the capacity of the land users to adapt to climate changes/ extremes and mitigate climate related disasters?

Did the Approach lead to employment, income opportunities?
to trainers of peer farmers

Main motivation of land users to implement SLM

- ✓ increased production
- ✓ increased profit(ability), improved cost-benefit-ratio
- ✓ reduced land degradation
- ✓ reduced risk of disasters
- ✓ reduced workload
- payments/ subsidies
- rules and regulations (fines)/ enforcement
- ✓ prestige, social pressure/ social cohesion
- ✓ affiliation to movement/ project/ group/ networks
- ✓ environmental consciousness
- customs and beliefs, morals
- ✓ enhanced SLM knowledge and skills
- ✓ aesthetic improvement
- ✓ conflict mitigation

Sustainability of Approach activities
Can the land users sustain what hat been implemented through the Approach (without external support)?

- no
- ✓ yes
- uncertain

The knowledge becomes local to the farmers; observes direct benefits whitin the shortest time of implementation, learn other things from neighbors without need for any motivation

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- farmers can easily learn from each other
- peer trains farmers within their local environment

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

- All available methods of passing information about the technologies are at the peer farmers disposal eg. market points, church, group meetings, tribal gatherings
- farmers use their local language to teach/demonstrate to each other

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- difficult to train peer farmers → use practicals
- peer farmers may not retain all the knowledge about the technology → use charts/pictures

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- costly to organise trainings for peers → use local education facilities such as schools for training peer farmers

REFERENCES

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Date of documentation: Dec. 18, 2017

Last update: Oct. 18, 2018

Resource persons
Kilama Odong - land user
Micheal Sunday - None

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/approaches/view/approaches_3323/

Linked SLM data
Technologies: Conservation Farming Basins in annual crops for Water conservation
https://qcat.wocat.net/en/wocat/technologies/view/technologies_3307/

Documentation was faciliated by
Institution

- Uganda Landcare Network (ULN) - Uganda

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Photo showing mulching using banana leaves. (Rick Kamugisha)

Mulching using banana leaves (Uganda)

Labolo Ma Kipo Mwanyi

DESCRIPTION

Dry banana leaves are spread in the soil for growing banana plantation for improving soil fertility and moisture content retention.

Locally obtained dry banana leaves is a low cost mulching material used by farmers in Northern Uganda to mulch soil in order to grow banana with the aim of improving soil fertility and soil moisture content retention.
The land user identifies a banana plantation usually 0.5 to 2 acres planted with sweet banana, Bogoya, Fear 17 varieties and spread the banana leaves across the banana plantation usually below 40-60 cm to the mother plant using 2-4 people per day, hoes and pangas.
Mulching is preferred because it uses locally available banana leaves within the plantation. It does not require high maintenance costs to pay for labor, digging and transport. Costs would be incurred transporting the mulching material. In addition to conserving moisture in the soils, it reduces water runoff to avoid erosion and improves the soil as the mulch material rots.
However, it is important for the land user to be aware that mulching using banana leaves serve as breeding place for banana weevils and if the land user places the mulch too close to the mother plant it will affect the growth of the young suckers. This therefore means land users who need to use this low cost mulching material need to first work out proper procedures with the extension worker on how to mulch banana plantation before mulching.
To sustain this technology, the land users can integrate cultivating multipurpose tree species (Calliandra and Grivellea) to additionally stabilize the soils and improve soil fertility when the tree mature and leaves litter.

LOCATION

Location: Nwoya District, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.02756, 2.67981

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
- ☑ through projects/ external interventions

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use

Cropland

- Annual cropping

Number of growing seasons per year: 2

Water supply

- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation

- ✓ prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying

soil erosion by wind - Et: loss of topsoil

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

physical soil deterioration - Pc: compaction

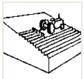
biological degradation - Bc: reduction of vegetation cover

water degradation - Hs: change in quantity of surface water, Hg: change in groundwater/aquifer level

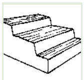
SLM group

- minimal soil disturbance
- integrated soil fertility management
- water harvesting

SLM measures



agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility

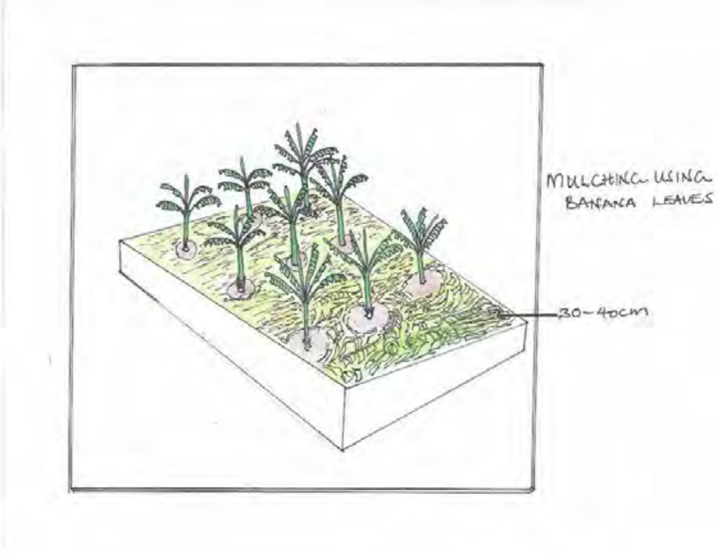


structural measures - S7: Water harvesting/ supply/ irrigation equipment

TECHNICAL DRAWING

Technical specifications

None



Author: Kaheru

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: 2 acres)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3200.0 UGX
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs

Labour for cutting and laying the banana leaves is the most important factor affecting costs.

Establishment activities

1. Site selection (Timing/ frequency: Once before before establishment)
2. look for inputs (labour) (Timing/ frequency: Once before establishment)
3. Cut the banana leaves (Timing/ frequency: During establishment)
4. Lay the banana leaves (Timing/ frequency: During establishment)

Establishment inputs and costs (per 2 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Persons days employed on monthly basis	persons	10.0	70000.0	700000.0	100.0
Equipment					
Hoes	Pieces	10.0	10000.0	100000.0	100.0
Pangas	Pieces	5.0	7000.0	35000.0	100.0
Other					
Training costs (transport)	sessions	3.0	30000.0	90000.0	100.0
Total costs for establishment of the Technology				**925'000.0**	

Maintenance activities

1. Re-mulching (Timing/ frequency: Twice a year)

Maintenance inputs and costs (per 2 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Persons days on monthly basis	Persons	4.0	150000.0	600000.0	100.0
Fertilizers and biocides					
					100.0
Total costs for maintenance of the Technology				**600'000.0**	

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

Agro-climatic zone

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

Specifications on climate

Average annual rainfall in mm: 1450.0
More rains during the wet season (March-May) with long dry spell around June - August.

- 2,001-3,000 mm
- 3,001-4,000 mm
- > 4,000 mm

Slope
- flat (0-2%)
- 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
- footslopes
- ✓ valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- 501-1,000 m a.s.l.
- ✓ 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
- not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- ✓ < 5 m
- 5-50 m
- > 50 m

Availability of surface water
- excess
- ✓ good
- medium
- poor/ none

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

Water quality refers to:

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- medium
- ✓ low

Habitat diversity
- high
- medium
- ✓ low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- ✓ mixed (subsistence/ commercial)
- commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- ✓ poor
- average
- rich
- very rich

Level of mechanization
- ✓ manual work
- animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- ✓ women
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household
- ✓ < 0.5 ha
- 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
- medium-scale
- large-scale

Land ownership
- state
- company
- ✓ communal/ village
- group
- individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ 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
None	poor			✓	good

IMPACTS

Socio-economic impacts

Impact		1	2	3	4	5	6	7		Comment
Crop production	decreased							✓	increased	As result of integration and application of manure from littered leaves of banana.
land management	hindered						✓		simplified	The farmer uses mulch material from the same garden that is mulching.
expenses on agricultural inputs	increased							✓	decreased	Expenses only incurred on purchase of pangas which are not high. Labour costs are high.
farm income	decreased							✓	increased	From the sale of matooke.
workload	increased		✓						decreased	Reduced labour and costs required on farm after mulching.

Socio-cultural impacts

Impact		1	2	3	4	5	6	7		Comment
food security/ self-sufficiency	reduced							✓	improved	With Mulching , the farmer is able to realise more bananas produced which makes him food secure. Even the money obtained from sale of banana is used to buy food like posho and beans.
national institutions	weakened							✓	strengthened	Especially with NUSAF which supported the farmer with trainings.
SLM/ land degradation knowledge	reduced							✓	improved	Trained by Northern Uganda Social Action Fund (NUSAF) and extension workers on mulching using bananas.

Ecological impacts

Impact		1	2	3	4	5	6	7		Comment
harvesting/ collection of water (runoff, dew, snow, etc)	reduced						✓		improved	Retained by mulch material.
surface runoff	increased							✓	decreased	
soil moisture	decreased							✓	increased	
soil cover	reduced						✓		improved	Due to mulch material.
soil organic matter/ below ground C	decreased							✓	increased	Due to decomposed mulch.
landslides/ debris flows	increased						✓		decreased	

Off-site impacts

Impact		1	2	3	4	5	6	7		Comment
water availability (groundwater, springs)	decreased							✓	increased	Retained by the mulch material.

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

		1	2	3	4	5	6	7	
Short-term returns	very negative					✓			very positive
Long-term returns	very negative						✓		very positive

Benefits compared with maintenance costs

		1	2	3	4	5	6	7	
Short-term returns	very negative						✓		very positive
Long-term returns	very negative						✓		very positive

Benefits are low in the short term with more labour costs for cutting and laying grass mulch while in the long run, less labour costs and more benefits (reduced soil erosion, increased production) resulting from decomposed mulch material.

CLIMATE CHANGE

Gradual climate change

		1	2	3	4	5		Comment
annual temperature increase	not well at all			✓			very well	
seasonal temperature increase	not well at all						very well	Season: dry season
annual rainfall increase	not well at all			✓			very well	

Climate-related extremes (disasters)

		1	2	3	4	5	
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%

Number of households and/ or area covered

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

- ✓ Yes
- No

Established a local collection centre for marketing bananas to avoid exploitation.

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

- Good for soil moisture retention and soil fertility improvement.
- Maintenance costs are low in the long run.
- Uses locally available mulch material which is easily accessible in the plantation.

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

- The technology is appropriate for both small scale and large scale land users with a banana plantation.
- The technology can easily be promoted and replicated by other farmers in other areas.
- Once established, its easy to manage and mentain as long as labour is available at affordable cost.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Prolonged drought affects the banana which may affect the quantity and quality of mulching material. → Integrate agrofrestry trees within the banana plantation (Grivellea and Calliandra).
- Labour Intensive associated with high costs in case the farmer has 10 acres and more. → Work in groups and exchange labour.
- Wind affects banana production which may affect the quality of mulching material. → Promote agroforestry trees (Callindra, Grivellea 0 within the technology to acts as soil fertility improving trees and wind breaks.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Prolonged drought affects the Banana yield and therefore may not be a solution to poor farmers, → Promote agroforestry tree planting (calliandra, Grivellea) that addresses climatic change issues.
- Requires a lot of labour. → Engage labour on monthly basis.
- Attract thieves who may want to eat and sell. → Strengthen Community local bylaws.
  If found stealing or encroaching pay 2 times the equivalent of what has been stolen.
- The technology is mostly affected by wind. → Promote agroforestry trees as wind breakers on the farm.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Stephanie Jaquet
Renate Fleiner
Nicole Harari
Drake Mubiru
Donia Jendoubi

Date of documentation: June 5, 2017

Last update: March 22, 2019

Resource persons
Andrew Ongai - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2757/
Video: https://player.vimeo.com/video/325827407

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Photo showing Mulching using grass on perenial cropland in Amuru District, Nothern Uganda. (Rick Kamugisha)

Mulching using grass on perennial crop land. (Uganda)

Pot Labolo me umu poto

DESCRIPTION

Laying grass (Poaceae) on perennial cropped land to reduce weeds, retain soil moisture and improve soil fertility.

Mulching using grass (Poaceae) on banana cropped land is a common practice usually promoted by farmers in Northern Uganda with the aim of increasing soil fertility, reducing the likelihood of weed problems growing around perennial plants, increase production and household income.
The farmer identifies a field planted with banana approximately 2 acres of land measuring at least 80 metres wide and 240 metres long located on a gentle sloping area of (3-5%), and mulch using grass which is grown in the planted banana garden. The mulch grass used comes from the same field carried away from other fields.
Using a panga the farmer uses 5 people paid on daily basis to cut and carry the grass and lay the grass at a distance of not more than 20- 40 cm to enable the suckers grow and to allow manure too close to the plant after grass decomposition and helps weeds control, With this technology, the farmer uses locally obtained grass mulch which is easily comes from the banana field that would considered a waste. Secondly the associated costs are only related to transport and labour are low both in the short and long term since the mulch used is obtained from the same field. Costs for labour and transport are incurred only when the mulch material is carried from other areas. Some others costs are for weeding which would be borne by the farmer.
However, the farmer need to know that organic mulches usually need to be applied in a loose or partially-rotted state or the first stages of decomposition, otherwise they can lead to nitrogen being taken from the soil, or anaerobic decomposition which can lead to 'sour mulch' which turns acidic and damages the plants it is supposed to be protecting. This advice can best be extended to the farmer by extension workers and expert farmers who the farmer needs to be if close contact during implementation of this technology.

LOCATION

Location: Amuru District, Northern Uganda, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.09295, 2.95257

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

In a permanently protected area?:

Date of implementation: 2010; less than 10 years ago (recently)

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

CLASSIFICATION OF THE TECHNOLOGY

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

Land use

Cropland
- Annual cropping
- Perennial (non-woody) cropping

Number of growing seasons per year: 2

Water supply
- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation
- ✓ prevent land degradation
- reduce land degradation
- ✓ restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

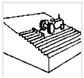
soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

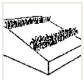
biological degradation - Bc: reduction of vegetation cover, Bs: quality and species composition/ diversity decline, Bl: loss of soil life

SLM group
- integrated soil fertility management
- water harvesting

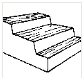
SLM measures



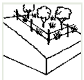
agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility



vegetative measures - V2: Grasses and perennial herbaceous plants, V3: Clearing of vegetation



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



management measures - M3: Layout according to natural and human environment, M5: Control/ change of species composition

TECHNICAL DRAWING

Technical specifications

None

Author: Kaheru

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: 2 acres)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3400.0 UGX
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs

Labour for cutting , carrying and laying grass and seedlings take the most costs. However this means that if the farmer does not need to add more suckers.

Establishment activities

1. Select the site planted with banana (Timing/ frequency: Before establishment)
2. Look for pangas to cut the grass (Timing/ frequency: Once before establishment)
3. look for labour to cut and carry the grass (Timing/ frequency: Before establishment)
4. Cut and curry grass using labour (Timing/ frequency: During establishment)
5. Lay the grass in the soil (Timing/ frequency: During establishment)

Establishment inputs and costs (per 2 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
persons days for cutting, carrying and laying grass	persons	5.0	150000.0	750000.0	100.0
Equipment					
Hoe	pieces	5.0	10000.0	50000.0	100.0
Panga	Pieces	5.0	7000.0	35000.0	100.0
Plant material					
Suckers in case the farmer want to add mulching	Suckers	200.0	5000.0	1000000.0	100.0
Other					
Transport	Lorry	1.0	100000.0	100000.0	
Total costs for establishment of the Technology				**1'935'000.0**	

Maintenance activities

1. Add mulch to the banana field after decomposition (Timing/ frequency: Twice a year)

Maintenance inputs and costs (per 2 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Persons days for adding mulch	Persons	3.0	150000.0	450000.0	100.0
Total costs for maintenance of the Technology				**450'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall

- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 1,001-1,500 mm

Agro-climatic zone

- [x] humid
- [ ] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate

Average annual rainfall in mm: 1400.0
Two rainy season and two dry season.
Rainy season: March to May and September to November
Dry season: December to February and June - August

- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

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

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

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [x] 501-1,000 m a.s.l.
- [ ] 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
- [x] concave situations
- [ ] not relevant

Soil depth
- [ ] very shallow (0-20 cm)
- [x] shallow (21-50 cm)
- [ ] 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
- [x] < 5 m
- [ ] 5-50 m
- [ ] > 50 m

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

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

Water quality refers to:

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

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

Level of mechanization
- [x] manual work
- [ ] 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
- [x] 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
- [x] small-scale
- [ ] 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
- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] 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

Impact		Rating		Comment
Crop production	decreased	✓ (6 of 7)	increased	Quantity before SLM: 25 bunches per month. Quantity after SLM: 35 bucnhes per month.
crop quality	decreased	✓ (6 of 7)	increased	Water moisture retention, better growth.
land management	hindered	✓ (6 of 7)	simplified	Mulch grass locally available, less costs, use of local labour.
expenses on agricultural inputs	increased	✓ (7 of 7)	decreased	Purchase of hoes and pangas which don't take a lot of money.
farm income	decreased	✓ (7 of 7)	increased	From the sale of banana.
workload	increased	✓ (7 of 7)	decreased	Reduced work load in the long run.

Socio-cultural impacts

Impact		Rating		Comment
SLM/ land degradation knowledge	reduced	✓ (7 of 7)	improved	Knowledge on how to mulch and distance.

Ecological impacts

Impact		Rating		Comment
water quantity	decreased	✓ (6 of 7)	increased	Retained by the mulched material.
harvesting/ collection of water (runoff, dew, snow, etc)	reduced	✓ (6 of 7)	improved	Due to use of mulch material.
surface runoff	increased	✓ (6 of 7)	decreased	Because of mulching.
soil moisture	decreased	✓ (6 of 7)	increased	Kept within the mulch.
soil cover	reduced	✓ (6 of 7)	improved	Mulch material.
soil organic matter/ below ground C	decreased	✓ (7 of 7)	increased	Due to decomposition of mulch grass.

Off-site impacts

Impact		Rating		Comment
water availability (groundwater, springs)	decreased	✓ (6 of 7)	increased	Kept within the mulch to be utilised by the banana during the dry season.

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Returns		Rating	
Short-term returns	very negative	✓ (6 of 7)	very positive
Long-term returns	very negative	✓ (7 of 7)	very positive

Benefits compared with maintenance costs

Returns		Rating	
Short-term returns	very negative	✓ (6 of 7)	very positive
Long-term returns	very negative	✓ (6 of 7)	very positive

Mulching using grass reduced workload in the short run associated with less costs in the long run .The labour that would be used for weeding and its associated costs reduce since no weeding is required when the banana is mulched. Mulching reduces weeds and increases water moist which increases banana production due to decomposed mulched material (grass).

CLIMATE CHANGE

Gradual climate change

Change		Rating		Comment
annual temperature decrease	not well at all	✓ (5 of 5)	very well	
seasonal temperature increase	not well at all	✓ (4 of 5)	very well	Season: wet/ rainy season
annual rainfall decrease	not well at all	✓ (3 of 5)	very well	

Climate-related extremes (disasters)

Extreme		Rating	
insect/ worm infestation	not well at all	✓ (3 of 5)	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%

Number of households and/ or area covered

5

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

- [x] Yes

Planting fertilizer trees (Calliandra).

☐ No

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

- Control weeds and improve soil fertility after decomposition.
- Uses local available grass materials within the banana (musa) garden for mulching which would be considered a waste.
- Cost effective. Low labour and transport costs since the grass mulch is locally obtained within the same field.

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

- Appropriate for farmers with low income.
- Is scalable, requires low labour and input costs.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Harbours insects which attack young suckers. → Apply pesticides.
- The technology is easily affected by roaming animals searching for pasture during the dry season when there is normally shortage of pasture. → Put in place byelws on controlled grazing
  Integrate fertilizer trees (calliandra and Grivellea) in the practice as an alternative.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Mulching can increase the risk of diseases especially if the grasses are obtained from outside the garden. → First use the grass in the same field.
- Mulching alone may not be a solution to increase production. The farmer needs also to mange well the banana by cutting banana leaves which can also act as mulching material.
  → Knowledge and skills be provided by the extension agent.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Donia Jendoubi
John Stephen Tenywa
Drake Mubiru
Nicole Harari
Renate Fleiner
Stephanie Jaquet

Date of documentation: June 11, 2017

Last update: March 22, 2019

Resource persons
Richard Nyeko - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2818/
Video: https://player.vimeo.com/video/325824131

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Two milker heifers to a pen (Rick Kamugisha)

Modern Intensive Livestock Management. (Uganda)

Gwoko dyang cak

DESCRIPTION

Intensive zero-grazing of hybrid dairy Hybrid (Holstein Friesian) cattle to produce a constant high yield of milk all-year around.

The productivity of modern intensive livestock management systems in northern Uganda is highly constrained by increasing household land shortage, poor quality pastures and rampant spread of livestock pests and diseases. Thus a large number of improved cattle are reared in closed systems where they are fed, treated and supervised. Some bulk feeds are grown on the same farm and the manure from the livestock housing units is used to improve soil fertility and crop yields of the same farm.

Improved breeds of cattle (75% Friesian and 25% local) are reared in paddocked land area of an average in 8 hectares, within which the animals are fed, watered and managed with medication. Approximately 25% of this land area is devoted to livestock structures, in which up to 64 Friesians are kept. The rest of the land is planted with improved pastures as well as other crops such as maize (Zea mays), cowpeas (Vigna unguiculata), fruit trees and vegetables. Manure is collected daily from an assembly point and applied to the crops. Improved pastures are also used for silage. The system further provides manure, which is valuable for soil fertility improvement in crop fields. Moreover, the confinement of the livestock system helps to reduce conflicts experienced in traditional free range grazing areas.

The approach and materials used in this intensive dairy cattle rearing system in northern Uganda closely follows specification for dairy cattle barns in New Zealand (www.simpleshelter.co.nz/). When properly implemented, the financial returns are substantial in the long term. However, establishment costs are relatively high for most average smallholder farmers in northern Uganda. The sustainable land management (SLM) benefits from this system justify its adoption, although carbon balance needs to be independently assessed.

LOCATION

Location: Gulu district, Northern region, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 32.34978, 2.80554

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?:

Date of implementation: 2007; 10-50 years ago

Type of introduction

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use

Cropland

- Annual cropping: cereals - maize, fodder crops - other, vegetables
- Tree and shrub cropping: fruits, other

Number of growing seasons per year: 3

Grazing land

- Cut-and-carry/ zero grazing
- Improved pastures

Animal type: cattle - dairy, 75% Friesian and 25% local

Species	Count
cattle - dairy	64

Water supply

- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation

- ✓ prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion

soil erosion by wind -

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

physical soil deterioration - Pc: compaction, Pu: loss of bio-productive function due to other activities

biological degradation - Bc: reduction of vegetation cover

water degradation - Ha: aridification

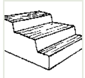
SLM group

- integrated crop-livestock management
- integrated soil fertility management

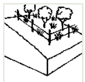
SLM measures

agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility

vegetative measures - V4: Replacement or removal of alien/ invasive species



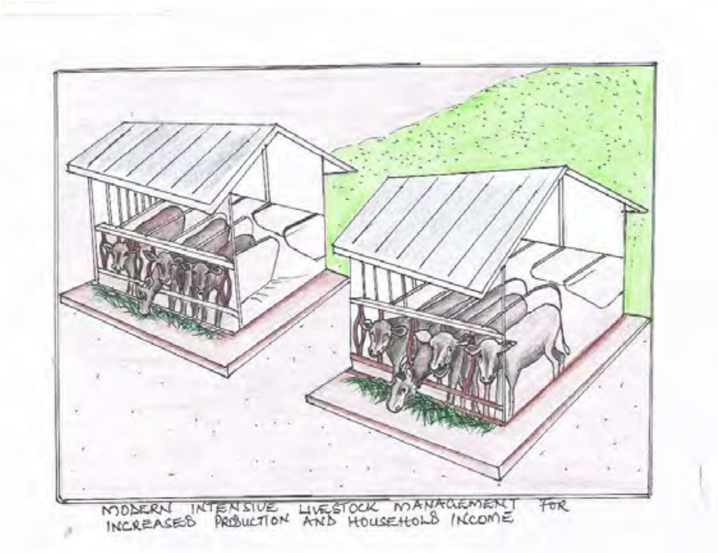
structural measures - S9: Shelters for plants and animals



management measures - M2: Change of management/ intensity level, M4: Major change in timing of activities, M6: Waste management (recycling, re-use or reduce)

TECHNICAL DRAWING

Technical specifications
None



Author: Kaheru

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology unit (unit: **Livestock Unit (LU)** volume, length: **1 Heifer**)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3400.0 UGX
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs
Labour and equipment takes most of the costs. Labour and equipment maintenance is routine monthly.

Establishment activities
1. Find and buy land (Timing/ frequency: Anytime, before establishment)
2. Survey land to get map especially for gradient and soils (Timing/ frequency: Anytime, before harvesting)
3. Remove all tree cover and stumps (Timing/ frequency: Dry season)
4. Disc Ploughing (Timing/ frequency: Dry season)
5. Plant Maize (Timing/ frequency: Rainy season)
6. Build silage bunker (Timing/ frequency: Anytime)
7. Construct Animal Barns (Timing/ frequency: Anytime)
8. Identify water source (Timing/ frequency: anytime)
9. Construct and fill water storage tanks (Timing/ frequency: Just before stocking)
10. Procure and stock in-calf cows (Timing/ frequency: After harvest of first crop of maize)

Establishment inputs and costs (per Livestock Unit (LU))

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Procure stock	Pieces	10.0	200000.0	2000000.0	100.0
Survey and map land	Pieces	1.0	23000000.0	23000000.0	100.0
Slash, cut trees, remove stumps	Person-days	60.0	5000.0	300000.0	100.0
Equipment					
Plant maize	Person-days	10.0	5000.0	50000.0	100.0
Weed maize	Person-days	20.0	5000.0	100000.0	100.0
Cut maize to make silage	Person-days	20.0	500.0	10000.0	100.0
Tractor, pump, water tank, piping	Pieces	1.0	7500000.0	7500000.0	100.0
Plant material					
Maize seed	Kg	325.0	5000.0	1625000.0	100.0
Fertilizers and biocides					
NPK fertilizers	Kg	1500.0	3000.0	4500000.0	100.0
Construction material					
Prefabs, roofing, bricks, sand, cement and construction costs	Pieces	1.0	5000.0	5000.0	
Total costs for establishment of the Technology				**39'090'000.0**	
Total costs for establishment of the Technology in USD				*11'497.06*	

Maintenance activities
1. Harrowing (Timing/ frequency: Dry season)
2. Planting (Timing/ frequency: Dry season (dry planting) and wet season)
3. Harvesting (cutting stalks for silage) (Timing/ frequency: Wet season)
4. Silage making (Timing/ frequency: Wet season)
5. Vaccination (Timing/ frequency: Continuous)
6. Deworming (Timing/ frequency: Continuous)
7. Milking and milk selling (Timing/ frequency: Continuous)
8. Maintenance of machinery (Timing/ frequency: Continuous)
9. Maintenance of barns (Timing/ frequency: Continuous)

Maintenance inputs and costs (per Livestock Unit (LU))

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
persons days paid monthly	persons	50.0	150000.0	7500000.0	100.0
Fertilizers and biocides					
Vaccines monthly	1	30.0			
Other					
Servicing and mainting equipemnt monthly	1	30.0			
Total costs for maintenance of the Technology				7'500'000.0	
Total costs for maintenance of the Technology in USD				*2'205.88*	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 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
- [x] humid
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
Average annual rainfall in mm: 1350.0
2 seasons of rainfall.

