Photo showing Taungya Agroforestry system (citrus,maize and cassava) with dranaige channels in Amuru District, Northern Uganda (Jalia Namakula)

Taungya Agroforestry System for Increased Production, Food Security, Soil Fertility and Household Income (Uganda)

DESCRIPTION

Taungya agro-forestry system (citrus,maize and cassava) involves the planting of crops in young tree plantations. The food crops are normally planted with trees to provide shade for the young seedlings especially during the dry season; the crop litter acts as mulch and compost after decomposition thereby regulating soil temperature, and improving soil moisture retention.

The Taungya Agroforestry farming practice is promoted in Northern Uganda that allows farmers to cultivate food crops in young tree plantations for increased production, food security, soil fertility improvement and household income. The practice was started in Malaysia in 1896 and because of the increase in average annual temperatures in Uganda, it is gradually gaining momentum in Uganda.

This technology was established on 1.6 ha of land out of 10 ha owned by the farmer. It lies on a gentle slope and stretched to the wetland. On one field citrus (citrus sinensis) was planted as the major crop the other crops grown include; maize (zea mays) local variety and cassava an improved variety (manihot esculenta) NASE14.

The citrus is grown for purely commercial purposes, the maize and cassava grown for food security and also provides shade for the young citrus trees especially during the dry season.

Establishing the system involved bush clearing and ox ploughing. Digging planting holes, applying manure and drainage channels dug after the seedlings had firmly established.

The citrus seedlings were planted in 90 cm × 90 cm × 45 cm (width × length × depth) planting holes, excavated to conserve soil moisture during prolonged dry spells. The citrus spacing was 8 m × 8 m.

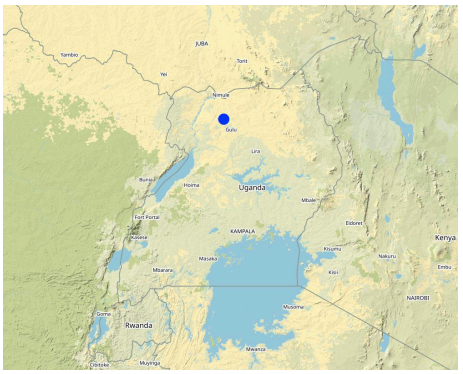
Within the citrus field, 30cm × 30 m mini drainage channels were made to drain excess water during the rainy season. The cassava was planted at 1 m × 1 m between the spaces of the citrus seedlings and then the maize was staggered within the field. Approximately 500 citrus seedlings were planted within the 1.6 ha.

In Taungya systems, the annual crops provide shade for the young trees and generate leaf litter which acts as mulch for moisture conservation and also enhances soil fertility. Taungya systems also increase household income because they allow crop diversification within the same field. The drainage channels reduce flood incidences on the field.

The system has a few challenges, for example during harvesting of cassava the citrus roots can be damaged, which affects their performance.

Establishing the drainage channels was labor intensive, thus the channels fall short of the recommended 60 cm recommended width.

LOCATION



Location: Pabbo Sub county , Amuru Districts, Northern Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 32.12677, 3.01642

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

Date of implementation: 2016

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

Photo showing agro forestry system , and drainage channels in Amuru District, Northern Uganda. (Jalia Namakula)

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
- [ ] 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 - Annual cropping, Perennial (non-woody) cropping
Main crops (cash and food crops): Cassava, Bananas, Citrus and Maize

