Photo showing Coffee, Banana inter-cropped with Onions (Irene Babirye)

Mixed Cropping of Coffee, Banana and Onions for Increased Production, Food Security and Household Income (Uganda)

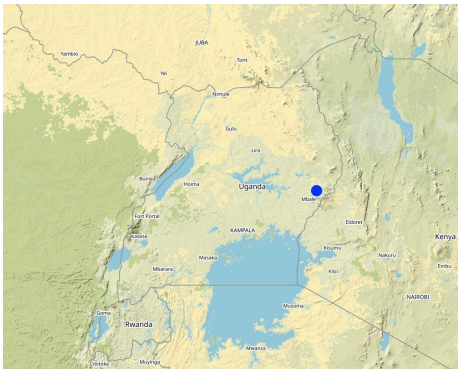
Okulima emwanyi, matooke n'obutugulu

DESCRIPTION

Mixed Cropping of coffee (Coffea Canephora) , banana (Musa) and onions (Allium cepa) is a sustainable traditional land management practice that involves the growing of two or more crops (coffee, banana and onions) at the same time on the same field by smallholder farmers for increased production, food security and household income.

Coffee, banana and onions mixed cropping; is a traditional practice promoted by smallholder farmers in Uganda established in Bulambuli district, Kibande Sub-county, Kimameli village. The area experiences two growing seasons per year; April up to July and September up to December with rainfall ranging from 1, 0001 mm-1,500 mm on 3.4 ha of land located on a gentle sloping area. The aim of this technology is increasing food production, household income , soil fertility improvement , maximizing crop production in a context of population pressure and declining arable land size.
Banana (Musa) and coffee (Coffea Canephora) plantations were established in 2016 followed by onions (Allium cepa) later in August 2017 with Coffee (Coffea robusta) planted at a spacing of 10 feet apart from Coffee to avoid competition for soil nutrients. Using hoes, pangas, coffee and onion seedlings, banana suckers were inter cropped at the ratio of 1 banana to 4 coffee trees on a 3.4 ha. Coffee trees were pruned initially to create room for the banana plants during their establishment. When coffee and banana were planted simultaneously in the field, onions were grown in between them for one year to provide some income before the banana and coffee were ready for harvesting. To establish such a technology the farmer accomplished the following activities: 1.preparing the garden (labor time: four days with three people), 2.Manure application where compost manure was mixed with soil (labor time: one day by three people), 3. Planting (three days by three people for all the crops), 4.Pruning where relevant adjustments were done regularly to the system (e.g. mature coffee trees are pruned to create space for onions to grow is done every three days by one person), and 5. Weeding since inter cropping requires weeding which should be done manually and not with a hoe because it may accidentally damage the roots of the coffee plant.
What is liked about this technology is that its very good according to the farmer's experience. It is applied on a small piece of land and it incorporates many crops which helps to improve soil fertility, increase crop yield which generates more income and food for consumption. There is also good utilization of labor as a farmer will work on all the crops simultaneously. The farmer testified that bananas provide shade, mulch, nutrients and moisture to young coffee trees. These beneficial effects may particularly be relevant to increase the resilience of the coffee production systems when temperature increases and rainfall becomes more erratic due to climate change. On the other hand coffee being a perennial crop, it requires high levels of initial investment (i.e. labor and capital) with a 10 - 15 years time horizon. The extended time period before realization of economic benefits usually discourages land users from adopting coffee inter cropping with other crops. Also, coffee creates shade which does not favor the growth of maize, beans and tomatoes in the same land, hence there's competition between the crops for nutrients.

LOCATION



Location: Kikameli village, Kibande sub-county, Bulambuli District, Eastern Region, Uganda

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
- 34.36704, 1.27509

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

Date of implementation: 2017

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
- [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

Cropland - Annual cropping, Perennial (non-woody) cropping
Main crops (cash and food crops): Coffee, Banana and Onions

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

- [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

soil erosion by wind - Et: loss of topsoil

biological degradation - Bq: quantity/ biomass decline, Bp: increase of pests/ diseases, loss of predators

SLM group

- integrated soil fertility management
- integrated pest and disease management (incl. organic agriculture)
- home gardens