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

Landforms
- [x] plateau/plains
- [x] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [ ] 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.
- [x] 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)
- [x] shallow (21-50 cm)
- [ ] moderately deep (51-80 cm)
- [x] deep (81-120 cm)
- [ ] very deep (> 120 cm)

Soil texture (topsoil)
- [ ] coarse/ light (sandy)
- [ ] 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
- [x] high (>3%)
- [x] medium (1-3%)
- [ ] low (<1%)

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

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

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

Water quality refers to:

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

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

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

very rich

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- ✓ women
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household
- < 0.5 ha
- 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
- ✓ medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ 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	Quantity before SLM: Subsistence Quantity after SLM: Enough to feed over 60 hybrid cows. Maize and cow peas as feed supplements.
crop quality	decreased					✓			increased	Quantity before SLM: 0 Quantity after SLM: Bananas and fruit orchard introduced Application of manure.
fodder production	decreased							✓	increased	Quantity before SLM: 0 Quantity after SLM: Enough for 60 cow all-year around
fodder quality	decreased							✓	increased	Quantity before SLM: None Quantity after SLM: Feeds over 60 cows Planted maize and cow peas.
animal production	decreased							✓	increased	Quantity before SLM: 0 Quantity after SLM: >60
risk of production failure	increased						✓		decreased	Quantity before SLM: Dependent on rainfall availability Quantity after SLM: Managed crop and water production
product diversity	decreased						✓		increased	Quantity before SLM: Cereals only Quantity after SLM: Mixed crop and livestock production
production area (new land under cultivation/ use)	decreased				✓				increased	Quantity before SLM: 20 acres Quantity after SLM: 20 acres
land management	hindered							✓	simplified	Quantity before SLM: Communal Quantity after SLM: Individual Application of animal manure from the cows
drinking water availability	decreased							✓	increased	Quantity before SLM: 0 Quantity after SLM: Pumped from underground water.
drinking water quality	decreased							✓	increased	Quantity before SLM: None available Quantity after SLM: Safe drinking water for humans and livestock.
water availability for livestock	decreased							✓	increased	Quantity before SLM: None Quantity after SLM: Available
water quality for livestock	decreased							✓	increased	Quantity before SLM: None Quantity after SLM: Safe, clean drinking water.
expenses on agricultural inputs	increased	✓							decreased	Quantity before SLM: Tractors/ dairy industry tools and machinery Quantity after SLM: Hand hoe
farm income	decreased							✓	increased	Quantity before SLM: Subsistent Quantity after SLM: Commercial
diversity of income sources	decreased							✓	increased	Quantity before SLM: Subsistence

workload	increased	[✓][ ][ ][ ][ ][ ][ ]	decreased	Quantity after SLM: Dairy products Quantity before SLM: 20 -50 employees Quantity after SLM: Single households Enough employees employed to work on farm.
None	Decreased	[ ][ ][ ][✓][ ][ ][ ]	Increased	Quantity before SLM: No training facility for the community Quantity after SLM: Dairy farming training and extension for community

Socio-cultural impacts

food security/ self-sufficiency	reduced	[ ][ ][ ][ ][ ][ ][✓]	improved	Quantity before SLM: Subsistence Quantity after SLM: Surplus production
health situation	worsened	[ ][ ][ ][ ][ ][ ][✓]	improved	Quantity before SLM: Low Quantity after SLM: High
land use/ water rights	worsened	[ ][ ][ ][ ][ ][ ][✓]	improved	Quantity before SLM: None Quantity after SLM: Individual pumped water
cultural opportunities (eg spiritual, aesthetic, others)	reduced	[ ][ ][ ][ ][ ][ ][✓]	improved	Quantity before SLM: No training center in area Quantity after SLM: High-end veterinary training and extension facility
SLM/ land degradation knowledge	reduced	[ ][ ][ ][ ][ ][ ][✓]	improved	Quantity before SLM: No record Quantity after SLM: Proper records including digital research weather station

Ecological impacts

water quantity	decreased	[ ][ ][ ][ ][ ][ ][✓]	increased	Quantity before SLM: High runoff Quantity after SLM: High retension
water quality	decreased	[ ][ ][ ][ ][ ][ ][✓]	increased	Quantity before SLM: None Quantity after SLM: Available drinking water
surface runoff	increased	[ ][ ][ ][ ][ ][ ][✓]	decreased	Quantity before SLM: No management measures Quantity after SLM: Management measures in place
soil moisture	decreased	[ ][ ][ ][ ][ ][ ][✓]	increased	Quantity before SLM: Low Quantity after SLM: Very high Increased ground cover ensures high soil moisture on cropland.
soil cover	reduced	[ ][ ][ ][ ][ ][ ][✓]	improved	Quantity before SLM: None Quantity after SLM: Planted grasses, cereals, legumes and fruit trees
nutrient cycling/ recharge	decreased	[ ][ ][ ][ ][ ][ ][✓]	increased	Quantity before SLM: None Quantity after SLM: Farmyard manuring
soil organic matter/ below ground C	decreased	[ ][ ][ ][ ][ ][ ][✓]	increased	Quantity before SLM: Not managed Quantity after SLM: Properly managed through "turning"
biomass/ above ground C	decreased	[ ][ ][ ][ ][ ][ ][✓]	increased	Quantity before SLM: A few crops during rainy season Quantity after SLM: Intensive fodder cropping to meet needs for dairy farming
animal diversity	decreased	[ ][ ][ ][ ][ ][✓][ ]	increased	Quantity before SLM: No animals Quantity after SLM: Cows on dairy farm
emission of carbon and greenhouse gases	increased	[ ][ ][✓][ ][ ][ ][ ]	decreased	Quantity before SLM: Dairy Farm Production Quantity after SLM: Subsistence crop production Dairy cows emit methane and mechanisation involves burning fossil fuels both of which leave a bigger carbon footprint than the is counterbalanced by the crops that are grown for forder. Good management of the plant biodiversity at the stream banks helps offset the carbon footprint somehow but may not be sufficient

Off-site impacts

impact of greenhouse gases	increased	[ ][ ][✓][ ][ ][ ][ ]	reduced	Quantity before SLM: Dairy farming Quantity after SLM: No livestock

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

The technology is highly productive in the medium to longer term.

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all	[ ][ ][ ][ ][✓]	very well	
seasonal temperature increase	not well at all	[ ][ ][ ][ ][✓]	very well	Season: dry season

annual rainfall decrease	not well at all ✓ (4/5) very well	
seasonal rainfall decrease	not well at all ✓ (4/5) very well	Season: wet/ rainy season

Climate-related extremes (disasters)

local rainstorm	not well at all ✓ (5/5) very well	
local thunderstorm	not well at all ✓ (5/5) very well	
local hailstorm	not well at all ✓ (4/5) very well	
heatwave	not well at all ✓ (3/5) very well	
drought	not well at all ✓ (4/5) very well	
epidemic diseases	not well at all ✓ (5/5) very well	

Other climate-related consequences

reduced growing period	not well at all ✓ (4/5) very well	

ADOPTION AND ADAPTATION

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

- ✓ single cases/ experimental
- 1-10%
- 11-50%
- > 50%

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

- ✓ 0-10%
- 11-50%
- 51-90%
- 91-100%

Number of households and/ or area covered

1

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

- ✓ Yes
- No

To which changing conditions?

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

Hybrids which combine high milk yield and tolerance for local weather conditions are being bred in preference to original 75 percent parent stock.

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Environment is controlled to create microclimate suitable to technology.
- Technology creates an isolated complete ecosystem.

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

- Once established, the technology is extremely profitable.
- Opportunities established for training extension delivery personnel through demonstration of good practices.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Inputs make technology quite expensive. → Calculate economic profitability carefully to maintain efficient production.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Combining intensive productivity with training carries the risk of introducing animal diseases from the high flux of visitors. → Disinfection basins have been placed at various points on the farm.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Donia Jendoubi
John Stephen Tenywa
Nicole Harari
Renate Fleiner
Stephanie Jaquet
Alexandra Gavilano

Date of documentation: May 2, 2017

Last update: Aug. 11, 2019

Resource persons
Faith Sabiti Kidega - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2143/
Video: https://player.vimeo.com/video/325824987

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Key references
- None:

Links to relevant information which is available online
- None: None

Photo showing Maize and Soya Intercroped in northern Uganda (Issa Aiga)

Intercropping Soya and Maize (Uganda)

Ribo Kodi Aryo

DESCRIPTION

Soybean (Glycine max) and maize (Zea Mays) and planted together in the same field to increase soil fertility, production and household income.

Inter cropping is a practice where farmers cultivate two different crops in the same field. Usually, a leguminous crop (Soybean) is planted with a non-leguminous crop (Maize). The leguminous crop helps to fix nitrogen in to the soil; produce nitrogen generated from the decomposition of the rich crop residues, and adds nutrient to the soil. This in turn reduces the net demand for fertilizers based on nitrogen. The farmer planted soybean variety Maksoya 3N with a yield potential of 3,500 kg/ha; at a spacing of 10cm × 30cm with 2 seeds per hole and at a seed rate of 20 - 25 kg/acre. Longe 7H Maize variety was then sparsely inter-planted at a spacing of 30cm x 10m with 3 seeds per hole; in between the soybean.
Intercropping Maize and soybean is particularly important because soybean is mainly a cash crop and thus act as a source of income while the maize provides food for the household. If one crop fails, the other may survive hence acts as insurance against crop failure. Planting two crops in a field also reduces the workload associated with cultivating each crop in separate fields. The root systems of the two crops are at different soil layers hence competition for nutrients and water is minimal.
A good intercrop has the main crop and the minor crop. The main crop usually has the recommended seed rate of mono crop while the minor crop may be planted depending on its relative importance and effect on the main crop. However, in intercropping system, the yield potentials of each of the crops is realized.

LOCATION

Location: Gulu District, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.4377, 2.8499

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?:

Date of implementation: 2014; less than 10 years ago (recently)

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

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

Number of growing seasons per year: 2

Water supply

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

Purpose related to land degradation

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

Degradation addressed

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

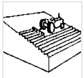
physical soil deterioration - Ps: subsidence of organic soils, settling of soil

biological degradation - Bc: reduction of vegetation cover, Bq: quantity/ biomass decline, Bl: loss of soil life

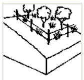
SLM group

- improved ground/ vegetation cover
- integrated soil fertility management

SLM measures



agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility

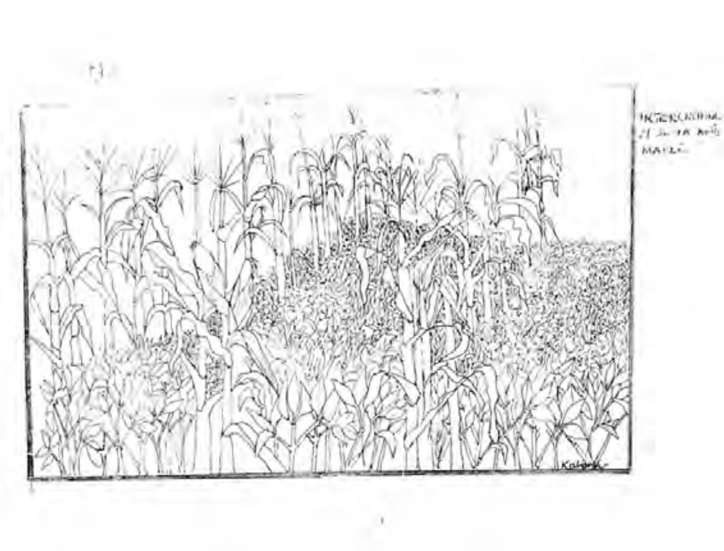


management measures - M3: Layout according to natural and human environment, M4: Major change in timing of activities, M5: Control/ change of species composition

TECHNICAL DRAWING

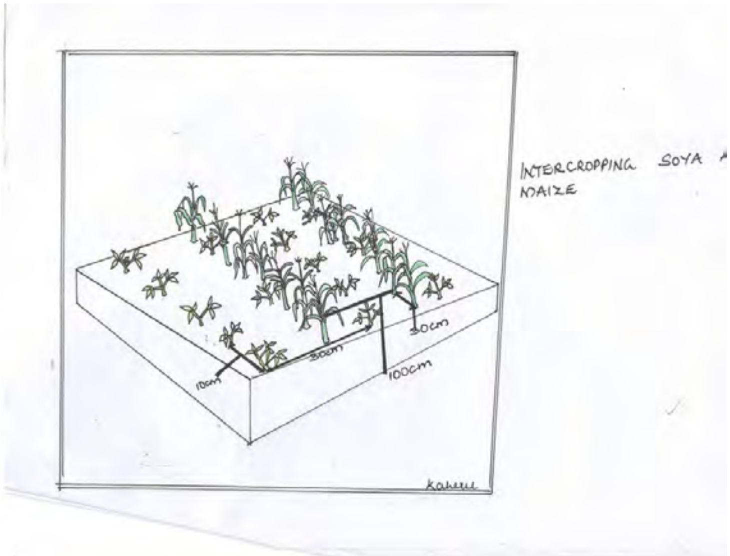
Technical specifications

None



Author: Kaheru

None



Author: Kaheru Prossy

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **7 acres**)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3400.0 UGX
- Average wage cost of hired labour per day: 5000 per person per day

Most important factors affecting the costs

Labour takes most of the costs.

Establishment activities

1. Land preparation (Timing/ frequency: once in a year (March))
2. Planting (Timing/ frequency: Once in a year (April))
3. Weeding (Timing/ frequency: Once in a year (May))

Establishment inputs and costs (per 7 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Labour for planting land	persons	5.0	5000.0	25000.0	100.0
labour for applying seed	Persons	5.0	5000.0	25000.0	100.0
Equipment					
Hoe	Pieces	4.0	10000.0	40000.0	100.0
Watering can	Pieces	4.0	100000.0	400000.0	100.0
Slasher	Pieces	3.0	7000.0	21000.0	100.0
Plant material					
Soya bean	kgs	120.0	2500.0	300000.0	100.0
Maize seeds	kgs	5.0	2000.0	10000.0	100.0
Total costs for establishment of the Technology				821'000.0	

Maintenance activities
1. Weeding (Timing/ frequency: Once a season)
2. Harvesting (Timing/ frequency: Once a season)

Maintenance inputs and costs (per 7 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
labour	Persons	10.0	5000.0	50000.0	100.0
Total costs for maintenance of the Technology				50'000.0	

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
Average annual rainfall in mm: 1200.0

Slope
- flat (0-2%)
- ✓ 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
- footslopes
- ✓ valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- ✓ 501-1,000 m a.s.l.
- 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
- ✓ not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Water quality refers to:

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)

Off-farm income
- ✓ less than 10% of all income

Relative level of wealth
- very poor

Level of mechanization
- ✓ manual work

- ✓ mixed (subsistence/ commercial)
- commercial/ market

- 10-50% of all income
- > 50% of all income

- poor
- ✓ average
- rich
- very rich

- ✓ animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- ✓ women
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household
- < 0.5 ha
- 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
- ✓ medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- 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	Quantity before SLM: 0.5 bag Quantity after SLM: 3 bags Increased yield from soya and maize compared to before the technology.
crop quality	decreased						✓		increased	Crops grow vigorously, good pod filling.
risk of production failure	increased						✓		decreased	In case of one crop failure the other crop the other crop survives.
product diversity	decreased					✓			increased	Quantity before SLM: 1 crop Quantity after SLM: 2 crops More than one crop in the field.
production area (new land under cultivation/ use)	decreased						✓		increased	Due to intercropping.
expenses on agricultural inputs	increased		✓						decreased	especially on seeds and labour

Socio-cultural impacts

food security/ self-sufficiency	reduced							✓	improved

Ecological impacts

soil cover	reduced							✓	improved	Maize stalks and soya wastes are left in the garden to provide mulch after decomposition.
nutrient cycling/ recharge	decreased							✓	increased	The leguminous crop helps to fix nitrogen into the soil; produce nitrogen generated from the decomposition of the rich crop residues, and adds nutrient to the soil.

Off-site impacts

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 (✓ second from right)

CLIMATE CHANGE

Climate-related extremes (disasters)
local hailstorm — not well at all / very well (✓ middle)

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology
- [ ] single cases/ experimental
- [ ] 1-10%
- [x] 11-50%
- [ ] > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?
- [ ] 0-10%
- [x] 11-50%
- [ ] 51-90%
- [ ] 91-100%

Has the Technology been modified recently to adapt to changing conditions?
- [ ] Yes
- [x] No

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
- An assurance against crop failure - when one crop fails the other one steps in for food security and income.
- Act as both a food and a cash crop.

Strengths: compiler's or other key resource person's view
- The technology saves time for other activities in a year.
- Can be replicated else where by other small scale and large scale farmers with similar or different pieces of land.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome
- Competition for nutrients among crops and yield may not be like in mono culture. → Ensuring proper crop combination per inter crop.
- Congestion among crops if the spacing is not done well → Ensuring proper spacing between crops.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome
- If the land user depends on inter cropping annual crops on may not be paying in the short run. → Promote inter cropping with perennial crops like bananas for mulching using bananas. Diversification (Livestock and other crops like beans and banana).
- The way the inter crop looks now is not a good enough as the land user needs advice from the extension worker on how to do inter cropping with the right spacings and the appropriate used crops. → A good intercrop skills should be provided such as including cover crops like beans and Mucuna Spp.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Stephanie Jaquet
Renate Fleiner
Nicole Harari
John Stephen Tenywa
Donia Jendoubi

Date of documentation: June 10, 2017

Last update: March 13, 2019

Resource persons
John Oloya - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2815/
Video: https://player.vimeo.com/video/323399783

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

A typical cover crop that grows in garden (Amale Balla Sunday)

Growing cover crops for weed control (Uganda)

Pito cam me neko doo

DESCRIPTION

Cultivating Leguminous crops in weed prone fields to help overgrow and kill the weeds

Weeds account for a substantial proportion of crop yield losses among farming communities in northern Uganda. Weeds reduce farm and forest productivity, by depriving them of soil nutrients and water, the latter especially during dry seasons.

Majority of farmers in northern Uganda weed fields using rudimentary methods such as hand-hoeing and hand picking; both of which are manual and ineffective. Mechanized and herbicide weeding methods are out of reach of typical small scale farmers in the region. Moreover, alternative, more cost effective and environmentally augmenting natural weed control methods such as cover crops or living mulch exist, but are yet to be adopted widely in the region. Cover crops are creeping leguminous crops such as Mucunapruriens or Macuna beans and local wild beans, which are planted in fields purposely to suppress weeds, control runoff and soil erosion, conserve soil moisture, fix nitrogen, regulate soil temperature, improve soil structure and provide fodder for livestock.

In northern Uganda, cover crops are usually planted at a spacing of 2 meter by 2 meter (see Figure below) and in holes of 5 cm depth. Cover mulches are generally planted after the main crops have been harvested to minimize cover crop-main crop completion for resources. Nevertheless, planting while the main crop is growing in the field is also possible. However, the main crops should be given up to five weeks to establish before planting your cover crop.

The cover crop technology, being a natural phenomenon is usually affordable by typical small scale farmers in northern Uganda. The only challenge is to access to quality seed of suitable cover crops. Otherwise, after sowing the first and purchased seed, the farmer uses own seed harvested from previous crops for subsequent season sowing. However, the farmer needs to ensure that cover crops do not become invasive in cropping fields. This is done by clearing cover crops just before their fruits mature. As such, only a portion of the cover crop to be left for seed purpose is allowed growth to full maturity.

LOCATION

Location: Nwoya District, Gulu, Uganda

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 32.34873, 2.80399
- 31.99971, 2.63453

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2013; less than 10 years ago (recently)

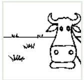
Type of introduction
- ☐ through land users' innovation
- ☐ as part of a traditional system (> 50 years)
- ☐ during experiments/ research
- ☑ through projects/ external interventions

CLASSIFICATION OF THE TECHNOLOGY

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

Land use

Cropland - Annual cropping, Perennial (non-woody) cropping, Tree and shrub cropping
Main crops (cash and food crops): Maize, cassava, bananas, oranges, mangoes, tree plantations



Grazing land - Extensive grazing land: Semi-nomadism/ pastoralism
Intensive grazing/ fodder production: Cut-and-carry/ zero grazing, Improved pastures

Water supply
- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Number of growing seasons per year: 2
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

Purpose related to land degradation
- prevent land degradation
- ✓ reduce land degradation
- ✓ restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion

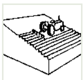
soil erosion by wind - Et: loss of topsoil

chemical soil deterioration - Cp: soil pollution

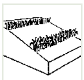
biological degradation - Bp: increase of pests/ diseases, loss of predators

SLM group
- rotational systems (crop rotation, fallows, shifting cultivation)
- improved ground/ vegetation cover
- integrated pest and disease management (incl. organic agriculture)

SLM measures



agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility

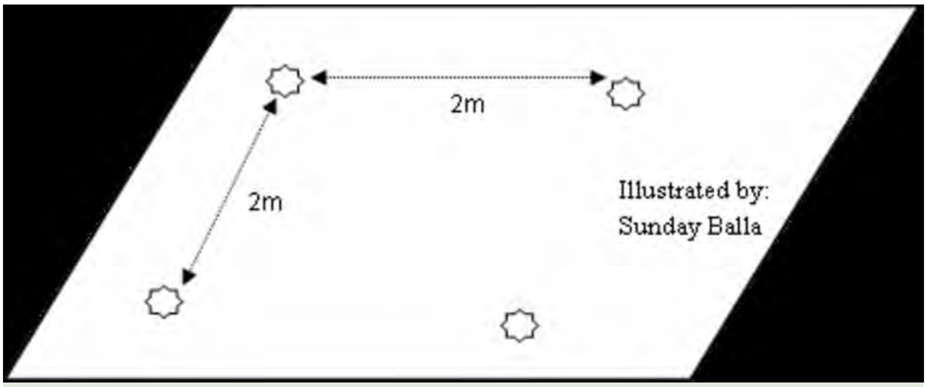


vegetative measures - V2: Grasses and perennial herbaceous plants

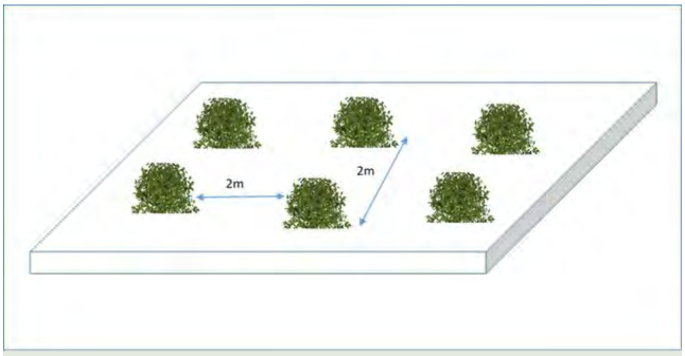
TECHNICAL DRAWING

Technical specifications

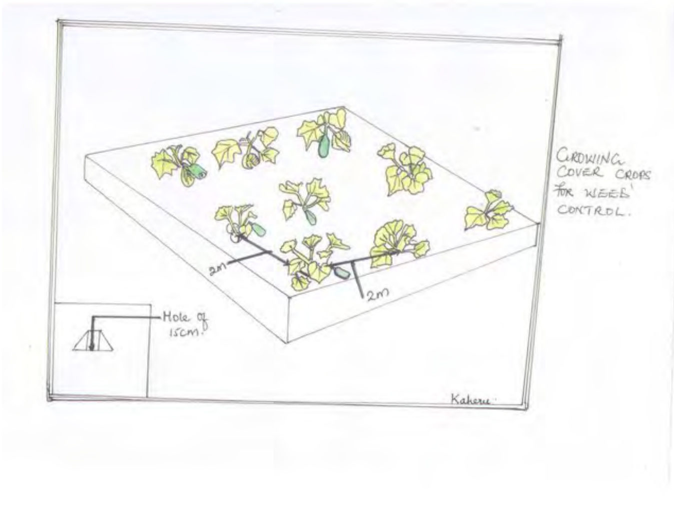
spacing between covercrop plants.
2mX2m, plant one seed per hole,



Author: sunday balla



Author: Amale Balla Sunday



Author: Kaheru prossy

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: 1ha)
- Currency used for cost calculation: **uganda shillings**
- Exchange rate (to USD): 1 USD = 3600.0 uganda shillings
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs
labour for slashing the covercrop

Establishment activities

1. obtaining seed (Timing/ frequency: dry season)
2. digging planting holes (Timing/ frequency: onset of rains)
3. planting covercrop seeds (Timing/ frequency: onset of rains)
4. clearing cover crops (partly) (Timing/ frequency: at fruit set)
5. harvesting covercrop seed (Timing/ frequency: at seed maturity)

Establishment inputs and costs (per 1ha)

Specify input	Unit	Quantity	Costs per Unit (uganda shillings)	Total costs per input (uganda shillings)	% of costs borne by land users
Labour					
during planting	personnel	2.0	5000.0	10000.0	100.0
Clearing	personnel	6.0	5000.0	30000.0	100.0
harvesting	personnel	1.0	5000.0	5000.0	100.0
Equipment					
hand Hoe	pieces	1.0	12000.0	12000.0	100.0
slashers	pieces	1.0	6000.0	6000.0	100.0
Plant material					
seed	kg	2.0	8000.0	16000.0	100.0
Total costs for establishment of the Technology				**79'000.0**	

Maintenance activities

1. planting (Timing/ frequency: once after every 3-4 years)
2. clearing (Timing/ frequency: once after every 3-4 years)
3. seed harvesting and saving (Timing/ frequency: once after every 3-4 years)

Maintenance inputs and costs (per 1ha)

Specify input	Unit	Quantity	Costs per Unit (uganda shillings)	Total costs per input (uganda shillings)	% of costs borne by land users
Labour					
planting	personnel	0.5	5000.0	2500.0	100.0
slashing	personnel	1.5	5000.0	7500.0	100.0
Equipment					
handhoe	pieces	0.25	12000.0	3000.0	100.0
slashers	pieces	0.25	6000.0	1500.0	100.0
Total costs for maintenance of the Technology				14'500.0	

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
n.a.