Water supply

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

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

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 - Pw: waterlogging

biological degradation - Bc: reduction of vegetation cover

SLM group

- agroforestry
- water diversion and drainage

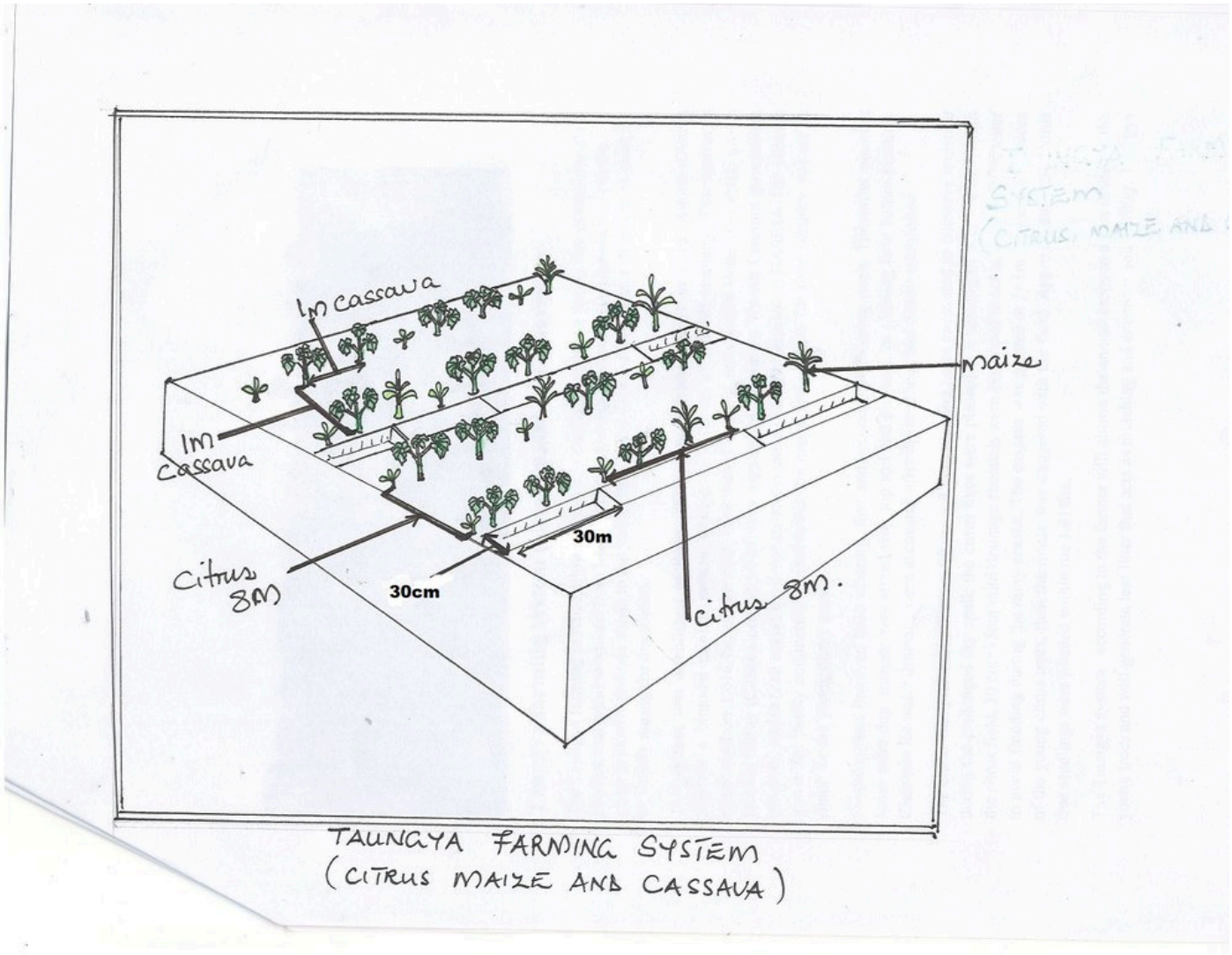
SLM measures

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

structural measures - S3: Graded ditches, channels, waterways

TECHNICAL DRAWING

Technical specifications



Author: Prossy Kaheru
The citrus was planted in a planting hole of, width(75cm), length(75cm), depth (30cm) at a spacing 3×3m. The cassava is an improved NARO (National Agricultural Research Organisation) NASE14 planted at a spacing of 1m×1m. The maize, a local variety was planted staggeringly in the field. The drainage channels are narrow and measured at 30cm(width)×15cm(depth)×30m(length).