Slope
- ☐ flat (0-2%)
- ☑ 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
- ☐ footslopes
- ☐ valley floors

Altitude
- ☐ 0-100 m a.s.l.
- ☐ 101-500 m a.s.l.
- ☐ 501-1,000 m a.s.l.
- ☑ 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
- ☑ not relevant

Soil depth
- ☐ very shallow (0-20 cm)
- ☑ shallow (21-50 cm)
- ☐ moderately deep (51-80 cm)
- ☐ deep (81-120 cm)
- ☐ very deep (> 120 cm)

Soil texture (topsoil)
- ☐ coarse/ light (sandy)
- ☑ medium (loamy, silty)
- ☐ fine/ heavy (clay)

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

Topsoil organic matter content
- ☐ high (>3%)
- ☑ medium (1-3%)
- ☐ low (<1%)

Groundwater table
- ☐ on surface
- ☐ < 5 m
- ☐ 5-50 m
- ☑ > 50 m

Availability of surface water
- ☐ excess
- ☐ good
- ☑ medium
- ☐ poor/ none

Water quality (untreated)
- ☐ good drinking water
- ☑ poor drinking water (treatment required)
- ☐ for agricultural use only (irrigation)
- ☐ unusable

Is salinity a problem?
- ☐ Yes
- ☑ No

Occurrence of flooding
- ☐ Yes
- ☑ No

Species diversity
- ☐ high
- ☑ medium
- ☐ low

Habitat diversity
- ☐ high
- ☑ medium
- ☐ low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- ☑ subsistence (self-supply)
- ☐ mixed (subsistence/ commercial
- ☐ commercial/ market

Off-farm income
- ☐ less than 10% of all income
- ☐ 10-50% of all income
- ☑ > 50% of all income

Relative level of wealth
- ☐ very poor
- ☑ poor
- ☐ average
- ☐ rich
- ☐ very rich

Level of mechanization
- ☑ manual work
- ☐ animal traction
- ☐ mechanized/ motorized

Sedentary or nomadic
- ☑ Sedentary
- ☐ Semi-nomadic
- ☐ Nomadic

Individuals or groups
- ☑ individual/ household
- ☐ groups/ community
- ☐ cooperative
- ☐ employee (company, government)

Gender
- ☑ women
- ☑ men

Age
- ☐ children
- ☐ youth
- ☑ middle-aged
- ☑ elderly

Area used per household
- ☐ < 0.5 ha
- ☑ 0.5-1 ha
- ☐ 1-2 ha
- ☐ 2-5 ha

Scale
- ☐ small-scale
- ☑ medium-scale
- ☐ large-scale

Land ownership
- ☐ state
- ☐ company
- ☐ communal/ village
- ☐ group

Land use rights
- ☐ open access (unorganized)
- ☐ communal (organized)
- ☐ leased
- ☑ individual

- [ ] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

- [x] individual, not titled
- [ ] individual, titled

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

Access to services and infrastructure

Service	Rating (poor – good)
health	poor ✓ (1 of 3) good
education	poor ✓ (1 of 3) good
technical assistance	poor ✓ (1 of 3) good
employment (e.g. off-farm)	poor ✓ (1 of 3) good
markets	poor ✓ (1 of 3) good
energy	poor ✓ (1 of 3) good
roads and transport	poor ✓ (2 of 3) good
drinking water and sanitation	poor ✓ (1 of 3) good
financial services	poor ✓ (2 of 3) good

IMPACTS

Socio-economic impacts

Impact	Scale	Rating	Comments
Crop production	decreased – increased	✓ at position 7 of 7	Quantity before SLM: 1200kg per ha Quantity after SLM: 1800kg maize is considered
crop quality	decreased – increased	✓ at position 7 of 7	Quantity before SLM: poor seed Quantity after SLM: good quality seed
fodder production	decreased – increased	✓ at position 6 of 7	slashed cover crop as feeds
fodder quality	decreased – increased	✓ at position 6 of 7	
animal production	decreased – increased	✓ at position 5 of 7	
wood production	decreased – increased	✓ at position 4 of 7	
forest/ woodland quality	decreased – increased	✓ at position 4 of 7	
risk of production failure	increased – decreased	✓ at position 5 of 7	
production area (new land under cultivation/ use)	decreased – increased	✓ at position 5 of 7	
land management	hindered – simplified	✓ at position 6 of 7	Quantity before SLM: 0.5ha Quantity after SLM: 1ha
expenses on agricultural inputs	increased – decreased	✓ at position 6 of 7	Quantity before SLM: 20000 per year Quantity after SLM: 0 on herbicides
farm income	decreased – increased	✓ at position 6 of 7	
diversity of income sources	decreased – increased	✓ at position 5 of 7	
economic disparities	increased – decreased	✓ at position 5 of 7	
workload	increased – decreased	✓ at position 7 of 7	now weed garden once a season. used to weed 2-3 times per season

Socio-cultural impacts

Impact	Scale	Rating
food security/ self-sufficiency	reduced – improved	✓ at position 6 of 7
SLM/ land degradation knowledge	reduced – improved	✓ at position 6 of 7

Ecological impacts

Impact	Scale	Rating
surface runoff	increased – decreased	✓ at position 6 of 7
evaporation	increased – decreased	✓ at position 6 of 7

Off-site impacts

Impact	Scale	Rating
buffering/ filtering capacity (by soil, vegetation, wetlands)	reduced – improved	✓ at position 6 of 7
wind transported sediments	increased – reduced	✓ at position 6 of 7

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Returns	Scale	Rating
Short-term returns	very negative – very positive	✓ at position 6 of 7
Long-term returns	very negative – very positive	✓ at position 7 of 7

Benefits compared with maintenance costs

Returns	Scale	Rating
Short-term returns	very negative – very positive	✓ at position 6 of 7
Long-term returns	very negative – very positive	✓ at position 7 of 7

CLIMATE CHANGE

Gradual climate change

Change	Scale	Rating
annual temperature increase	not well at all – very well	✓ at position 5 of 5

seasonal temperature increase	not well at all				✓		very well	Season: dry season
annual rainfall decrease	not well at all					✓	very well	
seasonal rainfall decrease	not well at all					✓	very well	Season: wet/ rainy season
Climate-related extremes (disasters)								
local windstorm	not well at all				✓		very well	
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
- ✓ 1-10%
- 10-50%
- more than 50%

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

- ✓ 0-10%
- 10-50%
- 50-90%
- 90-100%

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

- ✓ Yes
- No

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

- reduce workload on the farmer during weeding
- reduce erosion and improve soil fertility as the cover crop in most cases is a legume

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

- sustainable source of green manure, animal manure
- farmers can save own seed
-

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- requires to be planted very early at onset of season
- can become invasive if not well managed

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

Compiler
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Reviewer
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Nicole Harari (nicole.harari@cde.unibe.ch)

Date of documentation: Dec. 6, 2017

Last update: June 27, 2018

Resource persons
Faith Sabiti Kidega - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_3306/

Linked SLM data
Approaches: Vegetative erosion control and conservation cropping system
https://qcat.wocat.net/en/wocat/approaches/view/approaches_2417/

Documentation was faciliated by
Institution
- Makerere University (Makerere University) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Heaps of animal manure in a citrus orchard (Jalia Namakula)

Animal manure use in a citrus orchard (Uganda)

Anyukwa

DESCRIPTION

Application of animal manure on citrus trees (citrus sinensis) for improving soil productivity. Every beginning of season (March and August) 40 kg of animal manure are applied, 60 cm away from the tree trunk, using the ring method to improve soil fertility for increased yields and farm income.

Use of animal manure is a recommended agronomic practice for soil fertility enhancement in agro-ecosystems. Animal manure application contributes to the build-up of soil organic matter and supplies most of the required nutrients, both of which ultimately improve soil health and productivity. Additionally, manure improves the soil’s water holding capacity, improves soil structure, resulting into improved water infiltration and reduced runoff.

Animal manure is applied on citrus trees at the Green Valley Enterprise farm located in Adjumani District found in Northern Uganda. The farm lies on a gentle slope in an area with predominantly sandy soils. This area experiences a bimodal rainfall pattern with an annual average of 1000 mm. The farm is strategically located close to River Adidi, which is used to provide water for irrigation during the dry months. The purpose of animal manure application on the citrus trees is to increase soil fertility and health, thus improving fruit quality and quantity. Since the soils on the farm are sandy, the land user needs to have a good soil fertility and water management plan in place.

At the beginning of every cropping season, 70 bags of animal manure from cows, each weighing about 100 kg are bought and applied on over 111 citrus trees planted on an acre of land. The citrus trees are a mixture of Washington navel and Hamlin, planted at a spacing of 6×6 m. Before application, the animal manure is collected, heaped and left to decompose under shade at the owner’s kraal for 4 months. At the farm, the manure is applied using the ring method, that is, 60 cm radius from the tree trunk and covered with grass mulch. Forty (40) kg of the manure is applied per tree per season. Application of the animal manure on one acre is estimated to cost UGX 540,000, while maintenance costs are estimated to be UGX 50,000 per season.

At this farm, animal manure application has increased citrus fruit yields up to seven folds. When covered with grass mulch it improves soil moisture retention, hence the farmer is able to have two major harvests annually. In addition, the trees on which manure is applied are more tolerant to dry spells. The main disadvantages of use of animal manure are intensive labour requirement for handling, and variability in manure quality depending on the source.

LOCATION

Location: Elegu Central, Northern Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 32.00569, 3.5288

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?:

Date of implementation: 10-50 years ago

Type of introduction

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] reduce risk of disasters
- [ ] 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

- Perennial (non-woody) cropping: banana/plantain/abaca
- Tree and shrub cropping: citrus

Number of growing seasons per year: 2

Water supply

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

Purpose related to land degradation

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

Degradation addressed

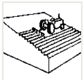
chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

biological degradation - Bc: reduction of vegetation cover, Bl: loss of soil life

SLM group

- integrated soil fertility management

SLM measures



agronomic measures - A2: Organic matter/ soil fertility

TECHNICAL DRAWING

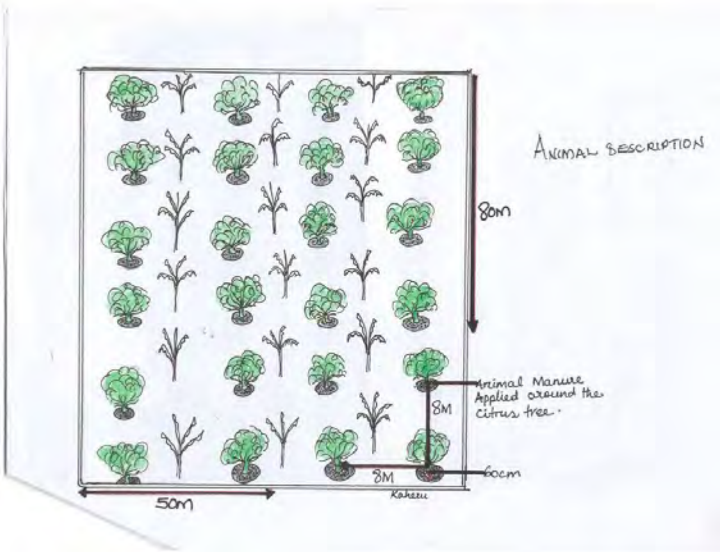
Technical specifications

40 kg of animal manure are applied per citrus tree

citrus is planted at 8×8m

111 orange trees were planted, oranges planted are the Washington navel and Hamline type

The manure is applied using the ring method 60cm away from the tree trunk and covered with mulch



Author: Prossy Kaheru

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1 acre**; conversion factor to one hectare: **1 ha = 0.40 ha**)
- Currency used for cost calculation: **Ug Shillings (UGX)**
- Exchange rate (to USD): 1 USD = 3650.0 Ug Shillings (UGX)
- Average wage cost of hired labour per day: 6660

Most important factors affecting the costs

Quantities of the manure

Establishment activities

1. heaping of manure (Timing/ frequency: Twice annually)
2. transporting (Timing/ frequency: Twice annually)
3. loading and offloading (Timing/ frequency: Twice annually)
4. manure application (Timing/ frequency: Twice annually)

Establishment inputs and costs (per 1 acre)

Specify input	Unit	Quantity	Costs per Unit (Ug Shillings (UGX))	Total costs per input (Ug Shillings (UGX))	% of costs borne by land users
Labour					
Heaping manure	heaps	20.0	2000.0	40000.0	100.0
Transporting	heaps	20.0	5000.0	100000.0	100.0
Application	acre	1.0	50000.0	50000.0	100.0
Fertilizers and biocides					
animal manure	bags	70.0	5000.0	350000.0	100.0
Total costs for establishment of the Technology				**540'000.0**	
Total costs for establishment of the Technology in USD				*147.95*	

Maintenance activities

1. collecting and heaping manure (Timing/ frequency: Twice)
2. transporting (Timing/ frequency: Twice)
3. application of manure (Timing/ frequency: Twice)

Maintenance inputs and costs (per 1 acre)

Specify input	Unit	Quantity	Costs per Unit (Ug Shillings (UGX))	Total costs per input (Ug Shillings (UGX))	% of costs borne by land users
Labour					
collecting	heap	10.0	5000.0	50000.0	100.0
		1.0			
Total costs for maintenance of the Technology				**50'000.0**	
Total costs for maintenance of the Technology in USD				*13.7*	

NATURAL ENVIRONMENT

Average annual rainfall

- < 250 mm
- 251-500 mm

Agro-climatic zone

- ✓ humid
- sub-humid

Specifications on climate

Average annual rainfall in mm: 1217.0

The rainfall on set have delayed for the last 2 seasons (2016,

- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 1,001-1,500 mm
- [ ] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

- [ ] semi-arid
- [ ] arid

2017) from March-April

Slope
- [x] flat (0-2%)
- [ ] 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
- [ ] footslopes
- [x] 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)
- [ ] medium (loamy, silty)
- [x] fine/ heavy (clay)

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

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

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

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

Water quality refers to:

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [x] Yes
- [ ] No

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

Habitat diversity
- [x] high
- [ ] 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
- [ ] average
- [x] rich
- [ ] very rich

Level of mechanization
- [ ] manual work
- [ ] animal traction
- [x] 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
- [ ] 0.5-1 ha
- [ ] 1-2 ha
- [x] 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
- [ ] medium-scale
- [x] large-scale

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

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

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

Access to services and infrastructure

	poor				good
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		Quantity before SLM: 75 oranges per tree Quantity after SLM: 200 oranges per tree
crop quality	decreased ✓ increased		with application of animal manure fruit sizes have increased
farm income	decreased ✓ increased		farm income has increased though no records are given

Socio-cultural impacts

food security/ self-sufficiency	reduced ✓ improved		The oranges are consumed by the family therefore providing nutritional benefits to family.

Ecological impacts

soil moisture	decreased ✓ increased		Using manure has increased soil organic matter, which in turn increases fertility and soil moisture retention,
drought impacts	increased ✓ decreased		Because it increases soil fertility and soil moisture retention animal manure helps the citrus trees to tolerate dry spells.

Off-site impacts

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	

The land user attests that benefits surpass both establishment and maintenance costs

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all ✓ very well
annual rainfall decrease	not well at all ✓ very well

Climate-related extremes (disasters)

Dry spells	not well at all ✓ very well

ADOPTION AND ADAPTATION

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

- ✓ single cases/ experimental
- 1-10%
- 11-50%
- > 50%

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

- 0-10%
- 11-50%
- 51-90%
- 91-100%

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

- Yes
- ✓ No

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

- Animal manure increases the quantity and quality of the citrus
- It increases the water holding capacity
- It improves soil fertility

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

- It is improves agro-ecosystem functioning
- increases farm income
- improves food security of family

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- If not proper covered with soil or mulch, nutrients can easily be eroded → cover it properly or apply beneath the soil
- manure is not readily accessible → outsource from different farmers

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- it is slow in action hence easily affected by weather → it is applied on perennial crops
- May contain excess salts

REFERENCES

Compiler
Jalia Namakula

Reviewer
Alexandra Gavilano
Nicole Harari
Drake Mubiru

Date of documentation: May 16, 2017

Last update: Aug. 8, 2019

Resource persons
Charles Ojoadi - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2254/
Video: https://player.vimeo.com/video/254984294

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- Uganda Landcare Network (ULN) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Photo showing pigs tethered for animal manure. (Issa Aiga)

Intensive Pig farming for soil fertility improvement and household income (Uganda)

Gwoko Opego Kidyang Pi Yubu Moc can

DESCRIPTION

Pigs are kept to produce manure used for soil fertility improvement and household income.

Pig farming has become a popular and lucrative business among farmers in Northern Uganda. It is considered to be a quick means of improving soil fertility and household incomes, thus improving land productivity and reducing poverty.

Pigs are normally fed reguraly on maize bran purchased or maize grain produced as the most common food ration but could also benefit from having a ratio with protein from soybeans produced on farm, and home-made feeds mainly in the form of cassava, brew waste and potatoes as well as adequate supply of drinking water for purposes of fattening, animal manure and income provision.

10-12 pigs are kept in a pen measuring 6 to 8 m wide, 8 m long and 3.5 m high with a space for feeding and bedding. The materials needed for constructing the pen are iron sheets, wood, and nails. Sanitation in pig farming is important in order to keep the pigs disease-free. Therefore, a mechanism for easy cleaning and removal of waste is necessary for any type of pig housing using sawdust. The farmer uses simple local brooms, basins, and buckets to clean and remove manure on a daily basis and applied in nearby gardens
After five to seven months, pigs are likely to have attained an ideal market weight of more than 70 – 100kg. The farmer may decide to sell or slaughter for meat. Compared to most livestock species, pigs have a higher turnover rate due to a shorter gestation period in addition to providing manure which the farmer applies on the gardens to increase soil fertility for increased food production. Pigs also have higher returns on investment due to a larger litter size and higher feed conversion ratio. These factors make pig farming a more profitable livestock enterprise, since more meat is produced and sold in a shorter period, relative to other domestic animals.
However, the farmer needs to be aware that pigs are easily attacked by bacteria and virus related diseases, which result into diarrhoea, leading to death. Treatment requires high-level skills, which may need the attention of an extension worker to provide advisory services and treatment in case they fall sick.

LOCATION

Location: Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 33.10022, 3.16303

Spread of the Technology: applied at specific points/ concentrated on a small area

In a permanently protected area?:

Date of implementation: 2015; less than 10 years ago (recently)

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] 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
- [x] Improve learning with the community on tithered livestock mangement for manure

Land use

Water supply

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

Purpose related to land degradation

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

Degradation addressed

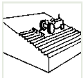
chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

biological degradation - Bc: reduction of vegetation cover

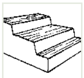
SLM group

- integrated crop-livestock management
- integrated soil fertility management
- Piggery

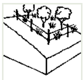
SLM measures



agronomic measures - A2: Organic matter/ soil fertility



structural measures - S9: Shelters for plants and animals



management measures - M6: Waste management (recycling, re-use or reduce)

TECHNICAL DRAWING

Technical specifications

None

Author: Pito Alex

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **less than 0.05 acre, 6 to 8 m wide, 8 m long and 3.5 m high**)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3400.0 UGX
- Average wage cost of hired labour per day: 7000

Most important factors affecting the costs

Labour takes most of the costs because its required regularly during establishment and maintenance.

Establishment activities

1. Select site where to put pigs (Timing/ frequency: Once before establishment)
2. Build a pen for pigs (Timing/ frequency: Once before establishment)
3. Look for inputs (Timing/ frequency: Once during estabslsihment/ routine)
4. Purchase pigs (Timing/ frequency: Once during establsihment)
5. Put pigs in the pen (Timing/ frequency: Once during establlsihment)
6. Feedding pigs (Timing/ frequency: Daily)
7. Watering pigs (Timing/ frequency: Daily)
8. Spraying pigs (Timing/ frequency: Weekly)

Establishment inputs and costs (per less than 0.05 acre, 6 to 8 m wide, 8 m long and 3.5 m high)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Persons days on monthly basis	persons	4.0	210000.0	840000.0	100.0
Equipment					
Nails	kgs	10.0	2500.0	25000.0	100.0
Hoes	Pieces	1.0	10000.0	10000.0	100.0
Spade	Pieces	1.0	10000.0	10000.0	100.0
Wheel barrow	Pieces	1.0	75000.0	75000.0	100.0
Iron sheets	pieces	6.0	20000.0	120000.0	100.0
Fertilizers and biocides					
Pestcide	litres	5.0	15000.0	75000.0	
Construction material					
Poles	Pieces	20.0	5000.0	100000.0	100.0
wood	pieces	15.0	5000.0	75000.0	100.0
Other					
Feeds on weekly basis	kgs	100.0	3000.0	300000.0	100.0
Total costs for establishment of the Technology				**1'630'000.0**	

Maintenance activities

1. Cleaning and removing manure (Timing/ frequency: Daily)
2. Giving drinking water to pigs (Timing/ frequency: Daily)
3. Spraying the pigs (Timing/ frequency: Weekly)
4. Feeding the pigs (Timing/ frequency: Daily)
5. Manure application in the field to improve soil fertility (Timing/ frequency: Weekly)

Maintenance inputs and costs (per less than 0.05 acre, 6 to 8 m wide, 8 m long and 3.5 m high)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
persons days on monthly basis	persons	4.0	210000.0	840000.0	100.0
					100.0
Total costs for maintenance of the Technology				840'000.0	

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
Average annual rainfall in mm: 1200.0
Two rainy seasons.

Slope
- flat (0-2%)
- ✓ 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- 501-1,000 m a.s.l.
- ✓ 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
- not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- ✓ < 5 m
- 5-50 m
- > 50 m

Availability of surface water
- excess
- ✓ good
- medium
- poor/ none

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

Water quality refers to:

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- medium
- ✓ low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- ✓ mixed (subsistence/ commercial)
- commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ manual work
- animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- women
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household
- ✓ < 0.5 ha
- 0.5-1 ha
- 1-2 ha
- 2-5 ha
- 5-15 ha
- 15-50 ha
- 50-100 ha
- 100-500 ha

Scale
- small-scale
- ✓ medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- individual

Water use rights
- ✓ open access (unorganized)
- communal (organized)

500-1,000 ha	leased
1,000-10,000 ha	individual
> 10,000 ha	

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	Quantity before SLM: 0 Quantity after SLM: 250kgs Manure application on the maize field to improve soil fertility.
crop quality	decreased						✓		increased	Especially maize.
fodder production	decreased					✓			increased	For feeding the pigs.
animal production	decreased						✓		increased	Good feeding/purchase after sell of maize.
land management	hindered							✓	simplified	manure application.
drinking water quality	decreased							✓	increased	
water quality for livestock	decreased					✓			increased	Quantity before SLM: 0 Quantity after SLM: 1 water harvesting tank to be used for drinking by the pigs.
expenses on agricultural inputs	increased					✓			decreased	Spend on pesticides.
farm income	decreased						✓		increased	Quantity before SLM: 0 Quantity after SLM: 800000 sale of maize and 2 pigs.
workload	increased						✓		decreased	Looking after pigs and maize on farm.

Socio-cultural impacts

food security/ self-sufficiency	reduced							✓	improved	Especially with the harvest of maize.
SLM/ land degradation knowledge	reduced						✓		improved	Training on planting maize, feeding the pigs and manure application in the maize field.

Ecological impacts

soil cover	reduced						✓		improved	Animal manure application in the maize field.
soil loss	increased						✓		decreased	Zero grazing avoiding overgrazing.
soil organic matter/ below ground C	decreased							✓	increased	Due to application of manure.
vegetation cover	decreased							✓	increased	Zero grazing.
beneficial species (predators, earthworms, pollinators)	decreased						✓		increased	Pigs.
pest/ disease control	decreased			✓					increased	Support from extension workers.

Off-site impacts

damage on neighbours' fields	increased						✓		reduced	Zero grazing as pigs are destructive.

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

Short term- High costs on labour and inputs. Long term - Low costs required only for labour to maintain the technology.

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	

ADOPTION AND ADAPTATION

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

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

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

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

Number of households and/ or area covered
5

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

- [x] Yes
- [ ] No

To which changing conditions?

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

Planted Agroforestry trees (avocado and calliandra) as feed supplement.

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Can easily be replicated in some other areas.
- Cheap to maintain once established: require low costs for maintenance.
- Provide manure which is applied on farm for increased maize production.

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

- Rewarding to both small and scale land users in terms of Income from the sale of pigs.
- Provide manure for maize production.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Expensive to feed during the dry season: costly due to shortage of feeds. → Promote alternative farm feeds on farm e.g avocado and calliandra trees.

Weaknesses/ disadvantages/ risks: compiler’s or other key resource person’s view → how to overcome

- Easily attacked by bacteria and virus related diseases which result into constant Diarrhoea. → Improve hygiene.
- Intensive Labour. → Use both family labour.
- Requires some capital which may not be available with the land user who may want to start. → Form saving and loans group/ association.
  Access agricultural loans for farmers and pay after sale of pigs.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Renate Fleiner
Nicole Harari
Drake Mubiru
Donia Jendoubi

Date of documentation: June 10, 2017

Last update: March 22, 2019

Resource persons
Alex Pito - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2812/
Video: https://player.vimeo.com/video/325842937

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)


Locally grazed cows for soil fertility improvement Northern Uganda. (Issa Aiga)

Controlled livestock grazing for soil fertility improvement (Uganda)

DESCRIPTION

Integrated crop-livestock production for improved soil fertility management. Local cows are tied to trees to facilitate manure collection.

Controlled livestock grazing is a common practice promoted by farmers in Northern Uganda, who own up to 4-6 cows raised on two or more acres of land. Although the primary purpose is to produce milk for domestic consumption and for sale, the other subsidiary aim is to generate manure to replenish soil fertility on continuously cultivated and nutrient depleted land and pasture that the cows graze on. During the rainy season crops are planted and animals fed by cut and carry or pegged/ tied with a radius of 2-5 meters. During dry season the animals can graze on crop residues
For this technology, cattle are tethered/ tied on a pole (pegged) or tree using a sisal rope. Tethering distance should allow each cow to access pasture uninterrupted by others. The animals are rotated/ relocated routinely to minimise overgrazing in a given location. The manure produced is collected daily, and kept in heaps to compost for periods of 2 to 3 weeks, before being ferried to the fields for application for the cultivation of maize and other crops like soya bean . This technology requires possession of sufficient land for grazing the animals, as well as sufficient labour for handling manure through composting up to field application. The key inputs required for establishing this technology include labour, hand hoes, spades, sisal ropes, basins, sacks and basket for collecting manure and its transportation to the maize field, watering containers , spraying pumps for spraying animals against ticks and feeds to supplement the grazing during shortage of pasture.
The benefits derived from such a technology are both short and long term, including access to increased manure to apply on crop fields especially maize for increased production
To replicate this technology, the land user needs to have knowledge and skills on how to manage the animals to generate high quality manure, compost it and maintain it free of contamination with pesticides sprayed on the animals against pests and diseases, which may affect the quality of the manure and the safety of the users.

LOCATION

Location: Gulu Municipality, Gulu District, Northern Region, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 32.35755, 2.8364

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)

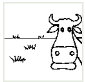
Type of introduction

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

CLASSIFICATION OF THE TECHNOLOGY

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

Land use



Grazing land
- Cut-and-carry/ zero grazing

Animal type: cattle - dairy

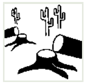
Species	Count
cattle - dairy	5

Water supply
- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation
- ✓ prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

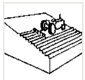
chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)



biological degradation - Bc: reduction of vegetation cover

SLM group
- integrated crop-livestock management
- integrated soil fertility management

SLM measures



agronomic measures - A2: Organic matter/ soil fertility

TECHNICAL DRAWING

Technical specifications

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology unit (unit: 0.5 acres volume, length: pegged/tied with a radius of 2-5 meters)
- Currency used for cost calculation: UGXUGX
- Exchange rate (to USD): 1 USD = 3445.0 UGX
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs
Labour takes the most costs since the tasks re routine compared to the cost of equipment which is bought and replaced after its worn out.

Establishment activities
1. Buy local cows/ varieties for keeping (Timing/ frequency: Once before stocking / dry season)
2. Look for inputs , labour, sack, basins and ropes (Timing/ frequency: Before stocking)
3. Tie the cows on a tree using a sisal rope (Timing/ frequency: During establishment)
4. Plant the crop to provide crop residues (Timing/ frequency: During the wet season)

Establishment inputs and costs (per 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Planting	persons	2.0	150000.0	300000.0	100.0
Tieing, feeding and grazing cows	persons	2.0	150000.0	300000.0	100.0
Equipment					
Hoe	pieces	1.0	10000.0	10000.0	1000.0
Spade	peices	1.0	10000.0	10000.0	1000.0
Spraying pump	pieces	1.0	250000.0	250000.0	100.0
Watering trays	pieces	6.0	100000.0	600000.0	100.0
Plant material					
Maize seed	Kgs	10.0	2500.0	25000.0	100.0
Other					
Local cows	cow	6.0	700000.0	4200000.0	
Buckets	pieces	1.0	3500.0	3500.0	100.0
Sack	pieces	2.0	1000.0	2000.0	100.0
Feeds	Kgs	100.0	4000.0	400000.0	100.0
Crop residues (not bought)					
Total costs for establishment of the Technology				**6'100'500.0**	
Total costs for establishment of the Technology in USD				*1'770.83*	

Maintenance activities
1. Watering the cow (Timing/ frequency: Daily during the dry season)
2. Tieing and feeding the cow (Timing/ frequency: Daily)
3. Spraying the cows against ticks (Timing/ frequency: Weekly)
4. Heaping and carrying manure to the garden (Timing/ frequency: Everyday/ after 2 weeks)
5. Applying manure in the soil (Timing/ frequency: Before planting season)
6. Relocating the cows (Timing/ frequency: Every after 2 days)
7. Cutting and carrying pasture (Timing/ frequency: After harvest)

Maintenance inputs and costs (per 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Labour paid on monthly basis	Persons	2.0	150000.0	300000.0	100.0
Equipment					
Replacement worn our equipment	pieces	3.0	20000.0	60000.0	100.0
Fertilizers and biocides					
Pestcide	litres	10.0	15000.0	150000.0	100.0
Total costs for maintenance of the Technology				**510'000.0**	
Total costs for maintenance of the Technology in USD				*148.04*	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 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
- [x] humid
- [ ] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
Average annual rainfall in mm: 1350.0

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

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

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [x] 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
- [x] concave situations
- [ ] not relevant

Soil depth
- [ ] very shallow (0-20 cm)
- [x] shallow (21-50 cm)
- [ ] 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

Availability of surface water

Water quality (untreated)

Is salinity a problem?

☐ on surface
✓ < 5 m
☐ 5-50 m
☐ > 50 m

☐ excess
☐ good
✓ medium
☐ poor/ none

✓ good drinking water
☐ poor drinking water (treatment required)
☐ for agricultural use only (irrigation)
☐ unusable

Water quality refers to:

✓ Yes
☐ No

Occurrence of flooding
☐ Yes
✓ No

Species diversity
☐ high
✓ medium
☐ low

Habitat diversity
☐ high
✓ medium
☐ low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
☐ subsistence (self-supply)
✓ mixed (subsistence/ commercial)
☐ commercial/ market

Off-farm income
✓ less than 10% of all income
☐ 10-50% of all income
☐ > 50% of all income

Relative level of wealth
☐ very poor
☐ poor
✓ average
☐ rich
☐ very rich

Level of mechanization
✓ manual work
✓ animal traction
☐ mechanized/ motorized

Sedentary or nomadic
✓ Sedentary
☐ Semi-nomadic
☐ Nomadic

Individuals or groups
✓ individual/ household
☐ groups/ community
☐ cooperative
☐ employee (company, government)

Gender
✓ women
✓ men

Age
☐ children
✓ youth
✓ middle-aged
☐ elderly

Area used per household
✓ < 0.5 ha
☐ 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
☐ medium-scale
☐ large-scale

Land ownership
☐ state
☐ company
☐ communal/ village
☐ group
✓ individual, not titled
☐ individual, titled

Land use rights
☐ open access (unorganized)
☐ communal (organized)
☐ leased
✓ individual

Water use rights
☐ open access (unorganized)
✓ communal (organized)
☐ leased
☐ 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

animal production	decreased						✓		increased	Milk production and the farmer has also increased the number of cows.
land management	hindered					✓			simplified	Application of locally obtained manure.
expenses on agricultural inputs	increased	✓							decreased	More money spent on buying pesticides, basins, buckets, and maize seed.
farm income	decreased							✓	increased	From sale of maize and milk.
workload	increased		✓						decreased	More activities during establishment.

Socio-cultural impacts

food security/ self-sufficiency	reduced							✓	improved	Availability of Maize after harvest for sale and household income.
SLM/ land degradation knowledge	reduced							✓	improved	Training on manure application in the maize field.

Ecological impacts

soil cover	reduced						✓		improved	Use of manure and maize stalks.

soil loss — increased ✓ decreased

Application of manure and decomposition of maize stalks.

Off-site impacts
damage on neighbours' fields — increased ✓ reduced

Restricted movements of the cows

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative	✓ (5 of 7)	very positive
Long-term returns	very negative	✓ (7 of 7)	very positive

Benefits compared with maintenance costs

Short-term returns	very negative	✓ (5 of 7)	very positive
Long-term returns	very negative	✓ (6 of 7)	very positive

More benefits after establishments. High costs during establishment.

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all	✓ (3 of 5)	very well	
seasonal temperature increase	not well at all	✓ (3 of 5)	very well	Season: dry season

Climate-related extremes (disasters)

epidemic diseases	not well at all	✓ (4 of 5)	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?

- [ ] Yes
- [x] No

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

- Yield potential is high with good feeding of the cows , right spacing and manure application in maize garden.
- The technology can easily be replicated by small scale and large scale land users to other areas.
- Uses sisal ropes which are cheap.

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

- Minimizes conflicts when cows are tied in one area.
- Good at providing income and manure for soil fertility improvement.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Requires constant labour. → Use family labour to supplement hired labour.
- Requires technical knowledge on management, spacing and treatment. → Seek technical advice from the extension worker.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Easily affected by pests and diseases. → Apply pesticides / seek technical advice from the extension worker.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Alexandra Gavilano
Rima Mekdaschi Studer
Renate Fleiner
Nicole Harari
John Stephen Tenywa
Donia Jendoubi

Date of documentation: June 5, 2017

Last update: Aug. 11, 2019

Resource persons
Robinson Ojok - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2761/
Video: https://player.vimeo.com/video/325822470

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- Uganda Landcare Network (ULN) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

A photo showing an Orchard of Mangoes and Oranges for Soil Fertility improvement in Gulu District. (Rick Kamugisha)

Orchard of Mangoes and Oranges for Soil Fertility Improvement. (Uganda)

Muyembe na mucungwa

DESCRIPTION

The technology involves growing of Mangoes (Mangifera indica) and Oranges (Citrus sinensis) in the same field with the aim of conserving the environment, protecting soil from erosion, and generating income from the sale of fruits.

Growing mangoes and oranges in the same field is a common sustainable land management cropping system practiced by farmers in Northern Uganda for soil fertility improvement. Under this practice farmer benefit from the litter of leaves when they fall and decompose to form manure to increase fertility of the soil. A farm located on a gentle slope of 3-5 % measuring an average size of 2-5 acres, is planted with orange varieties (Valencia and Hamlin) and mango varieties (Apple and Tommy) with the aim of generating household income and improving soil fertility litter and decomposition of the fallen leaves. The mango and orange seedlings are planted at a spacing of 10 m × 10 m in holes dug down to a depth of 30cm.
Seven to 10 workers are paid on a monthly basis and their day to day activities include establishing and maintaining the orchard; establishment entails slashing the field, digging the holes, and planting the seedlings, while maintenance entails spraying pests which attack the mangoes and oranges harvesting and marketing.
Planting more than one fruit trees in the same field increases saves use of more land which would be used for planting two fruit trees in separate gardens and saves labor since all the fruit trees are located and grown in one same field. Which in turn saves labour that would be used on two different fields. However, it is important for farmers to know that high costs are encountered at the beginning; this costs include buying seedlings, hoes, pangs, pesticides, spray pumps, and paying for labour. The costs are expected to reduce over time, leaving only costs of labour for weeding, monitoring, harvesting and marketing.
It is important for the land user to be aware that this technology is easily affected by pests and diseases. To control pests and disease, it is recommended to use dimethoiate, sprayed once every after 3 to 7 weeks.

LOCATION

Location: Gulu Municipality, Gulu District, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.3179, 2.69767

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use

Cropland

- Annual cropping
- Tree and shrub cropping: citrus, mango, mangosteen, guava

Number of growing seasons per year: 2

Water supply

- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation

- ✓ prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion

soil erosion by wind - Et: loss of topsoil

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

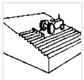
biological degradation - Bc: reduction of vegetation cover, Bs: quality and species composition/ diversity decline, Bp: increase of pests/ diseases, loss of predators

water degradation -

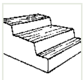
SLM group

- agroforestry
- integrated soil fertility management
- improved plant varieties/ animal breeds

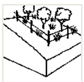
SLM measures



agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility, A3: Soil surface treatment, A5: Seed management, improved varieties



structural measures - S11: Others

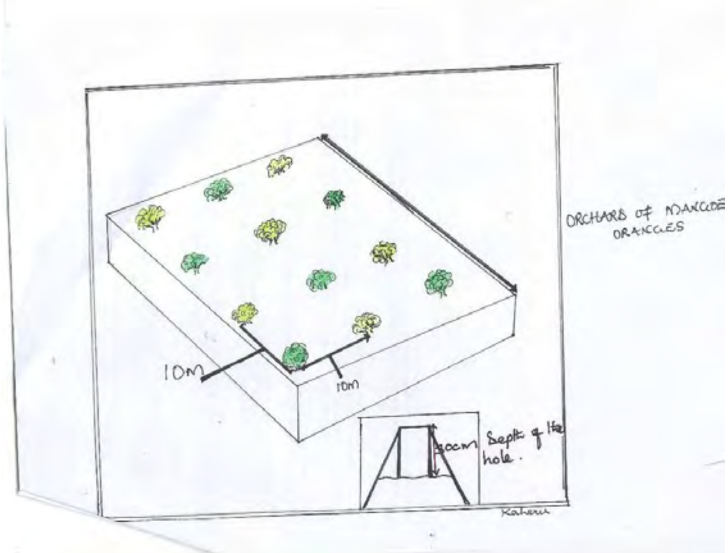


management measures - M1: Change of land use type, M2: Change of management/ intensity level, M4: Major change in timing of activities

TECHNICAL DRAWING

Technical specifications

None



Author: Walter Oduor

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3400.0 UGX
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs
Labour for planting, weeding , slashing and spraying take the most costs.

Establishment activities
1. Site / field selection (Timing/ frequency: Once before establishment)
2. Slashing the field (Timing/ frequency: Once before establishment)
3. Look for labour (Timing/ frequency: Before establishment)
4. Select for seedlings (Timing/ frequency: Before establishment)
5. Dig the hole (Timing/ frequency: During establishment)
6. Plant the seedlings (Timing/ frequency: Before estabslishment)
7. (Timing/ frequency: After establishment)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Persons days on monthly basis	Persons	8.0	100000.0	800000.0	100.0
Equipment					
Hoes	Pieces	4.0	10000.0	40000.0	100.0
Pangas	Pieces	4.0	7000.0	28000.0	
Spraying pumps	Pieces	2.0	250000.0	500000.0	
Plant material					
Seedlings	seedling	1000.0	2500.0	2500000.0	
Fertilizers and biocides					
Pestcides	litres	3.0	10000.0	30000.0	100.0
Construction material					
					100.0
Total costs for establishment of the Technology				**3'898'000.0**	
Total costs for establishment of the Technology in USD				*1'146.47*	

Maintenance activities
1. Slashing (Timing/ frequency: Twice a year)

Maintenance inputs and costs

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Persons days on monthly basis	Persons	2.0	100000.0	200000.0	100.0
labour for weeding daily basis	Persons	2.0	5000.0	10000.0	100.0
Fertilizers and biocides					
Pestcide	Litres	4.0	13000.0	52000.0	
Total costs for maintenance of the Technology				**262'000.0**	
Total costs for maintenance of the Technology in USD				*77.06*	

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
Average annual rainfall in mm: 1400.0
Two rainy season (March- may) and September to November.

Slope
- flat (0-2%)
- ✓ 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- ✓ 501-1,000 m a.s.l.
- 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
- ✓ not relevant

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

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

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

Topsoil organic matter content
- ✓ high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- ✓ < 5 m
- 5-50 m
- > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Water quality refers to:

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- mixed (subsistence/ commercial)
- ✓ commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ manual work
- animal traction
- ✓ mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- ✓ women
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household
- < 0.5 ha
- 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
- ✓ medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ 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	
land management	hindered						✓		simplified	
expenses on agricultural inputs	increased						✓		decreased	High due to purchase seedlings, labour, fertilizer costs during the short run but reducing in the long run.
farm income	decreased						✓		increased	From the sale of mangoes and oranges.
workload	increased	✓							decreased	

Socio-cultural impacts

SLM/ land degradation knowledge	reduced						✓		improved

Ecological impacts

Off-site impacts

water availability (groundwater, springs)	decreased					✓			increased

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

Climate-related extremes (disasters)

land fire	not well at all		✓				very well
landslide	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?

- [ ] Yes
- [x] No

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

- East to manage on farm.
- Cost effective: Returns are high if managed well.
- Controls soil erosion; Good at reducing soil erosion.
- Creates employment for many people and it is good at providing income after sale of fruits.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Appropriate to the rich only; Inputs are expensive. → Link the small scale land users to credit institutions with less interest rates to pay back later after selling their products.

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

- Its replicable; it can be used by both small and large scale land users.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Risky in case of pests and diseases; Low returns-low income.
  → On site training in pests and disease management.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Alexandra Gavilano
Stephanie Jaquet
Renate Fleiner
Nicole Harari
John Stephen Tenywa
Donia Jendoubi

Date of documentation: June 11, 2017

Last update: Aug. 10, 2019

Resource persons
Oduour Walter - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2817/
Video: https://player.vimeo.com/video/254846954

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Dairy cow grazing on natural pastures. (Betty Adoch)

Reclamation of indigenous pastures for dairy farming (Uganda)

Lum pi dyang cak

DESCRIPTION

Dairy cattle (Friesian) are grazed on indigenous pastures to promotes conservation of the indigenous grass species (guinea grass), which protects the soil against soil erosion and promotes biodiversity.

Indigenous pasture-based dairy farming is a balance between managing the pasture and the cows to maximize sustainable profit and promotes conservation of the indigenous grass species which protects the soil against soil erosion and promotes biodiversity. Northern Uganda has tropical savannah climate which receives moderate amount of rainfall ranging from 750-1000mm per annum. This is sometimes characterised by prolonged dry spells which hamper other economic activities like crop production. Therefore, to avoid the climatic shocks, this technology was introduced by the land user to diversify his economic activity other than only relying on crop production. The land user is a typical subsistence farmer whose major source of income depends on dairy farming to support his livelihood.

In this SLM technology, indigenous pastures are conserved for dairy farming. This is due to the existence of savannah grassland vegetation which provide abundant pastures for cattle grazing. This has favoured the rearing of Friesian cow on a flat landscape. A 30x40meters land was highly preserved for this technology. Five (5) cows are kept on this grazing field occupied by natural pasture (elephant grass) that the land user conserve. These grass are nutritious and the cows healthily and freely graze on them during wet and dry season. However, their movement is controlled by the headsman to avoid crop damage.

In order to maintain these grasses, during dry season, the land user creates a fire line around the conserved grazing area. This is to prevent the spread of wild fire from the nearby bush since it is a serious occurrence in the community. The conserved grass dries up during dry season but the dairy cows graze on it and can still produce high volume of milk as during the wet season. A cow produces daily 15 to 20 litters, they are milked twice a day and the milk is taken to town for sale. Soda ash are given to the cows to raise their appetite for pastures and water. Cows are source of milk, which is sold to generate revenue to the farmer for school fees, medications and cow dung is applied in orchard gardens and tree plantations to boost soil fertility.

To establish this technology, One Friesian cow were donated to the land user by a government project and a grazing field was secured which used to be for crop growing. Water tank placed on the grazing field. The grasses were conserved for the cow and shrub trees also protected for shade. With the help of artificial insemination, more calves were produce and today the land user have five cows that freely graze the area although their movement is controlled by the headsman.

This technology conserve grasses which cover the soil from the effects of soil erosion, reduce incidence of wild fire in the area, the shrubs trees are also protected to provide shade to the cows in the grazing field which promotes farmer managed natural regeneration and the grazing cows spread dung around the field which boost soil fertility.

During dry spells pasture growth is retarded and also becomes less nutritious that makes the cows to become skinny and water shortages. Besides, these cows are prone to pests and disease attacks that requires constant monitoring and treatment.

LOCATION

Location: Kitgum Municipality, Northern Uganda., Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.95404, 3.29509

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)

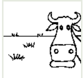
Type of introduction
- ☐ through land users' innovation
- ☐ as part of a traditional system (> 50 years)
- ☐ during experiments/ research
- ✓ through projects/ external interventions

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use



Grazing land
- Ranching
- Improved pastures

Animal type: cattle - dairy, exotic breed (Friesian cattle) for milk productio

Water supply

- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation

- ✓ prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying

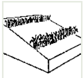
soil erosion by wind - Et: loss of topsoil, Ed: deflation and deposition

biological degradation - Bc: reduction of vegetation cover, Bh: loss of habitats, Bf: detrimental effects of fires

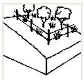
SLM group

- agroforestry
- pastoralism and grazing land management
- improved plant varieties/ animal breeds

SLM measures



vegetative measures - V1: Tree and shrub cover, V2: Grasses and perennial herbaceous plants

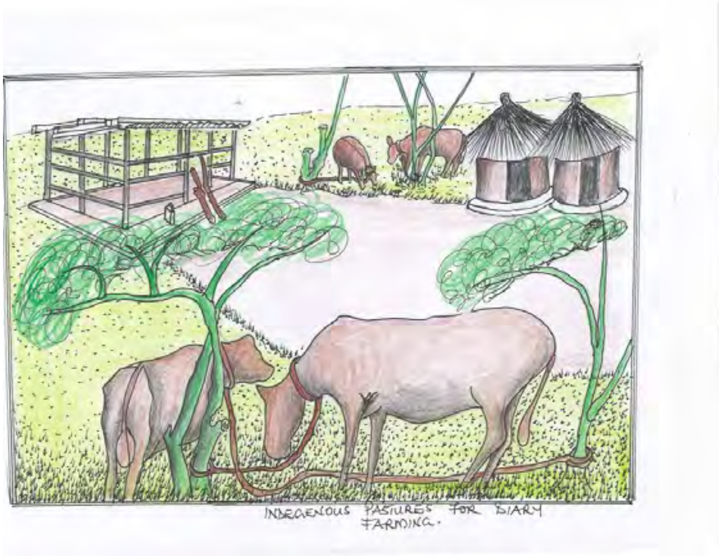


management measures - M1: Change of land use type

TECHNICAL DRAWING

Technical specifications

2 acres of land measuring 30x40 meters secured for grazing the cows. A kraal is constructed on the grazing field to accommodate the cows in the night. Pegging is done to prevent the cows from moving to cropland and after some time like afternoon the cows are shifted to another spot to graze. But also at time the cows are left to graze in the field with controlled movement. A kraal/shade is constructed, roofed with 5 pieces of iron sheet and supported by timbers that stands at a height of about 4meters.



Author: Betty Adoch.

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: 2acres)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3718.0 UGX
- Average wage cost of hired labour per day: 3000shs

Most important factors affecting the costs
The labour for firebreaks during dry seasons and maintaining the farm.

Establishment activities
1. clearing thony trees (Timing/ frequency: dry season)
2. regeneration of pastures (Timing/ frequency: dry season)
3. constructing cattle shade (Timing/ frequency: dry and wet)

Maintenance activities
1. Slashing the over grown grass (Timing/ frequency: dry and wet)
2. constant removal of thony trees (Timing/ frequency: dry and wet)
3. Refilling the water tank (Timing/ frequency: wet and dry season)
4. Rotational pegging (Timing/ frequency: Dry and wet seasons)
5. Taking/returing of cows to kraal every evening (Timing/ frequency: dry and wet seasons)
6. Replacing ropes to tie the cows during pegging (Timing/ frequency: dry and wet seasons)

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
Average annual rainfall in mm: 900.0
heavy rain in april, may, june, august, september and october. these reduces in july, november,december january , febuary and march.
Name of the meteorological station: kitgum weather station
savanna climate where rainfall is moderate and unreliable with hot temperatures throughtout the year.

Slope
- ✓ flat (0-2%)
- 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- ✓ 501-1,000 m a.s.l.
- 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
- ✓ not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table

Availability of surface water

Water quality (untreated)

Is salinity a problem?

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

- [ ] excess
- [x] good
- [ ] medium
- [ ] poor/ none

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

Water quality refers to:

- [ ] Yes
- [x] No

Occurrence of flooding

- [ ] Yes
- [x] No

Species diversity

- [x] high
- [ ] medium
- [ ] low

Habitat diversity

- [x] high
- [ ] medium
- [ ] low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation

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

Off-farm income

- [x] less than 10% of all income
- [ ] 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
- [ ] 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
- [x] elderly

Area used per household

- [ ] < 0.5 ha
- [x] 0.5-1 ha
- [ ] 1-2 ha
- [ ] 2-5 ha
- [x] 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

- [x] small-scale
- [ ] 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)
- [x] communal (organized)
- [ ] leased
- [ ] individual

Access to services and infrastructure

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

IMPACTS

Socio-economic impacts

	Scale	Rating (7-point scale)	Comments
fodder production	decreased – increased	✓ (7th)	Quantity before SLM: low Quantity after SLM: high Conserved pastures for cows.
water availability for livestock	decreased – increased	✓ (7th)	Quantity before SLM: low Quantity after SLM: high Water is stored in a tank for the animals.
farm income	decreased – increased	✓ (7th)	Quantity before SLM: low Quantity after SLM: high Through sales of milk.
economic disparities	increased – decreased	✓ (7th)	Quantity before SLM: highl Quantity after SLM: low Has his source of income.

Socio-cultural impacts

	Scale	Rating (7-point scale)	Comments
food security/ self-sufficiency	reduced – improved	✓ (7th)	Quantity before SLM: low Quantity after SLM: high Milk provide food to the land user.
SLM/ land degradation knowledge	reduced – improved	✓ (7th)	Quantity before SLM: low Quantity after SLM: high Aware of the importance of soil conservation.
conflict mitigation	worsened – improved	✓ (7th)	Quantity before SLM: low Quantity after SLM: high The grazing zone is secure from land disputes.

Ecological impacts

soil moisture	decreased	✓ increased	Quantity before SLM: low Quantity after SLM: high Grass cover soil from the effects of evaporations retaining more soil moistures.
soil cover	reduced	✓ improved	Quantity before SLM: low Quantity after SLM: high Grass protects the soil.
soil loss	increased	✓ decreased	Quantity before SLM: high Quantity after SLM: low Prevents soil erosion.
vegetation cover	decreased	✓ increased	Quantity before SLM: low Quantity after SLM: high Plants and trees exists.
plant diversity	decreased	✓ increased	Quantity before SLM: low Quantity after SLM: high Conservation of trees and grass for the animals.
emission of carbon and greenhouse gases	increased	✓ decreased	Quantity before SLM: high Quantity after SLM: low Plants acts as carbon sink.