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1.6 ha**)
- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3650.0 UGX
- Average wage cost of hired labour per day: 3000/=

Most important factors affecting the costs

Availability of labour

Establishment activities

1. Bush clearing (Timing/ frequency: July 2016)
2. Ploughing (Timing/ frequency: August 2016)
3. Digging planting basins (Timing/ frequency: August 2016)
4. Manure application (Timing/ frequency: September 2016)
5. Planting (Timing/ frequency: September 2016)
6. Digging planting basins (Timing/ frequency: September 2016)
7. Digging trenches (Timing/ frequency: April 2017)

Establishment inputs and costs (per 1.6 ha)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Bush clearing	people	5.0	75000.0	375000.0	100.0
Digging trenches	people	5.0	20000.0	100000.0	100.0
Ploughing	people	4.0	100000.0	400000.0	100.0
Diging basins	people	550.0	1000.0	550000.0	100.0
Equipment					
Planting	holes	550.0	500.0	275000.0	100.0
Plant material					

Citrus	plants	550.0	3000.0	1650000.0	
Cassava	bag	8.0	20000.0	160000.0	
Fertilizers and biocides					
Manure	bag	20.0	5000.0	100000.0	
Other					
Transport		10.0	60000.0	600000.0	100.0
Total costs for establishment of the Technology				**4'210'000.0**	

Maintenance activities
1. Weeding (Timing/ frequency: twice/season)
2. Spraying with fungicide (Timing/ frequency: once/month)

Maintenance inputs and costs (per 1.6 ha)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Weeding	acres	4.0	80000.0	320000.0	100.0
Spraying	acres	4.0	20000.0	80000.0	100.0
Equipment					
Spray pump	piece	1.0	120000.0	120000.0	100.0
Fertilizers and biocides					
Pesticides	Litres	1.0	20000.0	20000.0	100.0
Total costs for maintenance of the Technology				**540'000.0**	

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
Average annual rainfall in mm: 1813.0
The rainfall on set for the year 2017 started late i.e. in April instead of March
Name of the meteorological station: Gulu Meteorology Station

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.
- [ ] 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%)
- [x] medium (1-3%)
- [ ] low (<1%)

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

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

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

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

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

CHARACTERISTICS OF LAND USERS APPLYING THE TECHNOLOGY

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

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

Relative level of wealth
- [ ] very poor
- [ ] poor

Level of mechanization
- [x] manual work
- [ ] animal traction

- [ ] commercial/ market
- [ ] > 50% of all income
- [ ] average
- [x] rich
- [ ] very rich
- [ ] 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
- [x] < 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
- [ ] individual, not titled
- [ ] individual, titled
- [x] customary

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

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

risk of production failure

increased — decreased

The food crops provide shade to the young seedlings therefore reducing seedling growth failure.

expenses on agricultural inputs

increased — decreased

Because litter from the crops grown maintainces soil moisture and shade reduces soil temperatures, the need for the farmer to regularly irrigate the citrus seedling during the dry season reduces.

diversity of income sources

decreased — increased

The farmer expects to get multiple incomes from selling the citrus fruits and cassava

Socio-cultural impacts

food security/ self-sufficiency

reduced — improved

From the same piece of land, maize and cassava are available for food.

Ecological impacts

excess water drainage

reduced — improved

The channels drain excess water during the rainy season.

plant diversity

decreased — increased

Plant diversity is high because of mixed cropping (Cassava, Maize and Citrus)

Off-site impacts

downstream flooding (undesired)

increased — reduced

Water that comes from the garden is diverted into neighbours fields

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

It is only the maize that matures first therefore in the short term establishment costs are negative. Cassava and citrus are long term crops therefore benefits are realized much later.

CLIMATE CHANGE

Gradual climate change

annual temperature increase not well at all ✓ very well

annual rainfall decrease 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%
- [ ] 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%
- [x] 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

- The kind of ago-forestry improves food security
- There is an increase in incomes from the sale of crops
- The technology is good at reducing soil erosion.

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

- The technology encourages optimal utilisation of land
- Reduction of water logging

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

- Citrus takes long to mature Inter-crop with annuals

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

- Costly in terms of purchase of different seed varieties Join farmers associations for agricultural loan to pay after harvest and sale.
- If the cassava is not properly spaced it can interfere with root movement Plant the trees away from drainage channel

REFERENCES

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Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2830/
Video: https://player.vimeo.com/video/254848790

Linked SLM data
n.a.

Documentation was faciliated by

Institution
- n.a.

Project
- n.a.

Links to relevant information which is available online
- Evaluation of agroforestry systems for maize (Zea mays) productivity in South Africa: https://www.tandfonline.com/doi/abs/10.1080/02571862.2018.1459898