Off-site impacts

water availability (groundwater, springs)	decreased	✓ increased	Quantity before SLM: low Quantity after SLM: high Water source has been secured to constantly supply water for the animals during wet and dry seasons and also for other domestic activities.
buffering/ filtering capacity (by soil, vegetation, wetlands)	reduced	✓ improved	Quantity before SLM: low Quantity after SLM: high Plants roots filters the underground water.

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

Dairy cows produces a calf once a year after artificial insemination.

CLIMATE CHANGE

Gradual climate change

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

Climate-related extremes (disasters)

local rainstorm	not well at all	✓	very well
local thunderstorm	not well at all	✓	very well
local hailstorm	not well at all	✓	very well
heatwave	not well at all	✓	very well
drought	not well at all	✓	very well
land fire	not well at all	✓	very well
epidemic diseases	not well at all	✓	very well
insect/ worm infestation	not well at all	✓	very well

ADOPTION AND ADAPTATION

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

- single cases/ experimental
- ✓ 1-10%
- 11-50%
- > 50%

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

- ✓ 0-10%
- 11-50%
- 51-90%
- 91-100%

Number of households and/ or area covered

05 household

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

- ✓ Yes
- No

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
- Soils are protected from the effects of erosion.
- Cow dungs are used as manure on orchard gardens.

Strengths: compiler's or other key resource person's view
- Conservation of soil and improved soil fertility.
- Vegetation modifies the micro climate through the conserved pastures.
- Land protections from degradation by erosion.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome
- Pests and diseases that affects the cows. → Spraying and treatments.
- Inadequate pastures during dry seasons. → Supplement with maize brands,banana leaves, and hey.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome
- Water shortage during dry season. → Planning to build a better and larger tank.
- Failure of artificial insemination. → Need to acquire a Friesian bull.

REFERENCES

Compiler
betty adoch

Reviewer
Alexandra Gavilano
Rima Mekdaschi Studer
Stephanie Jaquet
Renate Fleiner
Nicole Harari
John Stephen Tenywa

Date of documentation: May 19, 2017

Last update: Aug. 8, 2019

Resource persons
Olum Geoffrey - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2321/
Video: https://player.vimeo.com/video/254823649

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Photo showing Left: The inlet to the Digester. Middle: Outlet tank/ Expansion Chamber. Right: Gas Stoves. (Joseline Kashagama)

Domestic Biogas Plant for fuel and organic fertilizer (Uganda)

Bayogasi

DESCRIPTION

Domestic biogas plant converts livestock manure into biogas and organic fertilizer. The technique uses cow dung to produce methane gas for lighting and heating.

Domestic biogas plants convert livestock manure into biogas and bio-slurry, a form of organic fertilizer (fermented manure). Biogas is a renewable energy or gas produced by the breakdown of organic matter in the absence of oxygen. Most people in Uganda, especially in rural areas, don't have access to electricity and mostly rely on firewood and charcoal (mostly in urban areas). This has led to depletion of forests since these forests are the main supply of wood fuel. The domestic biogas technique uses fresh cow dung to produce methane gas for lighting and heating.

This technology is viable for smallholder farmers with livestock that are capable of producing 25 kg of fresh dung per day, typically about five indigenous cows. This makes the technology suitable for smallholders in developing countries. Fresh cow dung is collected and mixed with water at a ratio of 1:1, depending on the thickness of the dung, to produce a free-flowing mixture. The mixture is poured into the digester where microbes break it down under an oxygen-free environment and in the process release methane gas which is harvested in a cylinder and piped straight into the home for lighting and/ or heating.
Dimensions for the Digester (4m in diameter and 3 m in depth). Overflow tank/ Outlet is 2 meters by 2 meters. Materials used in the construction of the plant include sand, cement, bricks, iron rods, gravel and water. Biogas stove, lamp and its appliances and gas controller or pressure gauge are connected after the construction of the biogas plant which can be purchased from specified outlets on the urban markets.

Production and use of biogas protects the environment through reduced tree cutting and emission of harmful greenhouse gases (GHG). It also eases the workload of rural women and children by providing a safe and cheap source of fuel since it reduces the risk encountered by children and women looking for firewood and spares their time that would otherwise be spent in the process. The bi-product (bio-slurry) removed from the digester at the end of the process is used as organic fertilizer which boosts crop productivity and is a highly nutritious feed supplement for animals.
The technology has safety issues especially on the side of children when it comes to the flammable gas.

LOCATION

Location: Sisiyi Sub county, Gibuzale Parish, Bulabuli District, Eastern Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 34.31587, 1.27661

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2016

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use

Cropland - Perennial (non-woody) cropping
Main crops (cash and food crops): Coffee and Bananas

Grazing land - Intensive grazing/ fodder production: Cut-and-carry/ zero grazing
Main animal species and products: Cows

Water supply

- rainfed
- ✓ mixed rainfed-irrigated
- full irrigation

Number of growing seasons per year: 3
Land use before implementation of the Technology: n.a.
Livestock density: 3 cows

Purpose related to land degradation

- ✓ prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

biological degradation - Bc: reduction of vegetation cover, Bq: quantity/ biomass decline

SLM group

- natural and semi-natural forest management
- integrated soil fertility management
- energy efficiency technologies

SLM measures

agronomic measures - A2: Organic matter/ soil fertility

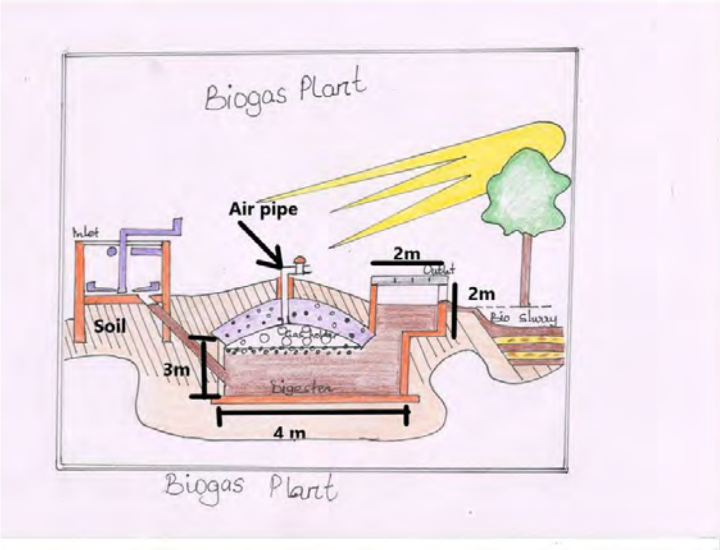
structural measures - S10: Energy saving measures

management measures - M6: Waste management (recycling, re-use or reduce)

TECHNICAL DRAWING

Technical specifications

Components and Construction of the Bio gas plant
The size of the biogas plant is based on the availability of raw materials, use and financial status. The Biogas plant has the following components the inlet pipe/ tank, the digester, the outlet tank and gas pipe. Materials used in the construction of the plant include Sand, Cement, bricks, iron rods, gravel and water.
The land should be leveled before construction after which the pits are evacuated in their proper sizes and depth. After which construction of the walls begins with a mixture of cement and sand with a ratio of 1:4.
The inlet pipe is about 15cm in diameter which is connected to the digester. Dimensions for the Digester are 4m in diameter and 3m in depth with the thickness of 35cm and strong enough to with stand the load since they are partially buried under ground. The gas pipe is connected to the digester which carries the gas to the point of utilization, such as a stove or lamp. The digester is connected to the overflow tank which is 2 meters in diameter and 2meters in depth.
Biogas stove, lamp and its appliances and gas controller or gauge are connected after the construction of the biogas plant.



Author: Prossy Kaheru

Production of Biogas
Biogas is produced from biodegradable materials such as animal dung mixed with water. Before the dung is fed into the plant, it is mixed with water in a tank or basin to give a solid content of 1: 1.5 ratios in the slurry. The mixture is discharged into the digester through the inlet pipe. The mixture ferments inside this digester and biogas is produced through bacterial action, the gas of which settles on top of the slurry in the digester which goes through a gas pipe connected on top of the tank. The gas pipe has a gas/pressure regulator which controls the outlet pressure of the gas to the gas burner or bulb. The digested slurry is discharged into the outlet tank through the outlet opening and use a fertiliser.

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology unit (unit: **Construction Materials** volume, length: **Volume**)
- Currency used for cost calculation: **US Dollars**
- Exchange rate (to USD): 1 USD = 3600.0
- Average wage cost of hired labour per day: $ 1.389

Most important factors affecting the costs
The construction costs, determined by the size of the biogas plant.

Establishment activities
1. Plan and take measurements (Timing/ frequency: Not applicable)
2. Buy and deliver the construction materials (Timing/ frequency: Not applicable)
3. Dig the pits (Timing/ frequency: Not applicable)
4. Build the concrete (Timing/ frequency: Not applicable)
5. Put the pipes (Timing/ frequency: Not applicable)
6. Connect to the stove and lamp (Timing/ frequency: Not applicable)

Establishment inputs and costs (per Construction Materials)

Specify input	Unit	Quantity	Costs per Unit (US Dollars)	Total costs per input (US Dollars)	% of costs borne by land users
Labour					
Man labour (Digging the holes))	Person-days	2.0	13.89	27.78	50.0
Man labour (Building)	person-days	20.0	4.17	83.4	50.0
Equipment					
Stove	piece	1.0	27.78	27.78	50.0
Lamp	Piece	1.0	27.78	27.78	100.0
Construction material					
Bricks	Piece	700.0	0.042	29.4	50.0
Cement	Bag (50kg)	11.0	8.89	97.79	50.0
Sand	Tonnes	1.0	41.67	41.67	50.0
Stones	Tonnes	0.5	27.78	13.89	50.0
Other					
Pipes	piece @ 10m	3.0	4.17	12.51	50.0
Wire goose	Meters	3.0	1.94	5.82	50.0
Transportation	Trip	3.0	27.78	83.34	50.0
Total costs for establishment of the Technology				**451.16**	

Maintenance activities
1. Manual mixing of the dung & water (Timing/ frequency: Every Morning)
2. Add mixture (dung & water) (Timing/ frequency: Every morning)
3. Emptying of the the overflow (Timing/ frequency: When necessary)

Maintenance inputs and costs (per Construction Materials)

Specify input	Unit	Quantity	Costs per Unit (US Dollars)	Total costs per input (US Dollars)	% of costs borne by land users
Labour					
Man Labour	persons- days	2.0	1.39	2.78	100.0
Equipment					
Mixing Basin	piece	1.0	1.39	1.39	100.0
Fertilizers and biocides					
Cow dung	kg	40.0	0.028	1.12	100.0
Water	Litres	20.0	0.0014	0.03	100.0
Total costs for maintenance of the Technology				5.32	

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
Average annual rainfall in mm: 1600.0
The zone receives a bi-modal pattern of rainfall, with the wettest months being April and October, while July to August and December to February are relatively dry.
Name of the meteorological station: Buginyanya Zonal Agricultural Research and Development Institute - BugiZARDI

Slope
- flat (0-2%)
- 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- 501-1,000 m a.s.l.
- 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
- ✓ not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- ✓ on surface
- < 5 m
- 5-50 m
- > 50 m

Availability of surface water
- excess
- ✓ good
- medium
- poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- ✓ high
- medium
- low

Habitat diversity
- high
- medium
- ✓ low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- mixed (subsistence/ commercial
- ✓ commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ manual work
- animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- ✓ women
- ✓ men

Age
- ✓ children
- youth
- ✓ middle-aged
- elderly

Area used per household
- < 0.5 ha
- 0.5-1 ha
- 1-2 ha
- ✓ 2-5 ha

Scale
- ✓ small-scale
- medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

- [ ] 5-15 ha
- [ ] 15-50 ha
- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

- [x] individual, not titled
- [ ] individual, titled

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

Access to services and infrastructure

		1	2	3	
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

		1	2	3	4	5	6	7		
Crop production	decreased							✓	increased	Quantity before SLM: 800kg Quantity after SLM: 1200kg The land user uses the organic manure in his coffee plantation which has greatly led to increased yields.
crop quality	decreased							✓	increased	Bigger coffee beans
energy generation (e.g. hydro, bio)	decreased							✓	increased	Use of biogas for lighting and heating
expenses on agricultural inputs	increased							✓	decreased	No costs on purchase of fertilizer since the land user applies the bi-product (fermented manure) of the biogas.
farm income	decreased							✓	increased	Quantity before SLM: UGX 1040000 Quantity after SLM: UGX 1560000 More yields hence more incomes
workload	increased							✓	decreased	No more fetching firewood for cooking

Socio-cultural impacts

		1	2	3	4	5	6	7		
food security/ self-sufficiency	reduced							✓	improved	
health situation	worsened							✓	improved	Use of biogas reduces effects of smoke inhaled through the use of firewood hence reduced lung diseases.
SLM/ land degradation knowledge	reduced						✓		improved	Increased knowledge on the use of organic manure as a sustainability practice.
situation of socially and economically disadvantaged groups (gender, age, status, ehtnicity etc.)	worsened							✓	improved	Biogas use favours women and the disabled as it reduces the workload of fetching firewood especially from distant areas or forests.

Ecological impacts

		1	2	3	4	5	6	7		
soil moisture	decreased							✓	increased	The bi-product from the biogas plant is watery hence its used in the farm to moist the soil
soil cover	reduced							✓	improved	Use of biogas reduces tree cutting
nutrient cycling/ recharge	decreased							✓	increased	The bi- product removed from the digester at the end of the process is used as organic fertilizer
soil organic matter/ below ground C	decreased							✓	increased	Use of organic manure supports multiplication of organic matter in the soil

Off-site impacts

		1	2	3	4	5	6	7		
groundwater/ river pollution	increased						✓		reduced	The dung and urine from the animals is used as material in the biogas plant which would have been washed away by run off water into the river.
damage on neighbours' fields	increased						✓		reduced	The user doesn't have to encourage on the neighbours' land to fetch firewood since biogas is now used for heating.
impact of greenhouse gases	increased							✓	reduced	Reduced bad smells from the dung

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Short-term returns	very negative	✓ (2nd of 7)	very positive
Long-term returns	very negative	✓ (7th of 7)	very positive

Benefits compared with maintenance costs

Short-term returns	very negative	✓ (7th of 7)	very positive
Long-term returns	very negative	✓ (7th of 7)	very positive

No maintenance costs involved hence higher benefits.

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all	✓ (4th of 5)	very well	
seasonal rainfall decrease	not well at all	✓ (4th of 5)	very well	Season: wet/ rainy season

ADOPTION AND ADAPTATION

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

- [ ] single cases/ experimental
- [x] 1-10%
- [ ] 10-50%
- [ ] more than 50%

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

- [x] 0-10%
- [ ] 10-50%
- [ ] 50-90%
- [ ] 90-100%

Number of households and/ or area covered

10

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

- [ ] Yes
- [x] No

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

- It eases the workload by providing a safe and cheap source of fuel compared to firewood
- The bi- product at the end of the process is used as organic fertilizer that boosts crop production

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

- Biogas protects the environment through reduced deforestation hence climate change mitigation.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Inadequate dung → Collects dung from cattle owners in the area

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Safety issues especially on the side of children when it comes to the flammable gas → Continuous safety education measures to prevent fire out breaks

REFERENCES

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Nicole Harari (nicole.harari@cde.unibe.ch)

Date of documentation: Feb. 1, 2018

Last update: Nov. 13, 2019

Resource persons
Patrick Wodonya - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_3371/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- National Agricultural Research Organisation (NARO) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Links to relevant information which is available online

- Uganda Domestic Biogas Programme (UDBP): https://www.ngoaidmap.org/projects/3031
- Power for the Poor From Animal Manure, Food Waste: https://www.sierraclub.org/sierra/2018-1-january-february/faces-clean-energy/power-for-poor-animal-manure-food-waste

Dairy cattle feeding on fodder in the parlour (Amon Aine)

Dairy cattle fed with supplementary fodder (Uganda)

Ebinyasi bye ente

DESCRIPTION

Elephant grass (Pennisteum purpureum) and calliandra (Calliandra calothyrsus), are harvested and chopped using a chaff cutter to produce fodder for dairy cows. The chaff is then mixed with cotton seed cake, molasses and maize bran to improve palatability and nutrient quality for dairy cows. The cattle graze in paddocks during the day and receive the fodder at evening milking.

High quality fodder for livestock is made by mixing chaff of elephant grass (Pennisteum purpureum) and calliandra (Calliandra calothyrsus) with maize bran, cotton seed cake and molasses. These fodder pastures are grown on a 10 acre piece of land and harvested twice a week for chopping into chaff. For calliandra (a leguminous tree), leaves are harvested while elephant grass is cut at ground level. This vegetation is transported to the electric chaff cutter by tractor. At its best, the chaff is evenly cut, free of dust, of good colour and has a fresh aroma. The chaff is chopped into small pieces which allows for easy mixing with supplements. Chaff in Uganda can be produced on farm or purchased from commercial chaff cutting mills, which grow pastures and process them for sell to farmers during pasture scarcity in the long dry spells.
The farmer in Bushenyi District learnt the technology at a trade show. Today, he processes fodder for his 50 dairy cattle under an intensive system. His grazing/paddock land is about 20 hectares in total and is divided into 8 paddocks which are used in rotation. The cows graze for 8 hours daily. Every evening their diet is supplemented with the processed fodder in the milking parlour. The fields are allowed to mature at intervals to produce a continuous supply of grass for fodder throughout the growing season. The fodder processing procedure includes:
i) Cutting mature pasture grass at ground level and collecting the grass from the fields;
ii) Transportation of elephant grass and calliandrafrom the fields to the fodder shed;
iii) Offloading and sorting of pasture grass/ fodder into different classes of similar diameter and lengths for easy handling during chaff cutting;
iv) Chopping of pastures/ fodder into small pieces using the electric chaff cutter;
v) Mixing the chaffed fodder, cotton seed cake, molasses and maize bran to improve the palatability and nutrient quality of the chaffed fodder.
vi). Putting the processed fodder into troughs for cattle to feed on during milking.
Processing enough pasture grass into chaff for cattle feeding is described by the farmer to be a relatively expensive and a labour intensive process. The key expenses in establishing the system include costs of buying fodder (if not readily available on the farm), purchasing a chaff cutter and buying supplements. The farmer requires 0.5 tonnes of chaffed fodder mixed with supplements to feed 50 dairy cows on a daily basis. The main costs are labour, fodder supplements, the electric chaff cutter, tractor hire and daily operation costs.
The fodder cut into small pieces mixes easily with supplements to make a well nutrient balanced ration. This is palatable and encourages cattle to eat non-selectively and without spilling,hence minimizing wastage. The processed fodder is easy to store in bags and can be kept on wooden pallets raised off ground in a cool store. The farmer notes that the chaffed fodder can further be processed into hay or silage for storage to be fed to cattle during the seasons of pasture scarcity, especially the long dry spells of early June to late August and early December to late February. The system enables the farmer

LOCATION

Location: Bushenyi District, Kyamuhunga sub county, Uganda, Western Region, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 30.1243, 0.4024

Spread of the Technology: evenly spread over an area (approx. 0.1-1 km2)

In a permanently protected area?:

Date of implementation: 2016; less than 10 years ago (recently)

Type of introduction

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

to keep more productive animals on his land than he could using other feeding regimes: in other words this is an intensive system that maximizes production per unit area.

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

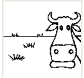
- [x] improve production
- [ ] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [x] reduce risk of disasters
- [x] adapt to climate change/ extremes and its impacts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

Land use

Cropland

- Annual cropping: fibre crops - cotton, fodder crops - other, cereals - maize, Pennisteum purpureum
- Tree and shrub cropping: fodder trees (Calliandra, Leucaena leucocephala, Prosopis, etc.)

Number of growing seasons per year: 2



Grazing land

- Cut-and-carry/ zero grazing
- Improved pastures

Animal type: cattle - dairy
Products and services: milk

Species	Count
cattle - dairy	50

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

physical soil deterioration - Pc: compaction, Pu: loss of bio-productive function due to other activities

biological degradation - Bc: reduction of vegetation cover, Bh: loss of habitats

other -

SLM group

- pastoralism and grazing land management
- integrated crop-livestock management
- improved plant varieties/ animal breeds

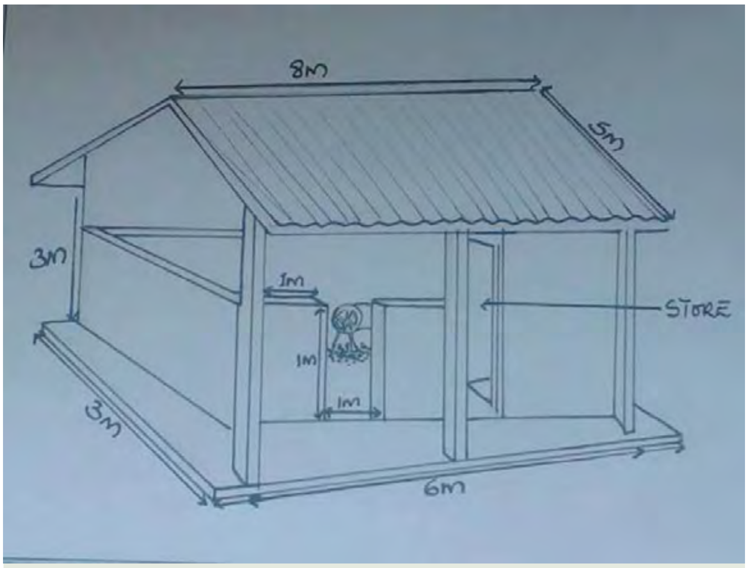
SLM measures

other measures

TECHNICAL DRAWING

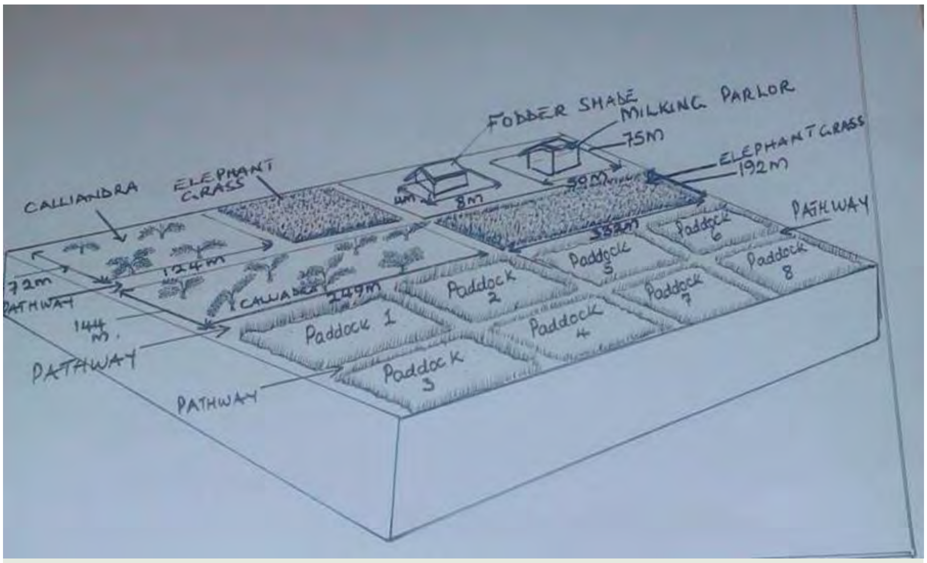
Technical specifications

The key requirements for the system are the fodder shed, chaff cutter and sources of pastures. The fodder shed of 3x6x6m was constructed close to the milking parlour for efficiency. A store of 2x2x2m for the chaff cutter and other equipment was constructed in one of the corners of the shed. Apart from the store, all other walls are constructed up to one meter height leaving two metres open to the roof for ventilation.



Author: Mrs Prosy Kaheru

None



Author: Mrs Prosy Kaheru

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area
- Currency used for cost calculation: **Uganda shillings**
- Exchange rate (to USD): 1 USD = 3638.0 Uganda shillings
- Average wage cost of hired labour per day: 10000

Most important factors affecting the costs

Establishing the fodder shade, purchasing the chaff cutter and daily operation costs.

Establishment activities

1. Clearing and Preparation of the garden. (Timing/ frequency: Best done at the end of the dry season.)
2. Planting of the desired improved pastures for fodder. (Timing/ frequency: At the start of the rain season.)
3. Construction of the fodder shed and store. (Timing/ frequency: Before the pastures are mature enough to start harvesting.)
4. Purchase and establishment of the chaff cutter. (Timing/ frequency: After establishment of the fodder shelter and store.)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (Uganda shillings)	Total costs per input (Uganda shillings)	% of costs borne by land users
Labour					
Labor	man/day	12.0	10000.0	120000.0	
Equipment					
Hoe	Pieces	2.0	15000.0	30000.0	
Panga	Pieces	1.0	5000.0	5000.0	
Hammer	pieces	1.0	5000.0	5000.0	
wheel burrow	Pieces	1.0	5000.0	5000.0	
Tractor hire	Hours	10.0	50000.0	500000.0	
chaff cutter	unit	1.0	1500000.0	1500000.0	
Construction material					
Metal rods	Pieces	4.0	20000.0	80000.0	
Cement	50kg bags	20.0	29000.0	580000.0	
Sand	Tonnes	2.5	70000.0	175000.0	
Bricks	Pieces	10000.0	150.0	1500000.0	
Timber	Pieces	20.0	5000.0	100000.0	
Iron sheets	Sheets	24.0	42000.0	1008000.0	
Gravel	Trips	1.0	75000.0	75000.0	
Total costs for establishment of the Technology				**5'683'000.0**	
Total costs for establishment of the Technology in USD				*1'562.12*	

Maintenance activities

1. Cutting and collecting of mature elephant grass (Pennisteum purpureum),and calliandra (Calliandra calothyrsus) to one point in the fields. (Timing/ frequency: each morning.)
2. Transportation of pasture grass to the fodder shed. (Timing/ frequency: After cutting.)
3. Offloading and sorting of pasture at the fodder shed. (Timing/ frequency: None)
4. Chopping of grass into small units using the electric chaff cutter. (Timing/ frequency: None)
5. Mixing the chaff with supplements. (Timing/ frequency: When the pastures are well chopped.)
6. Feeding the processed fodder in troughs. (Timing/ frequency: 30 minutes to milking time at dusk.)

Maintenance inputs and costs

Specify input	Unit	Quantity	Costs per Unit (Uganda shillings)	Total costs per input (Uganda shillings)	% of costs borne by land users
Labour					
Labor	Men/month	4.0	10000.0	40000.0	100.0
Equipment					
Panga					
Other					
Elephant grass (Pennisteum purpureum) and calliandra (Calliandracalothyrsus)	tonnes	0.5	100000.0	50000.0	100.0
Maize bran	tonnes	0.0625	88000.0	5500.0	100.0
Molasses	tonnes	0.13	173000.0	22490.0	100.0
Cotton seed cake	tonnes	0.0625	88000.0	5500.0	100.0
Total costs for maintenance of the Technology				**123'490.0**	
Total costs for maintenance of the Technology in USD				*33.94*	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [ ] 1,001-1,500 mm
- [x] 1,501-2,000 mm
- [ ] 2,001-3,000 mm
- [ ] 3,001-4,000 mm
- [ ] > 4,000 mm

Agro-climatic zone
- [x] humid
- [ ] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
March to May and Sept to Nov

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

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

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

Soil texture (topsoil)

- very shallow (0-20 cm)
- ✓ shallow (21-50 cm)
- moderately deep (51-80 cm)
- deep (81-120 cm)
- very deep (> 120 cm)

- coarse/ light (sandy)
- ✓ medium (loamy, silty)
- fine/ heavy (clay)

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Water quality refers to:

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- mixed (subsistence/ commercial)
- ✓ commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- average
- rich
- ✓ very rich

Level of mechanization
- manual work
- animal traction
- ✓ mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- women
- ✓ men

Age
- children
- youth
- middle-aged
- ✓ elderly

Area used per household
- < 0.5 ha
- 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
- medium-scale
- ✓ large-scale

Land ownership
- state
- company
- communal/ village
- group
- individual, not titled
- ✓ individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ 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

fodder production	decreased					✓		increased	
fodder quality	decreased					✓		increased	Supplements are added to chaffed fodder
animal production	decreased					✓		increased	The grazing cows are supplemented with fodder at milking in the evining
risk of production failure	increased					✓		decreased	Better quality and quantity pastures available for feeding livestock
expenses on agricultural inputs	increased				✓			decreased	
farm income	decreased					✓		increased	Increased milk production per cow
workload	increased	✓						decreased	Need to grow pasture grass and process them into chaffed supplemented fodder

Socio-cultural impacts

Ecological impacts

Impact	Scale start	Rating (✓ position)	Scale end	Comment
vegetation cover	decreased	5/7	increased	
biomass/ above ground C	decreased	2/7	increased	Cut and carry systems can drain the fields of nutrients if not replenished with fertilizer
beneficial species (predators, earthworms, pollinators)	decreased	6/7	increased	Calliandra and elephant grass
drought impacts	increased	6/7	decreased	It is possible to store and supplement livestock feed in the dry season if processed into hay
emission of carbon and greenhouse gases	increased	4/7	decreased	Pastures grown are carbon sinks

Off-site impacts

Impact	Scale start	Rating (✓ position)	Scale end	Comment
downstream siltation	increased	4/7	decreased	The pastures act as cover crops to regulate run off
damage on neighbours' fields	increased	5/7	reduced	Cattle have enough feed and therefore don't need to trespass onto neighbors' fields

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

Returns	Scale start	Rating (✓ position)	Scale end
Short-term returns	very negative	2/7	very positive
Long-term returns	very negative	6/7	very positive

Benefits compared with maintenance costs

Returns	Scale start	Rating (✓ position)	Scale end
Short-term returns	very negative	2/7	very positive
Long-term returns	very negative	6/7	very positive

CLIMATE CHANGE

Gradual climate change

Change	Scale start	Rating (✓ position)	Scale end	Comment
annual temperature decrease	not well at all	2/5	very well	
seasonal temperature increase	not well at all	3/5	very well	Season: dry season
annual rainfall decrease	not well at all	4/5	very well	
seasonal rainfall decrease	not well at all	4/5	very well	Season: wet/ rainy season

Climate-related extremes (disasters)

Extreme	Scale start	Rating (✓ position)	Scale end
local rainstorm	not well at all	4/5	very well
drought	not well at all	2/5	very well
landslide	not well at all	4/5	very well
epidemic diseases	not well at all	2/5	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?

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

Number of households and/ or area covered

1

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

- [ ] Yes
- [x] No

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

- The animals feed in the paddocks during the day and are supplemented with more palatable fodder at the milking parlor, to improve their diet.
- The nutrient quality of the fodder is supplemented to make a more balanced ration for the animals.
- Under this semi intensive farming system, more animals can be reared per unit area in contrast to a paddock-only system.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Expensive to maintain. Production of enough grass at one go and storage for use in the next few days → Production of enough pastures at ago and storing them for use in the next few days.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

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

- The farmer can further process the pastures into hay or silage for storage.
- The animals are not so much affected by pasture scarcities.
- There is chance to irrigate the pastures to cope with the long dry seasons.

- Need for labour for processing. Further mechanization of the process. → Further Mechanization of the process.

REFERENCES

Compiler
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Hanspeter Liniger
Donia Jendoubi
Brigitte Zimmermann

Date of documentation: Jan. 31, 2018

Last update: Aug. 22, 2019

Resource persons
- land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_3367/
Video: https://player.vimeo.com/video/261290691

Linked SLM data
Approaches: Fodder Crops Production https://qcat.wocat.net/en/wocat/approaches/view/approaches_2425/

Documentation was faciliated by
Institution
- National Agricultural Research Organisation (NARO) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

The photo shows barley fodder being grown on the trays in a shelter. (Babirye Sarah)

BARLEY FODDER MANAGEMENT FOR LIVESTOCK PRODUCTION AMONG SMALL HOLDER FARMERS (Uganda)

Balle

DESCRIPTION

Barley fodder technology is a livestock feed that grows under hydroponic system. This green feed is highly palatable, rich in protein and energy yet cost-effective. It takes few days to maturity (5-6 days) and can be grown in a smaller area.One kilogram of barley seeds can yield up to 6 to 6.5 kg of green feed.

Barley is a cereal grain that grows with hydroponic system to supplement on the feeds for livestock. This system enables crops to grow without soil so easily yet they mature within the shortest time in a smaller area. It is commonly used in the finishing rations. Barley sprouts the best, grows the fastest and is cost-effective. This green feed is less expensive yet highly palatable and nutritious for animals.
To work well for sprouted fodder, the barley seed needs a high germination rate. Sprouting barley consistently and economically needs a climate-controlled space, light (18 hours of light and 6 hours of darkness) and a watering system. The ideal temperature being 75 degrees F and 70% humidity. Air movement is necessary to control mold.
The technology ensures a reduction of pesticides and herbicides because the plants are in a protected environment .These sprouts are high in protein and fiber, and are naturally balanced in protein, fat and energy. Barley fodder has 95% of the energy and higher digestibility hence reducing the occurrence of digestive diseases, such as bloat. It is one of the most nutritious sprouts and is full of essential nutrients, vitamins and minerals. These are absorbed more efficiently due to the lack of enzyme inhibitors in sprouted grain. Dry barley seeds yields between 6-6.5kg of green feed. Feeding barley fodder will improve the overall health and wellbeing of animals. With this technology, farmers can easily anticipate the expected amount of feeds. Despite the benefits, growing barley requires skills, knowledge and constant supervision especially maintaining the conditions required. Barley seeds are at times hard to get. In case of commercial/large livestock farming, the technology is not economically feasible. Bacterial and fungal growth is also another challenge like the common bread mould therefore seeds must be sterilized.
Th Steps taken to grow barley seeds are as follows.
•On day 1, the barley seeds are laid on plastic trays after being soaked in water for 8-12 hours or an overnight. These seeds must be moist and kept clean. In case of any moulds, hydrogen peroxide may be used in the soaking water to kill mould.
•On day 2, the trays are placed on shelves where they are stacked. On this day, initial sprouting begins. Seeds must be kept moist, but not water-logged. Manually, water should be spread every after 4-5 hours. The seeds will usually sprout within 24 hours.
•On the third day, initial shooting begins. Watering still proceeds.
•From the 4-5th day, the root mat or the mat stem begin to grow.
•On the 6-7 the day, the farmers begins to harvest the barley grass and gives to the livestock. The grass has produced a 6-8 inch high grass mat with a 2 inch mat of interwoven roots. The sprouted grain is harvested by removing the tray or sliding the mat off the tray in one long sheet. The mats can be cut to the appropriate size and fed to animals. Livestock will eat the whole thing like seeds, roots, and grass therefore, there is minimal waste. Barley is a major feeding option when pastureland and/or hay are in short supply, or adds a highly nutritious and relished supplement to traditional grazing.

LOCATION

Location: Kyanja,Gayaza, KAMPALA, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.59331, 0.4015

Spread of the Technology: applied at specific points/ concentrated on a small area

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

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

Initial costs involved to a small scale farmer are minimal. This includes buying clean seeds, 5 kg costing 15,000/= 10 plastic trays (50000), 2 watering cans (20000), 1 bucket for soaking seeds (10000),watering seeds 6 times (18000), soaking seeds (3000),labour for making shelves (30000),Papyrus mat (20000) ,2 kg of nails (10000) , timber for making shelves (50000) ,chopping ready folder (3000) totalling to 232,000/= for a start. However, this depends on the amount of fodder a farmer wants to produce.
A kg of barley seeds yields to 7-10 kg of green fodder. Each kg of fodder is sold at 1500 hence in a kg planted, a farmer is likely to earn 15000/=
The technology is advantageous in that there is little or insignificant costs involved on maintenance of the technology. Maintenance only involves daily watering of seeds (18000/6 days), cleaning the treys after use (3000) and supervision on barley during growing for 6 days (18000) totaling to 39000/=.

The photo above explains the stages involved while growing barley grass.Source:(Growing Sprouted Fodder For Livestock by Jason Wiskerchen Monday, March 19, 2012 (Babirye Sarah)

CLASSIFICATION OF THE TECHNOLOGY

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

Land use

Other - Specify: Labaratory
Remarks: The demonstration was done at Kyanja National research Organization in a laboratory.

Water supply
- rainfed
- ✓ mixed rainfed-irrigated
- full irrigation

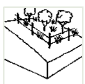
Number of growing seasons per year: n.a.
Land use before implementation of the Technology: n.a.
Livestock density: n.a.

Purpose related to land degradation
- prevent land degradation
- reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- ✓ not applicable

Degradation addressed

SLM group
- integrated crop-livestock management
- minimal soil disturbance

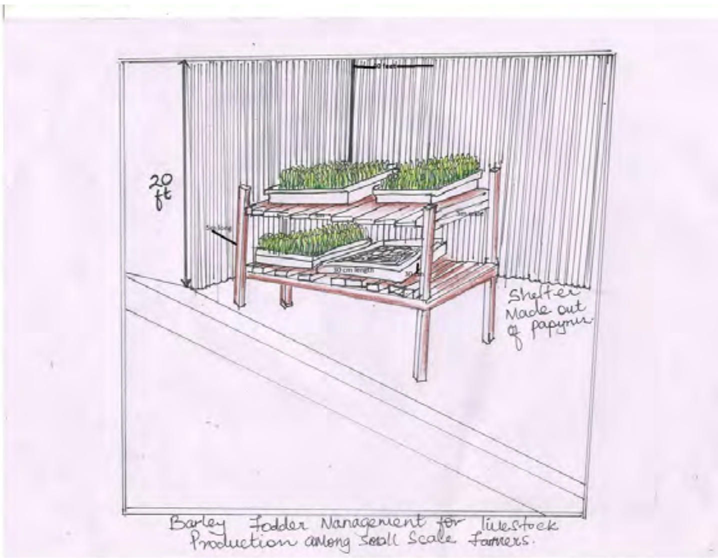
SLM measures


management measures - M2: Change of management/ intensity level

TECHNICAL DRAWING

Technical specifications

The shelter is constructed at 20 feet long and 20 feet wide
Trays(10) of 30cm wide and 30 cm length
Barley seeds(5kg)
Shelves (20) of 3m wide and 3m long
Papyrus mats (2) of 20feet wide and 40 feet long
Shelves stand of 5m long



Author: Prossy Kaheru

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology unit
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3600.0 UGX
- Average wage cost of hired labour per day: 3000/= per day

Most important factors affecting the costs
labour takes the most costs

Establishment activities
1. Buying seeds (Timing/ frequency: Every planting time)
2. Clean the seeds if dirty to avoid molds (Timing/ frequency: Before planting if they are dirty)
3. Soak the seeds for 8-12 hours (Timing/ frequency: 8-12 hours)
4. Place the trays on the shelves (Timing/ frequency: Once from 1-5 day)
5. Water the seeds planted on the tray every 4-8 hours (Timing/ frequency: 4-8 hours for 5 days after planting)
6. Harvest and chop the leaves,stems and roots,then give to the livestock (Timing/ frequency: After harvesting)

Establishment inputs and costs

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Making shelves	Man day	1.0	30000.0	30000.0	
Clean the seeds if they are dirty	Man day	1.0	3000.0	3000.0	
soaking the seeds into water	Man day	1.0	3000.0	3000.0	
Chop the fodder ready for feeding	Man day	1.0	3000.0	3000.0	
Equipment					
Water the seeds planted on the trey in every 4-8 hours	Man day	6.0	3000.0	18000.0	
Buying treys	piece	10.0	5000.0	50000.0	
Plant material					
Buying seeds	Kg	5.0	3000.0	15000.0	
Buying a watering can	piece	2.0	10000.0	20000.0	
Buying a bucket	piece	1.0	10000.0	10000.0	
Construction material					
Timber making shelves	piece	5.0	10000.0	50000.0	
Nails	Kg	2.0	5000.0	10000.0	
Papyrus mats	piece	2.0	10000.0	20000.0	
Total costs for establishment of the Technology				**232'000.0**	

Maintenance activities
1. Watering the seeds (Timing/ frequency: Every day after planting to harvest)
2. Maintaining the room temperature (Timing/ frequency: Every day after planting to harvest)
3. Replacing poles (Timing/ frequency: Once a year)
4. Cleaning the equipments like treys (Timing/ frequency: After harvesting)
5. Replacement of shelves (Timing/ frequency: Once a yeay)

Maintenance inputs and costs

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Watering seeds	Man day	6.0	3000.0	18000.0	
Cleaning the equipments(trays)	Man day	1.0	3000.0	3000.0	
Equipment					
Spervision of the growing barley	Man day	6.0	3000.0	18000.0	
Total costs for maintenance of the Technology				39'000.0	

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
n.a.

Slope
- flat (0-2%)
- 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- ✓ 501-1,000 m a.s.l.
- 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
- ✓ not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- ✓ < 5 m
- 5-50 m
- > 50 m

Availability of surface water
- excess
- ✓ good
- medium
- poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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- less than 10% of all income
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- Semi-nomadic
- Nomadic

Individuals or groups
- individual/ household
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- cooperative
- ✓ employee (company, government)

Gender
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- ✓ men

Age
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- ✓ youth
- middle-aged
- elderly

Area used per household
- < 0.5 ha
- ✓ 0.5-1 ha
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- 2-5 ha
- 5-15 ha
- 15-50 ha

Scale
- ✓ small-scale
- medium-scale
- large-scale

Land ownership
- ✓ state
- company
- communal/ village
- group
- individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- ✓ leased
- individual

Water use rights
- open access (unorganized)

- [ ] 50-100 ha
- [ ] 100-500 ha
- [ ] 500-1,000 ha
- [ ] 1,000-10,000 ha
- [ ] > 10,000 ha

- [ ] communal (organized)
- [x] leased
- [ ] 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

fodder quality	decreased							✓	increased	Improves on fodder for animals.ie 1 kg of barley yields 7-10 kg of green fodder
animal production	decreased							✓	increased	The animals that feed on barley supplements reduced suffering from bloating because of high digestibility
farm income	decreased							✓	increased	Barley grass is highly nutritious with a lot of protein content. Coupled with being palatable, the animals can grow first and sold off on time.

Socio-cultural impacts

health situation	worsened							✓	improved	The health situations of animals is improved. Barley fodder has 95% of the energy and higher digestibility hence reducing the occurrence of digestive diseases, such as bloat. It is one of the most nutritious sprouts and is full of essential nutrients, vitamins and minerals.

Ecological impacts

Off-site impacts

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

Climate-related extremes (disasters)

drought	not well at all	✓					very well
insect/ worm infestation	not well at all	✓					very well
Too high temperature	not well at all	✓					very well

ADOPTION AND ADAPTATION

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

- [ ] single cases/ experimental
- [ ] 1-10%
- [x] 10-50%
- [ ] more than 50%

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

- [ ] 0-10%
- [x] 10-50%
- [ ] 50-90%
- [ ] 90-100%

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

- [x] Yes
- [ ] No

It is operated in a moist, cool environment

To which changing conditions?

- [x] climatic change/ extremes

changing markets
labour availability (e.g. due to migration)

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- It is less cost effective yet highly nutritious. A Kg of Barley is nutritionally equivalent to 3Kg of other grass like the Lucerne.
- Barley grows in a very short period of time
- It requires a small piece of area to grow barley

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

- Barley improves the overall health and wellbeing of animals
- It has higher digestibility hence reduces on some diseases like bloat
- Barley growing does not involve the use of soil hence cost effective

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- The technology requires skills and knowledge especially to manage the conditions for growth → Encouraging farmers to train from model farmers
- Barley seeds are at times hard to get. → Promoting the barley seed multiplication in large quantities
- The technology requires maximum supervision → Always endeavor to do maximum supervision

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- Bacterial and fungal growth is also another challenge e.g the common bread mould. → Seeds must be sterilized
- Barley is not economically feasible for large scale farmers on pasture production → To grow more pastures in addition to barley as feed supplements
- It cannot be stored for a long period of time → Serve it in the first days after harvest.

REFERENCES

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Date of documentation: March 22, 2018

Last update: Aug. 2, 2019

Resource persons
Fred Kabanda - SLM specialist

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_3453/
Video: https://player.vimeo.com/video/261459679

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- National Agricultural Research Organisation (NARO) - Uganda

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Key references

- Growing Sprouted Fodder For Livestock by Jason Wiskerchen Monday, March 19, 2012,: https://www.peakprosperity.com/growing-sprouted-fodder-for-livestock-2/

Links to relevant information which is available online

- https://www.hydroponics-simplified.com/hydroponic-fodder-advantages.html: http://www.fodderconsultants.com/advantages.html

Soil and Water Conservation Practices

Maize (*Zea mays*) growing with contours

Fruit tree growing for restoration of degraded lands

(*Citrus spp*) orchard with grass mulch and trenches for soil and water conservation

Trenches for soil and water conservation under banana (*Musa spp*)

Conservation farming basins in annual crops for soil and water conservation

Maize field along contour lines. (Betty Adoch)

Maize (zea mays) growing with contours (Uganda)

Poto Anywagi idye Tule.

DESCRIPTION

Contour farming is a practice of ploughing and/or planting across a slope following its elevation contour lines. The contour lines create a water break which reduces rill and gully forms of soil erosion in case of heavy storms. The water break allows more time for more water to percolate/sink into the soil, thus reducing the amount of water left to run off the surface.

Improved Maize variety (Longe 10) is popularly grown in Northern Uganda due to its high yielding ability. Northern Uganda has a generally flat landscape although along the river banks it is slopy with high risk of soil erosion. This has motivated the land user to grow his maize along the slope using contour ploughing which is a sustainable land management practice. Contour farming is a practice of ploughing and/or planting across a slope following its elevation contour lines. The contour lines create a water break which reduces rill and gully forms of soil erosion in case of heavy storms. The water break allows more time for more water to percolate/sink into the soil, thus reducing the amount of water left to run off the surface. Northern Uganda has a tropical savanna climate with one growing season. Rainfall is usually moderate ranging from 1000-1500 mm per annum and sometimes occurs with heavy storms. Rainfall is received from April to November with a dry spell in June and July which affects crop growth.
The maize was grown for commercial purposes in a 25 x 25 acres of land on contour lines with the aim of controlling soil erosion, and increase plant nutrients, soil moisture, productivity and household income. The maize is planted along the contour lines at a spacing of 30 cm between the maize plants and of 1 meter between the rows that runs across the contour field. Holes for planting maize are dug at a depth of 30 cm along the contours with four maize seeds planted per hole and covered with soil immediately since the contours creates a water break which reduces the formation of rills and gullies during heavy water run-off which is a major cause of soil erosion.
The activities involved in establishing such a technology include clearing the field during the dry season in March and second ploughing in early April to alter the soil and allow proper decomposition of the grass and also creating contours during planting in early April at the onset of the rainy season. Weeding is done twice, first two weeks after maize germination in late April, and lastly in June.
Inputs needed to establish the technology include ox-plough, hoes, and pangas used to clear the field. Inputs for maintaining the technology include hoes for weeding the maize crop and also checking that the contours are not destroyed by the run-off.
The technology is liked because it is good at controlling soil erosion on the gently sloping field, increases plant nutrients and soil moisture, and increases productivity. But it is disadvantageous when contours collapse which is accelerating the speed of surface run-off.

LOCATION

Location: Gulu district, Northern Uganda., Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.3592, 2.9278

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

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

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use

Cropland - Annual cropping
Main crops (cash and food crops): maize

Water supply

- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Number of growing seasons per year: 1

Land use before implementation of the Technology: uncultivated land

Livestock density: n.a.

Purpose related to land degradation

- ✓ prevent land degradation
- ✓ reduce land degradation
- restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

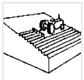
Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying

SLM group

- minimal soil disturbance
- integrated soil fertility management

SLM measures

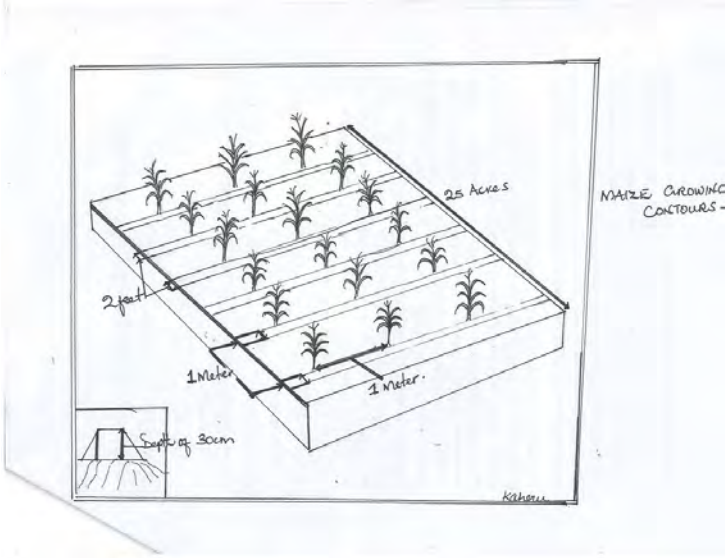


agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility, A3: Soil surface treatment, A5: Seed management, improved varieties

TECHNICAL DRAWING

Technical specifications

Contours are created on a gentle slope using ox-plough. Maize holes are dug at a depth of 30 cm and a spacing of 30 x 30 cm. The distance between the contours are 1 x 1 meter. The contours are helpful in improving infiltration rates and controlling soil erosion.



Author: Betty Adoch.

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: 25 acres)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = n.a UGX
- Average wage cost of hired labour per day: 5000 shs

Most important factors affecting the costs

High costs of weeding and thinning the crop.

Establishment activities

1. Clearing garden (Timing/ frequency: March)
2. Ox-ploughing to create contours (Timing/ frequency: April)
3. Planting (Timing/ frequency: April)
4. Weeding (Timing/ frequency: Late April)
5. Thinning (Timing/ frequency: Late April)

Establishment inputs and costs (per 25 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Clearing land	days	30.0	5000.0	150000.0	100.0
Ox-ploughing	days	5.0	40000.0	200000.0	100.0
Equipment					
Ox-plough	pices	5.0	20000.0	100000.0	100.0
Hoes for digging left over grass	pices	10.0	12000.0	120000.0	100.0
Pangas for cutting tress in the field	pices	10.0	12000.0	120000.0	100.0
Plant material					
Seedlings	kgs	150.0	6000.0	900000.0	100.0
Total costs for establishment of the Technology				**1'590'000.0**	

Maintenance activities

1. Weeding (Timing/ frequency: Late April)
2. Thinning (Timing/ frequency: Late April)

Maintenance inputs and costs (per 25 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Weeding	days	10.0	5000.0	50000.0	100.0
Thining	days	10.0	5000.0	50000.0	100.0
Total costs for maintenance of the Technology				**100'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall

- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [x] 751-1,000 mm

Agro-climatic zone

- [ ] humid
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate

Average annual rainfall in mm: 1000.0
Rainfall is heavy in the months of April, May, August, September and October. This facilitates crop growth.
Name of the meteorological station: Gulu weather station.

- 1,001-1,500 mm
- 1,501-2,000 mm
- 2,001-3,000 mm
- 3,001-4,000 mm
- > 4,000 mm

Tropical savanna climate

Slope
- ✓ flat (0-2%)
- 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- 501-1,000 m a.s.l.
- ✓ 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
- not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
- ✓ good
- medium
- poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- ✓ mixed (subsistence/ commercial
- commercial/ market

Off-farm income
- less than 10% of all income
- ✓ 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ manual work
- animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- ✓ women
- ✓ men

Age
- children
- youth
- ✓ middle-aged
- elderly

Area used per household
- ✓ < 0.5 ha
- 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
- ✓ medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- 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

Impact										Notes
Crop production	decreased							✓	increased	Quantity before SLM: low Quantity after SLM: high SLM knowledge gained
crop quality	decreased							✓	increased	Quantity before SLM: low Quantity after SLM: high SLM knowledge acquired
farm income	decreased							✓	increased	Quantity before SLM: low Quantity after SLM: high proper method of farming leading to increased yield and income through SLM knowledge

Socio-cultural impacts

Impact										Notes
food security/ self-sufficiency	reduced							✓	improved	Quantity before SLM: low Quantity after SLM: high knowledge of SLM leading to increased yield
SLM/ land degradation knowledge	reduced							✓	improved	Quantity before SLM: low Quantity after SLM: high proper method of farming along a gentle slope using contours

Ecological impacts

Impact										Notes
harvesting/ collection of water (runoff, dew, snow, etc)	reduced						✓		improved	Quantity before SLM: low Quantity after SLM: high water is collected in the trenches between the contours increasing the infiltration rates and leading to high moisture content in the soil.
surface runoff	increased							✓	decreased	Quantity before SLM: high Quantity after SLM: low the contours reduce the high rate of surface run-off.
soil moisture	decreased							✓	increased	Quantity before SLM: low Quantity after SLM: high high soil moisture due to high rate of infiltration along contour lines

Off-site impacts

Impact										Notes
downstream siltation	increased							✓	decreased	Quantity before SLM: high Quantity after SLM: low the low rate of soil erosion along the contours reduces sediment deposition downstream.

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	
annual rainfall decrease	not well at all			✓			very well	
seasonal rainfall decrease	not well at all			✓			very well	Season: wet/ rainy season

Climate-related extremes (disasters)

tropical storm	not well at all			✓			very well
heatwave	not well at all			✓			very well
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
- 1-10%
- ✓ 10-50%
- more than 50%

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

- 0-10%
- ✓ 10-50%
- 50-90%
- 90-100%

Number of households and/ or area covered

50

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

- ✓ Yes

improved maize variety longe 10

☐ No

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

- source of food
- source of income

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

- creates social interactions
- promote food security

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- drought prone → water harvesting within the garden
- take long to mature → adapt fast maturing maize variety

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- pests and diseases → weeding and spraying to be done

REFERENCES

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Date of documentation: June 14, 2017

Last update: July 16, 2019

Resource persons
Geoffrey Tabu - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2836/
Video: https://player.vimeo.com/video/254846721

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- Uganda Landcare Network (ULN) - Uganda

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Mangoes and oranges orchard for restoration of degraded lands (Rick Kamugisha)

Fruit tree growing for restoration of degraded lands (Uganda)

DESCRIPTION

Fruit trees of Mangoes (Mangifera indica) and Oranges (Citrus sinensis) are grown on degraded land to improve soil fertility through deep soil nutrient mining and litter of leaves.

Fruit tree growing, with focus on mangoes and oranges, is a rewarding investment promoted by farmers in Northern Uganda with the aim of increasing fruit production for home consumption and income, and restoration of degraded land. On a farm located on a steep slope and measuring 40m x 100m (i.e. 1 acre), the land user select and plant disease tolerant, high yielding and marketable orange varieties (e.g. Valencia and Anlin) and mango varieties (Apple and Tommy) using spades, hoes, and pangas to excavate and dig up planting holes, 30 cm deep, with fruit trees planted at a spacing of 10 m ×10 m, during the rainy season; with 7 Cows, 5 goats and 4 sheep kept animal manure provision to apply on the technology using hired labour and supported by family labour. After establishment, the farmer keeps on observing the changes over time to see what is taking place with regard to vegetation growth, performance of fruit trees and how the visible soil properties are changing e.g. the colour showing a black sign of organic matter built up and soil health improvement.
Oranges and mangoes are susceptible to pests and diseases, which require money to buy pesticides and paying, as well as for hired labour for spraying. The farmer needs to be aware of these associated costs, which are rather high after establishment. Efforts by the farmer to integrate trenches within the degraded field is an additional option for the farmer to help enhance soil and water conservation by reducing water runoff. This is labour and capital intensive but beneficial in the short and long run.

LOCATION

Location: Gulu District, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.3179, 2.69767

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

In a permanently protected area?:

Date of implementation: 2015; less than 10 years ago (recently)

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

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

Land use

Water supply

- ✓ rainfed
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation

- ✓ prevent land degradation
- reduce land degradation
- ✓ restore/ rehabilitate severely degraded land
- adapt to land degradation
- not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying

soil erosion by wind - Et: loss of topsoil, Ed: deflation and deposition

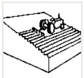
chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

biological degradation - Bc: reduction of vegetation cover, Bh: loss of habitats, Bq: quantity/ biomass decline, Bs: quality and species composition/ diversity decline

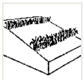
SLM group

- integrated crop-livestock management
- improved plant varieties/ animal breeds

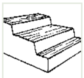
SLM measures



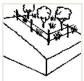
agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility, A5: Seed management, improved varieties



vegetative measures - V1: Tree and shrub cover



structural measures - S11: Others

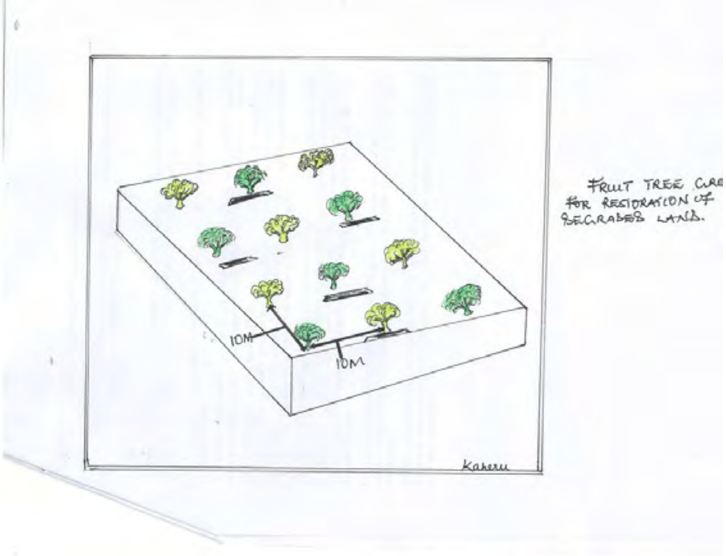


management measures - M1: Change of land use type, M2: Change of management/ intensity level, M3: Layout according to natural and human environment, M6: Waste management (recycling, re-use or reduce)

TECHNICAL DRAWING

Technical specifications

None



Author: Acen Constance

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: 0.5 acres)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3400.0 UGX
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs
Labour for planting , weeding and watering on monthly basis.

Establishment activities
1. Site selection/ degraded area (Timing/ frequency: Once before planting / during dry season)
2. Look for required labour and in puts (Timing/ frequency: Once before planting /during dry season)
3. Select nutrient fixing, high yiedling and marketable varieties (Timing/ frequency: Once before planting / during dry season)
4. Transport the varieties to the field (Timing/ frequency: On set of rains)
5. Diging the holes (Timing/ frequency: On set of rains)
6. Planting using labour (Timing/ frequency: During rainy season)
7. Watering in case of drought. (Timing/ frequency: During the dry season)

Establishment inputs and costs (per 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
persons days / monthly basis	Persons	5.0	150000.0	750000.0	1000.0
Equipment					
Hoe	Pieces	5.0	10000.0	50000.0	100.0
Pangas	Pieces	3.0	7000.0	21000.0	100.0
watering can	Pieces	2.0	5000.0	10000.0	100.0
Plant material					
Seedlings	kgs	1000.0	2500.0	2500000.0	100.0
Other					
Transport for seedlings	Lorry	2.0	100000.0	200000.0	
Total costs for establishment of the Technology				**3'531'000.0**	

Maintenance activities
1. Watering (Timing/ frequency: Daily, dry season)
2. Weeding (Timing/ frequency: Twice a year, wet and dry season)

Maintenance inputs and costs (per 0.5 acres)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Labour for watering (monthly)	persons	2.0	150000.0	300000.0	100.0
Labour for weeding (monthly)	persons	2.0	150000.0	300000.0	100.0
Total costs for maintenance of the Technology				**600'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall **Agro-climatic zone** **Specifications on climate**

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

- [ ] humid
- [x] sub-humid
- [ ] semi-arid
- [ ] arid

Average annual rainfall in mm: 1500.0
Two rainy and two dry seasons - Bimodal rainfall.

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

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

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [x] 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
- [x] convex situations
- [ ] concave situations
- [ ] not relevant

Soil depth
- [x] very shallow (0-20 cm)
- [ ] shallow (21-50 cm)
- [ ] 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
- [x] < 5 m
- [ ] 5-50 m
- [ ] > 50 m

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

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

Water quality refers to:

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

Habitat diversity
- [ ] high
- [ ] medium
- [x] 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
- [ ] 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
- [x] women
- [x] men

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

Area used per household
- [x] < 0.5 ha
- [ ] 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
- [x] small-scale
- [ ] 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
Security poor ✓ good

IMPACTS

Socio-economic impacts

Impact	Rating	Comment
Crop production	decreased ✓ increased	From the sale of fruits.
crop quality	decreased ✓ increased	Good due to litter / green leaves.
land management	hindered ✓ simplified	Use of fruit trees are good at restoring degraded areas.
expenses on agricultural inputs	increased ✓ decreased	Purchase of hoes, pangas and spades.
farm income	decreased ✓ increased	From the sale of fruits.
workload	increased ✓ decreased	Watering and weeding.

Socio-cultural impacts

Impact	Rating	Comment
SLM/ land degradation knowledge	reduced ✓ improved	Trainings on fruit farming and management by extension agents and fellow farmers.

Ecological impacts

Impact	Rating	Comment
soil moisture	decreased ✓ increased	Due to the grass covert that minimize the evapotranspiration.
soil cover	reduced ✓ improved	No cultivation/ allow grass to grow.
soil loss	increased ✓ decreased	Fruit trees stabilize the soils.
soil organic matter/ below ground C	decreased ✓ increased	Due to the mulch decomposition.
vegetation cover	decreased ✓ increased	Growing under the planted fruit trees.

Off-site impacts

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

Slightly Negative: More costs on labour and inputs. Very positive: Very positive returns in improving fertility due to leaves litter.

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: wet/ rainy season

Climate-related extremes (disasters)

insect/ worm infestation not well at all ✓ very well

ADOPTION AND ADAPTATION

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

- single cases/ experimental
- ✓ 1-10%
- 11-50%
- > 50%

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

- ✓ 0-10%
- 11-50%
- 51-90%
- 91-100%

Number of households and/ or area covered

5

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

- Yes

☑ No

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

- Appropriate for both small and large scale land users.
- Can be replicated and be promoted by other land users.
- Cost effective: Invest in more money at the establishment and earn more benefits (restoration of degraded areas, income, soil fertility improvement, employment and fruits for home consumption and sale).

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

- The technology is appreciated by the farmer and this is a sign of ownership - sustainability.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Very laborious (planting, wedding and watering). → Use family labour.
- Very expensive - buying seedlings and hire of labour. → Join savings groups that give loans at low interest rates (3%).
- Benefits are realized after a long period. → The land user can look for alternative sources of income to supplement the technology. Engage in selling seedlings as a business to those who may want to start establishing this technology.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

- No integration with other agroforestry trees for fodder yet as the land user has livestock. → The technology need to be integrated with agroforestry trees (callindra, Grivellea) for fodder since the land user has livestock.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Stephanie Jaquet
Renate Fleiner
Nicole Harari
Drake Mubiru
Donia Jendoubi

Date of documentation: June 11, 2017

Last update: March 13, 2019

Resource persons
Constance Acen - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2821/
Video: https://player.vimeo.com/video/323401183

Linked SLM data
n.a.

Documentation was faciliated by
Institution

- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)

Citrus orchard with grass and trenches for soil erosion control (Issa Aiga)

Citrus Orchard with Grass Mulch and Trenches for Soil Erosion Control (Uganda)

Poto mucungwa , magiumu kilum pi gengo kitete

DESCRIPTION

Integrating black spear grass (Heteropogon Contortus), elephant grass (Pennisetum Purpureum) and trenches into a Citrus orchard of Oranges (Citrus Sinensis) for soil and water erosion control.

Farmers in Northern Uganda with an average size of 0.5 acres of land or more grow Oranges (Valencia and Anlin) varieties planted with a spacing of 10 x10 m and integrate them with the use of locally obtained black spear grass and elephant grass on farm as mulching materials and trenches to slow down rainwater runoff while preserving soil moisture for increased production and household income. Citrus orchard of oranges (Citrus sinensis) with grass mulch and trenches is established on gently sloping land with grasses every year. The trenches are established within the citrus orchard for soil erosion control and environmental and water conservation.To establish this technology the land user will (1) identify an already planted Orchard of Oranges susceptible to soil and water erosion problems, (2) clear the grasses in the garden using a panga, (3) dig the trenches using a hoe, a spade and labour up to a depth of not more than 0.5 centimetres, (4) carry and lay the mulch to the garden using at least 3-4 workers per day with the grass mulch kept at a minimum distance of 20 centimetres away from the plant to allow for air circulation, (5) remove the sediments and re-apply them back to the field once the trenches are filled with the sediments. Mulched grass decomposes over time, improves fertility while trenches allow water harvesting and prevent soil and water erosion. However, the land user needs to be aware that trenches are labour intensive which could be the most expensive input, in addition to the cost of basic construction materials for digging trenches like a hoe, a panga and a spade which are in most cases bought once and used for a longer period of time. The benefits derived from this SLM technology are high in the long run as the technology is suitable for improving soil fertility and controlling soil erosion with the established grass mulch and trenches. Trenches and grass mulch retain water during heavy rains which is utilized by citrus during the dry season. The leaf litter from a citrus garden with minimum tillage when decomposed provides manure to enhance crop production generating increased income from the sale of fruits. However, this technology requires labour for planting, cutting the grass , watering and constructing the trenches which accounts for most of the costs. What is not liked about this technology is that the trenches are not easy to make and are labour-intensive.

LOCATION

Location: Gulu District, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 32.31759, 2.69736

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

In a permanently protected area?:

Date of implementation: 2011; less than 10 years ago (recently)

Type of introduction

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] 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

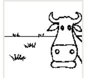
Land use

Land use mixed within the same land unit: Yes - Agroforestry

Cropland

- Tree and shrub cropping: citrus, Orchard of Oranges

Number of growing seasons per year: 2



Grazing land

Forest/ woodlands

Water supply

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

Purpose related to land degradation

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

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying

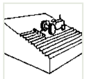
soil erosion by wind - Et: loss of topsoil

chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

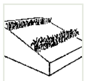
SLM group

- agroforestry
- integrated soil fertility management

SLM measures



agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility, A3: Soil surface treatment

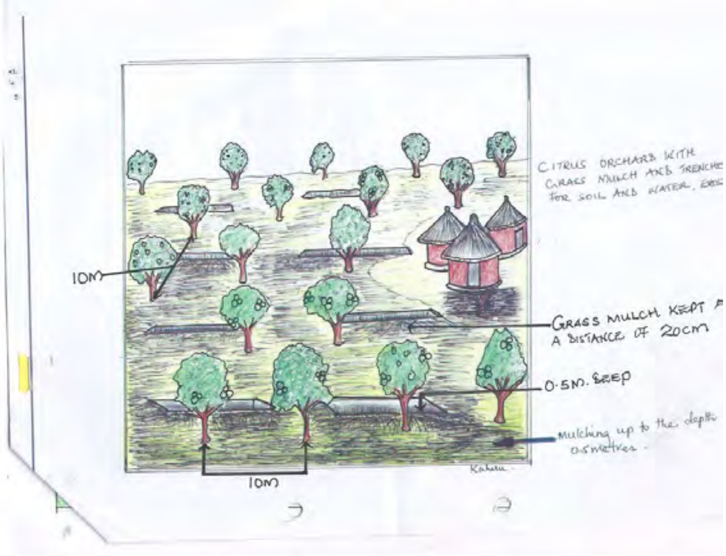


vegetative measures - V1: Tree and shrub cover

TECHNICAL DRAWING

Technical specifications

The vertical drawing only contains citrus fruits of oranges that are planted integrated with grass mulch and trenches for soil and water conservation. Mulching should be done up to a depth 0.5 cm with the mulch kept at a minimum of 20 cm away from the plant to allow for air circulation. Digging of the trench is done at a depth of 0.5 metres with the spacing of 10mx10m between the Orange trees.



Author: Proscovia Kaheru

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: 1 acre)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3400.0 UGX
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs
Labour for digging trenches , cutting and carrying grass is the most expensive input affecting the costs.

Establishment activities
1. Identify the citrus orchard with spear grass (Timing/ frequency: Once before before establishment)
2. Cut the spear grass (Timing/ frequency: Once before establishment)
3. Dig the trenches (Timing/ frequency: Once during establishment)
4. Carry the grass (Timing/ frequency: During establishment)
5. Lay the grass (Timing/ frequency: During establishment)

Establishment inputs and costs (per 1 acre)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Persons days hired per month	persons	10.0	7000.0	70000.0	100.0
Equipment					
Spades	Pieces	5.0	10000.0	50000.0	100.0
Hoe	Pieces	10.0	10000.0	100000.0	100.0
A -frame	Pieces	2.0	15000.0	30000.0	100.0
Panga	Pieces	4.0	7000.0	28000.0	100.0
Total costs for establishment of the Technology				**278'000.0**	
Total costs for establishment of the Technology in USD				*81.76*	

Maintenance activities
1. Removing soil in the trenches (Timing/ frequency: Every time the trench is re-filled with soil)

Maintenance inputs and costs (per 1 acre)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Persons days on ddaily basis	Persons	4.0	7000.0	28000.0	100.0
Total costs for maintenance of the Technology				**28'000.0**	
Total costs for maintenance of the Technology in USD				*8.24*	

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

Agro-climatic zone
- ☐ humid
- ☑ sub-humid
- ☐ semi-arid
- ☐ arid

Specifications on climate
Average annual rainfall in mm: 1350.0
The area experiences two rainy seasons per year, in March to April and in September to November, with a dry season around December to March.

- 2,001-3,000 mm
- 3,001-4,000 mm
- > 4,000 mm

Slope
- flat (0-2%)
- ✓ 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
- footslopes
- valley floors

Altitude
- 0-100 m a.s.l.
- 101-500 m a.s.l.
- 501-1,000 m a.s.l.
- 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
- not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Water quality refers to:

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- ✓ mixed (subsistence/ commercial)
- commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- poor
- ✓ average
- rich
- very rich

Level of mechanization
- ✓ manual work
- animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- ✓ groups/ community
- cooperative
- employee (company, government)

Gender
- ✓ women
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household
- ✓ < 0.5 ha
- 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
- medium-scale
- large-scale

Land ownership
- state
- company
- ✓ communal/ village
- group
- ✓ individual, not titled
- individual, titled

Land use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- ✓ individual

Access to services and infrastructure

	poor				good
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

Impact		Rating		Comment
land management	hindered	☐☐☐☐☐✓☐	simplified	The technology relies on use of locally obtained grass mulch within the field.
expenses on agricultural inputs	increased	☐☐✓☐☐☐☐	decreased	The technology requires inputs like hoes, pangas and spades which are not very expensive.
workload	increased	☐✓☐☐☐☐☐	decreased	Requires more labour for digging trenches and carrying grass mulch at the time of establishment.

Socio-cultural impacts

Impact		Rating		Comment
SLM/ land degradation knowledge	reduced	☐☐☐☐☐✓☐	improved	

Ecological impacts

Impact		Rating		Comment
harvesting/ collection of water (runoff, dew, snow, etc)	reduced	☐☐☐☐☐✓☐	improved	
surface runoff	increased	☐☐☐☐☐✓☐	decreased	Due to mulching grass and trenches
soil moisture	decreased	☐☐☐☐☐✓☐	increased	
soil cover	reduced	☐☐☐☐☐✓☐	improved	
soil loss	increased	☐☐☐☐☐✓☐	decreased	

Off-site impacts

Impact		Rating		Comment
water availability (groundwater, springs)	decreased	☐☐☐☐✓☐☐	increased	Retained by the trenches and grass much

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

		Rating	
Short-term returns	very negative	☐☐✓☐☐☐☐	very positive
Long-term returns	very negative	☐☐☐☐☐✓☐	very positive

Benefits compared with maintenance costs

		Rating	
Short-term returns	very negative	☐☐☐☐☐✓☐	very positive
Long-term returns	very negative	☐☐☐☐☐✓☐	very positive

In the short run, the costs of digging trenches and carrying grass are more than the benefits. Benefits include that mulched grass improves the soil fertility and trenches allow water harvesting and prevention of soil and water erosion. In the short term, the digging of trenches are the most expensive input.

CLIMATE CHANGE

Gradual climate change

		Rating		
annual temperature increase	not well at all	☐☐✓☐☐	very well	
annual rainfall increase	not well at all	☐☐☐✓☐	very well	
seasonal rainfall decrease	not well at all	☐☐✓☐☐	very well	Season: wet/ rainy season

Climate-related extremes (disasters)

		Rating	
drought	not well at all	☐☐✓☐☐	very well
epidemic diseases	not well at all	☐☐✓☐☐	very well

ADOPTION AND ADAPTATION

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

- ☐ single cases/ experimental
- ✓ 1-10%
- ☐ 11-50%
- ☐ > 50%

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

- ✓ 0-10%
- ☐ 11-50%
- ☐ 51-90%
- ☐ 91-100%

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

- ☐ Yes
- ✓ No

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

- The technology is replicable and can be promoted elsewhere by other land users (small and large scale land users).
- More benefits in terms of low labour requirements, soil fertility improvement and increased income from the sale of fruits in the long run. A reduction in labour requirements Implies low

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Labour intensive → Use of family or hired labour or even work in groups.

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

costs incurred to pay labour.
- Trenches and Grass mulch retain water during heavy rains which is utilized by citrus during the dry season. When the leaves of the citrus trees falls down, they decompose form manure that enhances citrus production.

Strengths: compiler's or other key resource person's view
- The technology is cost effective with high costs of investment at establishment but high benefits in the long run (increased income, soil erosion control and provision of fruits for home consumption and sale).

- The technology is very costly and not readily for small scale land users → Link land users to SACCO's where they can obtain credit at low interest rates.
- Very difficult for women to adopt when it comes to making trenches → Women can hire men to help or form joint working groups with men focusing on trench making as a business.

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Alexandra Gavilano
Renate Fleiner
Nicole Harari
Drake Mubiru

Date of documentation: June 12, 2017

Last update: Aug. 11, 2019

Resource persons
Alex w Oduor - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2826/

Linked SLM data
n.a.

Documentation was faciliated by
Institution
- Uganda Landcare Network (ULN) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)


Trenches for soil and water conservation under banana. (Issa Aiga)

Trenches for soil and water conservation under banana. (Uganda)

Baro kor pii

DESCRIPTION

Trenches commonly referred to as “fanny juu, fanya chini” increase water infiltration and reduce soil erosion.

Soil and water runoff is a major challenge encountered by farmers growing banana in Northern Uganda. As a remedy, farmers have started using trenches commonly referred to fanya juu, fanya chini. This is one of the technologies intended to help reduce soil and water runoff on cultivated and degraded land under banana in order to increase water infiltration and improve soil fertility.
The trenches are normally established during the dry season on small pieces of land of about 0.5 to 1 acre, with slopes ranging from 16 to 30% in areas with high rainfall. The trenches are measured, using a tape measure, 0.5 m deep and 50 m long banana planted at a spacing of 3 metres between plants to allow suckers to grow in addition to applying cow dung during maintenance which is locally obtained at no cost.
Implements and materials required to construct the trenches include ropes, spades, and hoes. Once the trenches have been constructed, natural grass can be allowed to grow or elephant grass planted on both sides of the trenches to stabilize the soils and reduce sediments falling into the trenches.
In this practice, the land user starts with identifying soil erosion hotspots within the banana plantation where the trenches are to be established. This is followed by looking for labour and money to pay for digging the trenches.
Trenches are effective in reducing soil and water runoffs under banana production immediately when it starts raining. It is worth to note that, the costs associated with paying labour for digging the trenches and buying inputs are higher during establishment compared to the costs of maintenance; this is because during maintenance the land user only needs to pay for labour to remove sediments from the trenches.
Establishing trenches under banana plantations requires the land user to be provided with prior knowledge and skills through training on the proper procedures on establishing the trench using the correct measurements of 0.5 m deep and 50 m long with banana planted at a spacing of 3 metres with the help of a tape measure, ropes, spades, and hoes and as required inputs.

LOCATION

Location: Gulu District, Northern Region,Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites

- 32.32131, 2.6992

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

In a permanently protected area?:

Date of implementation: 2015; less than 10 years ago (recently)

Type of introduction

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- ✓ improve production
- ✓ reduce, prevent, restore land degradation
- conserve ecosystem
- protect a watershed/ downstream areas – in combination with

Land use

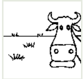
Cropland

- Annual cropping
- Perennial (non-woody) cropping: banana/plantain/abaca

229

other Technologies
preserve/ improve biodiversity
✓ reduce risk of disasters
adapt to climate change/ extremes and its impacts
mitigate climate change and its impacts
✓ create beneficial economic impact
create beneficial social impact

Number of growing seasons per year: 2



Grazing land

Other - Specify: Trenches

Water supply
✓ rainfed
mixed rainfed-irrigated
full irrigation

Purpose related to land degradation
✓ prevent land degradation
reduce land degradation
✓ restore/ rehabilitate severely degraded land
adapt to land degradation
not applicable

Degradation addressed

soil erosion by water - Wt: loss of topsoil/ surface erosion, Wg: gully erosion/ gullying, Wo: offsite degradation effects

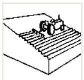
physical soil deterioration - Pw: waterlogging

biological degradation - Bc: reduction of vegetation cover

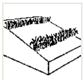
water degradation - Hw: reduction of the buffering capacity of wetland areas

SLM group
- integrated soil fertility management
- improved plant varieties/ animal breeds
- water harvesting

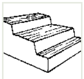
SLM measures



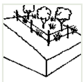
agronomic measures - A1: Vegetation/ soil cover, A2: Organic matter/ soil fertility, A5: Seed management, improved varieties



vegetative measures - V2: Grasses and perennial herbaceous plants



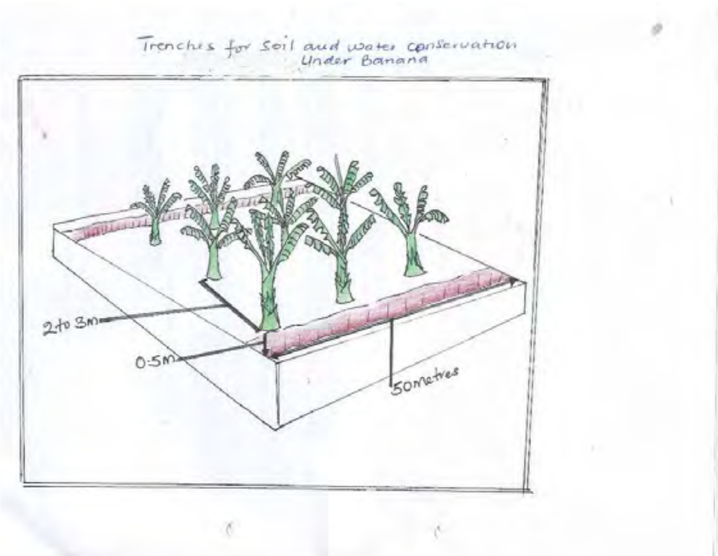
structural measures - S1: Terraces, S7: Water harvesting/ supply/ irrigation equipment



management measures - M1: Change of land use type, M2: Change of management/ intensity level

TECHNICAL DRAWING

Technical specifications
Trenches are normally established during the dry season on small pieces of land of about 0.5 to 1 acre, with slopes ranging from 16 to 30 % in areas with high rainfall. The trenches are measured using a tape measure, 0.5 m deep and 50 m long banana planted at a spacing of 3 metres between plants to allow suckers grow.



Author: Acen Kaven

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: **0.5 to 1 acre**)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3350.0 UGX

Most important factors affecting the costs
Labour for digging trenches, desilting and re-applying the silt in the garden.

- Average wage cost of hired labour per day: 5000

Establishment activities
1. Identify erosion hot spot area (Timing/ frequency: During the dry season/ after heavy rains)
2. Look for the tools and labour (Timing/ frequency: During the dry season)
3. Measure the size of trench (Timing/ frequency: During the dry season/ before rains set)
4. Dig the trench (Timing/ frequency: During the dry season/ before rains set)
5. Desilt when it fillsup with soil (Timing/ frequency: During the dry season/ after rains)

Establishment inputs and costs (per 0.5 to 1 acre)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Persons days	persons	10.0	5000.0	50000.0	100.0
Equipment					
Spade	Pieces		10000.0		100.0
Wheel barrow	Pieces		10000.0		100.0
Ropes	Pieces	1.0	3000.0	3000.0	100.0
Tape measure	pieces	1.0	25000.0	25000.0	
Total costs for establishment of the Technology				**78'000.0**	
Total costs for establishment of the Technology in USD				*23.28*	

Maintenance activities
1. Desiliting (Timing/ frequency: At least every year after heavy rains/ during dry season)

Maintenance inputs and costs (per 0.5 to 1 acre)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Labour	Persons	5.0	5000.0	25000.0	100.0
Fertilizers and biocides					
Fertiliser	Kgs	2.0	3500.0	7000.0	100.0
Biocides	litres	2.0	3500.0	7000.0	100.0
Total costs for maintenance of the Technology				**39'000.0**	
Total costs for maintenance of the Technology in USD				*11.64*	

NATURAL ENVIRONMENT

Average annual rainfall
- [ ] < 250 mm
- [ ] 251-500 mm
- [ ] 501-750 mm
- [ ] 751-1,000 mm
- [x] 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
- [x] humid
- [ ] sub-humid
- [ ] semi-arid
- [ ] arid

Specifications on climate
Average annual rainfall in mm: 1350.0
Two rainy season March -May and September to November.

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

Landforms
- [x] plateau/plains
- [ ] ridges
- [ ] mountain slopes
- [ ] hill slopes
- [ ] 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
- [x] concave situations
- [ ] not relevant

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

Soil texture (topsoil)
- [x] coarse/ light (sandy)
- [ ] 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
- [x] 5-50 m
- [ ] > 50 m

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

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

Water quality refers to:

Is salinity a problem?
- [ ] Yes
- [x] No

Occurrence of flooding
- [ ] Yes
- [x] No

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

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

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

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

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

Gender
- [ ] women
- [x] men

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

Area used per household
- [x] < 0.5 ha
- [ ] 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
- [x] small-scale
- [ ] medium-scale
- [ ] large-scale

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

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

Water use rights
- [x] open access (unorganized)
- [ ] communal (organized)
- [ ] leased
- [ ] 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	
land management	hindered							✓	simplified	
expenses on agricultural inputs	increased			✓					decreased	High at the time digging trenches but over a period of time reduces
farm income	decreased							✓	increased	From the sale of banana.
workload	increased							✓	decreased	More tasks at establishment and over a period of time reduces which affects labour costs.

Socio-cultural impacts

food security/ self-sufficiency	reduced					✓			improved	
SLM/ land degradation knowledge	reduced						✓		improved	Extension workers extend knowledge to the farmers and other farmers come to learn from other farmers promoting the technology.

Ecological impacts

soil cover	reduced						✓		improved	As a planted grasses (elephant grass) on the trench.
soil loss	increased							✓	decreased	Due to the presence of the trenches and grasses planted as stabilizers.
landslides/ debris flows	increased						✓		decreased	

Off-site impacts

water availability (groundwater, springs)	decreased						✓		increased	Water runoff is controlled by the trench.

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

More costs for labour and inputs for digging trenches at estsblishment than costs required for maintaing and desilting.

CLIMATE CHANGE

Gradual climate change

annual temperature increase	not well at all	☐☐✓☐☐	very well	
seasonal temperature decrease	not well at all	☐☐✓☐☐	very well	Season: wet/ rainy season

Climate-related extremes (disasters)

drought	not well at all	☐☐✓☐☐	very well
landslide	not well at all	☐☐✓☐☐	very well

ADOPTION AND ADAPTATION

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

- ☐ single cases/ experimental
- ✓ 1-10%
- ☐ 11-50%
- ☐ > 50%

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

- ☐ 0-10%
- ✓ 11-50%
- ☐ 51-90%
- ☐ 91-100%

Number of households and/ or area covered
Those who have adopted are those that are outiside the group as a resulting of copying from the group.

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

- ✓ Yes
- ☐ No

To which changing conditions?

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

By planting natural and elephant grass to reduce soil and water run off.

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- Good at reducing soil and water runoff.
- The costs of maintaining trenches in a banana plantation are rather low compared to the costs of estsblishment. Costs may be only high when it comes to weeding the banana.

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

- Trenches are effective in controlling soil erosion.

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- Labour intensive with high costs at estsblishment than maintenance. → Work in groups.
- Requires knowledge and skills which a farmer may not have at the time of establishment. → Consult extension agents to provide technical guidance.
  Provide trainings on proper procedures for estsblishment.

Weaknesses/ disadvantages/ risks: compiler’s or other key resource person’s view → how to overcome

- Trenches alone may not be a measure for reducing land degradation. → Plant agrofrestry trees (Callindra , Grivellea, and Elephant grass where trenches are established. Fodder).

REFERENCES

Compiler
Kamugisha Rick Nelson

Reviewer
Alexandra Gavilano
Stephanie Jaquet
Renate Fleiner
Nicole Harari
John Stephen Tenywa
Donia Jendoubi

Date of documentation: May 17, 2017

Last update: Aug. 11, 2019

Resource persons
Kaven Acen - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2274/
Video: https://player.vimeo.com/video/254983456

Linked SLM data
n.a.

Documentation was faciliated by

Institution

- CDE Centre for Development and Environment (CDE Centre for Development and Environment) - Switzerland

Project

- Scaling-up SLM practices by smallholder farmers (IFAD)


groundnuts planted in cf basins (Amale Balla Sunday)

Conservation Farming Basins in annual crops for Water conservation (Uganda)

tongo basin

DESCRIPTION

Basins are constructed in the field to act as water storage container. water is conserved within the basin and plants can survive with this conserved water during periods of little rainfall and dry spells.

Farmers in Northern Uganda are observing changes in weather patterns. Rainfall has become unpredictable and unreliable for sustainable farming, forcing farmers to adapt to these changes using available conservation farming technologies such as Conservation Farming (CF) Basins.
CF basins are water conservation structures constructed in the garden during dry seasons, stores the water during rainy seasons and ensure its availability for plants during periods of little or no rainfall. During construction of the basins, Plant residues in the field are slashed and retained within the garden. A CF hoe or common hoe is used to excavate holes of about 30cm long by 20cm wide, by 15cm deep. The Top soil is put on one side of the basin; while the subsoil is put on the other side. when the basin is ready, the top soil is put back to cover about half of the total basin depth. the spacing between basins depends on the type of crop to be planted. . For Groundnuts (Arachis hypogaea) its 30cmx30cm. The number of seeds per hole (seed rate) also depends on the crop. For maize, 3 plants per hole, groundnut-6-8 plants per hole, beans 6-8 plants per hole. The basin is now ready for planting at the onset of rains.
The basins are particularly important during critical growth periods such as germination, flowering and fruit set if sudden drought occurs. The basins conserve water, reduce surface runoff and support extended crop growth during dry seasons. After harvesting, crop residues are put back into the basin to decompose and add humus in to the soil. Farmers who practice this technology have reported healthy crop growth and reduced risk of crop failure with a harvest of 15 sac of groundnut per acre.
However, construction of CF basins is labor intensive because good basins can be constructed in the dry season when the soil is hard. This is challenge is outweighed by the fact that basins are constructed once every 3-4 years hence a positive gain in the long run.

LOCATION

Location: Nwoya district, Northern, Uganda

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites

- 32.00394, 2.63207
- 31.99963, 2.63519
- 31.88437, 2.53453

Spread of the Technology: applied at specific points/ concentrated on a small area

Date of implementation: 2016; less than 10 years ago (recently)

Type of introduction

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

CLASSIFICATION OF THE TECHNOLOGY

Main purpose

- [x] improve production
- [x] reduce, prevent, restore land degradation
- [ ] conserve ecosystem
- [ ] protect a watershed/ downstream areas – in combination with other Technologies
- [ ] preserve/ improve biodiversity
- [ ] 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
Main crops (cash and food crops): groundnut, beans, maize

Water supply

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

Number of growing seasons per year: 2
Land use before implementation of the Technology: n.a.
Livestock density: not relevant

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

soil erosion by water - Wt: loss of topsoil/ surface erosion

soil erosion by wind - Et: loss of topsoil

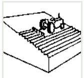
biological degradation - Bl: loss of soil life

water degradation - Hp: decline of surface water quality

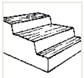
SLM group

- minimal soil disturbance
- water harvesting
- surface water management (spring, river, lakes, sea)

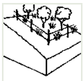
SLM measures



agronomic measures - A2: Organic matter/ soil fertility



structural measures - S11: Others

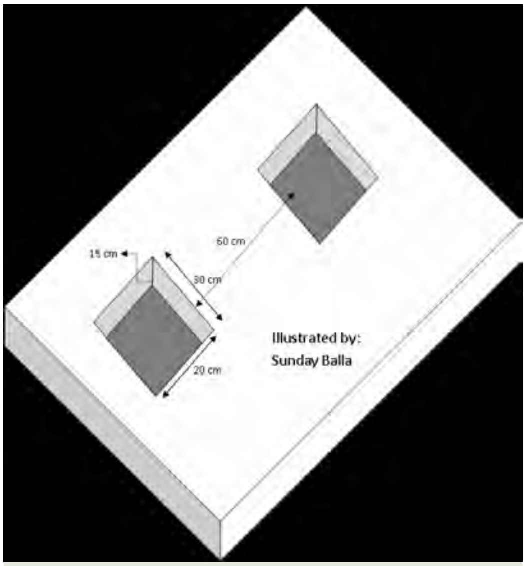


management measures - M2: Change of management/ intensity level

TECHNICAL DRAWING

Technical specifications

length of basin 30cm
width of basin 20cm
depth of basin 15cm
spacing between basins 30cm depending on crop
seed rate 6-8 plants per hole depending on the crop



Author: Sunday Balla

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs
- Costs are calculated: per Technology area (size and area unit: acre)
- Currency used for cost calculation: **uganda shillings**
- Exchange rate (to USD): 1 USD = 3600.0 uganda shillings
- Average wage cost of hired labour per day: 5000

Most important factors affecting the costs
labour for digging and un earthing the basins

Establishment activities
1. Slashing the field (clearence) (Timing/ frequency: dry season)
2. constructing basins (Timing/ frequency: dry season)
3. planting crops (Timing/ frequency: onset of rains)

Establishment inputs and costs (per acre)

Specify input	Unit	Quantity	Costs per Unit (uganda shillings)	Total costs per input (uganda shillings)	% of costs borne by land users
Labour					
personnel (slashing)	person days	15.0	5000.0	75000.0	100.0
personnel (construction of basins)	person days	30.0	3000.0	90000.0	100.0
personnel (planting)	person days	15.0	5000.0	75000.0	100.0
Equipment					
cf hoe	no	5.0	12000.0	60000.0	100.0
slashers	no	5.0	6000.0	30000.0	100.0
Plant material					
crop seed	kg	30.0	5000.0	150000.0	100.0
Total costs for establishment of the Technology				**480'000.0**	

Maintenance activities
1. un earthing filled holes (Timing/ frequency: dry season after 3 years of establishment'';)

Maintenance inputs and costs (per acre)

Specify input	Unit	Quantity	Costs per Unit (uganda shillings)	Total costs per input (uganda shillings)	% of costs borne by land users
Labour					
personnel	person days	15.0	3000.0	45000.0	100.0
Total costs for maintenance of the Technology				**45'000.0**	

NATURAL ENVIRONMENT

Average annual rainfall
- ☐ < 250 mm
- ☐ 251-500 mm
- ☐ 501-750 mm
- ☐ 751-1,000 mm
- ✓ 1,001-1,500 mm
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Agro-climatic zone
- ☐ humid
- ✓ sub-humid
- ☐ semi-arid
- ☐ arid

Specifications on climate
n.a.

- 2,001-3,000 mm
- 3,001-4,000 mm
- > 4,000 mm

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

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- hill slopes
- footslopes
- valley floors

Altitude
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- ✓ 1,001-1,500 m a.s.l.
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- 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
- ✓ not relevant

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

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

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

Topsoil organic matter content
- high (>3%)
- ✓ medium (1-3%)
- low (<1%)

Groundwater table
- on surface
- < 5 m
- ✓ 5-50 m
- > 50 m

Availability of surface water
- excess
- good
- ✓ medium
- poor/ none

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

Is salinity a problem?
- Yes
- ✓ No

Occurrence of flooding
- Yes
- ✓ No

Species diversity
- high
- ✓ medium
- low

Habitat diversity
- high
- ✓ medium
- low

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

Market orientation
- subsistence (self-supply)
- ✓ mixed (subsistence/ commercial
- commercial/ market

Off-farm income
- ✓ less than 10% of all income
- 10-50% of all income
- > 50% of all income

Relative level of wealth
- very poor
- ✓ poor
- average
- rich
- very rich

Level of mechanization
- ✓ manual work
- ✓ animal traction
- mechanized/ motorized

Sedentary or nomadic
- ✓ Sedentary
- Semi-nomadic
- Nomadic

Individuals or groups
- ✓ individual/ household
- groups/ community
- cooperative
- employee (company, government)

Gender
- ✓ women
- ✓ men

Age
- children
- ✓ youth
- ✓ middle-aged
- elderly

Area used per household
- < 0.5 ha
- ✓ 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
- medium-scale
- large-scale

Land ownership
- state
- company
- communal/ village
- group
- ✓ individual, not titled
- ✓ individual, titled

Land use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- ✓ individual

Water use rights
- open access (unorganized)
- ✓ communal (organized)
- leased
- individual

Access to services and infrastructure

	poor				good
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	
production area (new land under cultivation/ use)	decreased				✓				increased	
land management	hindered						✓		simplified	
demand for irrigation water	increased						✓		decreased	basins conserve water

Socio-cultural impacts

Ecological impacts

Off-site impacts

water availability (groundwater, springs)	decreased						✓		increased

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: wet/ rainy 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%
- [ ] 10-50%
- [ ] more than 50%

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

- [x] 0-10%
- [ ] 10-50%
- [ ] 50-90%
- [ ] 90-100%

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

- [x] Yes
- [ ] No

To which changing conditions?

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

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- constructed once every 3-4 years
- does not require technical skills or sophisticated equipment to construct the basins
- Reduced chances of crop failures due to droughts

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

- water storage efficiency is high
- plant roots can easily access water from the soil
- crop residues have additional functions to retain soil moisture

Weaknesses/ disadvantages/ risks: land user's view → how to overcome

- difficult to construct the basins → use CF hoe

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view → how to overcome

REFERENCES

Compiler
Sunday Balla Amale (sundayamale@gmail.com)

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Date of documentation: Dec. 6, 2017

Last update: Feb. 5, 2018

Resource persons
Sunday Balla Amale (sundayamale@gmail.com) - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_3307/

Linked SLM data
Approaches: Peer farmers as a village resource person for scaling Climate-Smart Agriculture (CSA) Practices
https://qcat.wocat.net/en/wocat/approaches/view/approaches_3323/

Documentation was faciliated by
Institution
- Makerere University (Makerere University) - Uganda

Project
- Scaling-up SLM practices by smallholder farmers (IFAD)

Demonstrations in Acholi Sub-Region including Adjumani

Decision Support Workshops for Selection of SLM Technologies

ULN, extension staff and NARO carried out participatory, multi-stakeholder decision support workshops with over 300 participants in the Acholi sub-region including Adjumani, using the documented SLM Technologies and Approaches presented in this collection. The aim of the workshops was to jointly identify and select promising SLM Technologies for implementation on demonstration sites. More information on the process is available here: http://www.ugacat.ug/slm-decision-support/.

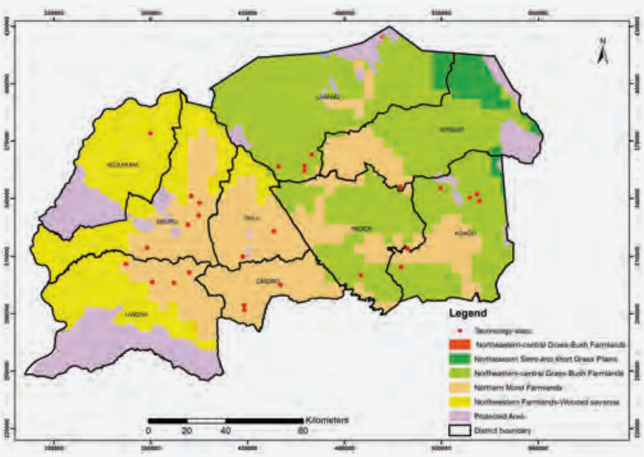
SLM Demonstrations with Champion farmers

Champion farmers were identified to host and manage demonstration sites. The following demonstration sites (see location map) were established by ULN, MAAIF and NARO:

No	Name of Demonstration	Village	District	Name of Demo Host
1	Compost / manure, beans (*Phaselous vulgaris*) with maize (*Zea mays*)	Pawidi	Kitgum	Mr and Mrs Oringa Banya Daniel Tutekeni farmers Group
2	Agroforestry (*Grevillea robusta*) with citrus fruit oranges (*Citrus sinensis*)	Balakwa	Kitgum	Mr and Mrs Okello Geoffrey
3	Intercrop cassava (*Manihota esculenta*) with beans (*Phaselous vulgaris*)	Balakwa	Kitgum	Mr and Mrs Obol David Odera
4	Cover crop with water melon (*Citrullus lanatus*)	Agwata	Lamwo	Mr and Mrs Ojok Denis
5	Apiary Kenya Top Bar (KTB)	Agwata	Lamwo	Mr and Mrs Abonga Simon
6	Intercrop cassava (*Manihota esculenta*) with soyabeans (*Glycine max*)	Pawena	Lamwo	Mr and Mrs Orach Patrick
7	Conservation basins with maize (*Zea mays*)	Bwobonam B	Nwoya	Mr and Mrs Banya Martin and Mrs Acan Grace
8	Compost / manure with beans (*Phaselous vulgaris*)	Lalar	Nwoya	Mr Ongaba William and Mrs Acan Betty
9	Mulching banana (*Musa spp*) with coffee (*Coffea*) with agroforestry	Bwobonan A	Nwoya	Mr and Mrs Ongai Andrew
10	Agroforestry with maize (*Zea mays*) with calliandra (*Calliandra calothyrs*)	Jurumini East	Adjumani	Mr Adrawa Kenyon and Mrs Jane Adrawa
11	Intercrop maize (*Zea mays*) with beans (*Phaselous vulgaris*)	Sodogo	Adjumani	Mr Ulego Zakio and Mrs Asianzo Perinna
12	Compost / manure	Elegu	Adjumani	Mr and Mrs Ojoadi Charles Wale
13	Agroforestry with beans (*Phaselous vulgaris*)	Loka Pet	Agago	Mr and Mrs Olwoch James
14	Intercrop maize (*Zea mays*) with beans (*Phaselous vulgaris*) with agroforestry	Kamonojui	Agago	Mr and Mrs Ocan Samwel
15	Apiary (local bee hives)	Akwang	Agago	Mr and Mrs Odola Phillip
16	Mulching of melon (*Citrullus lanatus*) and agroforestry	Ajanyi	Gulu	Mrs Abwono Hellen
17	Intercrop maize (*Zea mays*) with soya (*Glycine max*)	Ajanyi	Gulu	Mrs Angee Doreen
18	Compost / manure with mulching tomatoes (*Solanum*) with agroforestry	Oding	Gulu	Mr and Mrs Tabu Geoffrey
19	Intercrop beans (*Phaselous vulgaris*) with maize (*Zea mays*)	Lunyiri East	Pader	Mr and Mrs Oola Bongo
20	Agroforestry with soya bean (*Glycine max*)	Bolo Opet	Pader	Mr and Mrs Oryem Bosco
21	Conservation agriculture with beans (*Phaselous vulgaris*) and mulching	Tit Tit	Pader	Mr and Mrs Olanya Valentine Vicent
22	Mulched tomatoes hybrid (*Solanum spp*) with agroforestry	Kolo	Omoro	Mrs Constance Acen
23	Apiary	Pate	Omoro	Mr and Mrs Mwaka Abel
24	Conservation basins with beans (*Phaselous vulgaris*)	Twee lei	Omoro	Mrs Akidi Kala
25	Agroforestry with beans (*Phaselous vulgaris*)	Pericu	Amuru	Mr and Mrs Tabu Richard
26	Mulching bananas (*Musa acuminata*) with beans (*Phaselus vulgaris*)	Pakumu	Amuru	Mr and Mrs Nyeko Richard
27	Beans (*Phaselous vulgaris*) as a cover crop	Parubanga	Amuru	Mr and Mrs Ochieng Michael
28	Aquaculture	Palwong	Amuru	Mr and Mrs Okecokon Alex

Location of demonstration sites

(Mapped by Grace Nangendo)



Caption: Mulched Bananas in Amuru *(Photo by Issa Aligawesa)*

LESSONS LEARNED AND RECOMMENDATIONS

The documentation of SLM practices in Northern Uganda and beyond using the World Overview of Conservation Approaches and Technologies (WOCAT) methodology was a long protracted public and private partnership process characterised by enriching experiences and lots of lessons towards realizing Uganda's 2040 vision: "A Transformed Ugandan Society from a Peasant to a Modern and Prosperous Country" in line with global Sustainable Development Goals (SDGs). The outstanding synergy of key actors harmoniously working together can be mainly attributed to an enabling policy environment created by the Government of Uganda (GoU) exhibited at national and local government levels. The Ministry of Agriculture Animal Industries and Fisheries (MAAIF) as well as the Ministry of Local Government (MoLG) played catalytic roles in endorsing all activities, while linking them to government programmes for sustainability.

The Memorandum of Understanding (MoU) dated August, 2017 between MAAIF, Uganda Landcare Network (ULN) and WOCAT provided the legal framework and commitment of the government specifically towards capacity strengthening on Sustainable Land Management (SLM). This includes building and maintaining a national SLM database linked to the United Nations Convention to Combat Desertification (UNCCD) accredited WOCAT global SLM database. The National Agricultural Research Organization (NARO) as the host institution for the national SLM database was primarily motivated by the acquired expertise to document numerous good practices across the country. Consequently, the growing database of good practices from Uganda serves the planning, design and implementation of SLM projects across the country, presents learning opportunities from what has worked and is most applicable and relevant to national, regional and international projects.

The partnership with MoLG endorsed in August, 2016 facilitated close collaboration harnessing synergies while adding value to a government project for the Restoration of Livelihoods in Northern Uganda (PRELNOR). The documentation process conspicuously received interest and ownership across local government structures at district, sub-county, parish and village level.

Overall, the process benefited substantially from several strategic and hands on timely capacity building efforts. This resulted in a buy in from local government leadership at the inception of the project, delineating and mapping land degradation hotspots and identifying promising good SLM practices, getting familiar with and perfecting documentation using the rather demanding WOCAT questionnaire, compiling information on-line and finally assuring data quality in cooperation with the WOCAT secretariat. The online process, however, demanded internet connection, which was unfortunately erratic across the project sites. This challenge necessitated creating a documentation hub at ULN office in Kampala, which turned out to have multiple benefits including great coordination, team coherence, better time management and promptness in terms of schedules and response to review comments.

The database and catalogue at hand are a great success story showcasing how resilience can be built among small scale farmers in Northern Uganda and beyond while providing pace making arrangements for scaling up SLM to a wider geographical area with many people involved. Against a background of GoU endorsement, scaling is a reality albeit requiring thorough coordination and adequate resources that are embedded in partnership ventures. WOCAT technical backstopping in terms of data quality assurance and value addition is indispensable. The opportunity of digitizing entire documentation processes goes a long way to improve and shorten the process for better results. Capacity strengthening cannot be underestimated. It is the only way for learning, sharing, networking, updating procedures, building datasets and using the compiled and acquired knowledge for evidence-based decision making at all levels. Therefore, ULN remains committed towards steering the SLM documenting process as well as mobilizing coalition of grassroots institutions, extension agents, research and development partners as well as the private sector towards wide adoption of practices across landscapes.

ACRONYMS

As	Approaches
CDE	Centre for Development and Environment
CSA	Climate Smart Agriculture
GoU	Government of Uganda
IFAD	International Fund for Agricultural Development
KTB	Kenya Top Bar
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
MoLG	Ministry of Local Government
MoU	Memorandum of Understanding
NARO	National Agricultural Research Organization
NEG	National Expert Group
NEMA	National Environment Management Authority
PRELNOR	Programme for the Restoration of Livelihoods in the Northern Region
SDG	Sustainable Development Goals
SF	Soil Fertility
SLM	Sustainable Land Management
SWC	Soil and Water Conservation
ToT	Training of Trainers
Ts	Technologies
UFAAS	Uganda Forum for Agricultural Advisory Services
ULN	Uganda Land Landcare Network
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
WOCAT	World Overview of Conservation Approaches and Technologies


(Photo by Issa Aligawesa)

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