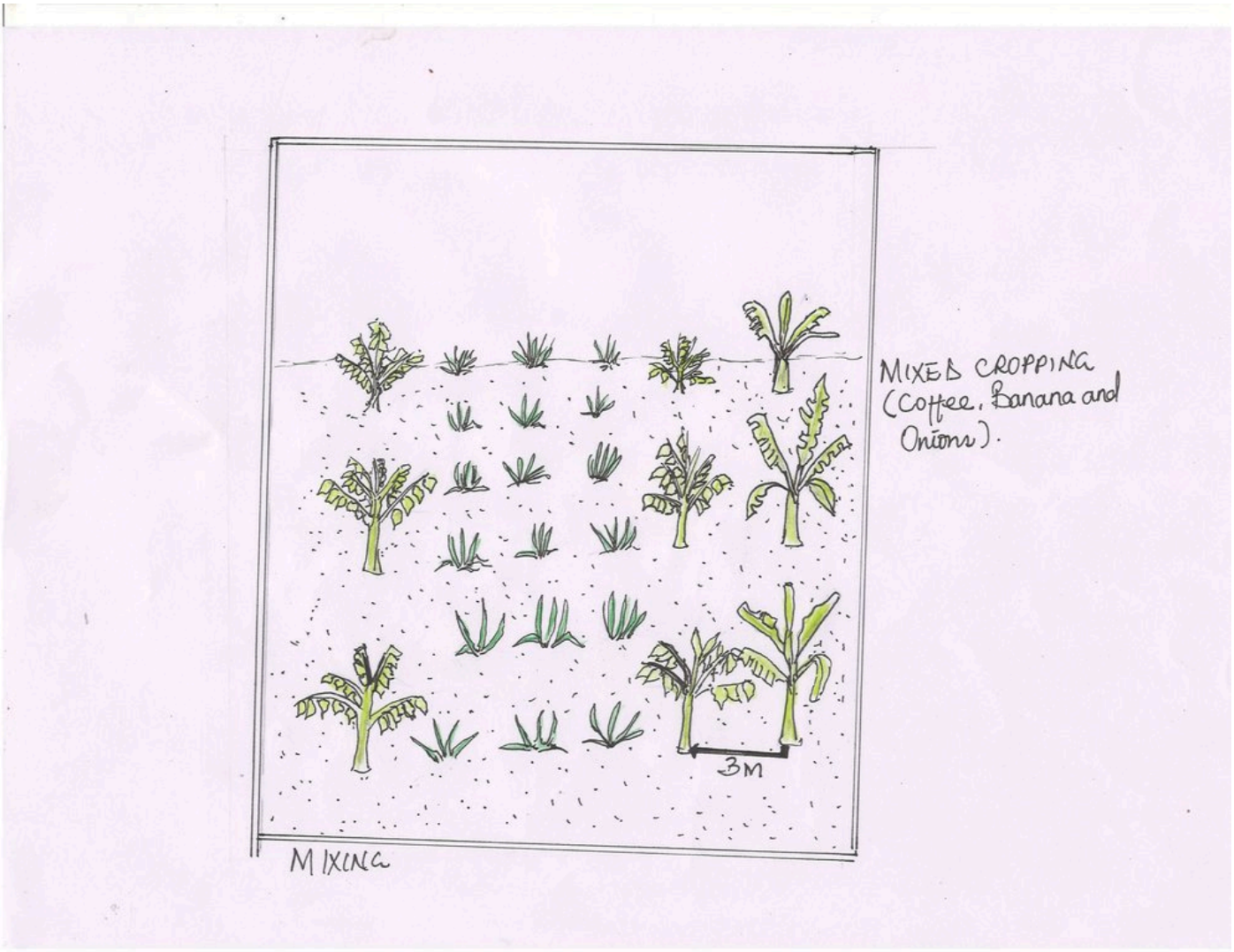
SLM measures

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

management measures - M4: Major change in timing of activities, M6: Waste management (recycling, re-use or reduce)

TECHNICAL DRAWING

Technical specifications



Author: Proscovia Kaheru
Banana and coffee plantations were established in 2016 and onions added later in August 2017. This practice is carried out on 3.4 ha.
Coffee is the major crop planted with spacing of 3m x 3m, then banana was intercropped at the ratio of 1 banana to 4 coffee trees.
The coffee trees were pruned initially to create room for the banana plants during their establishment. When coffee and banana were planted simultaneously in the field, onions were grown in between them for one year to provide some income before the banana and coffee were ready for harvesting.

The activities and labor demands include:
Digging holes and preparing the garden (labour time: 4 days by 3 people).
Manure application where compost manure was mixed with soil (labour time: 1 day by 3 people).
Planting (3 days by 3 people for all the crops).
Pruning where relevant adjustments are done regularly to the system (e.g. mature coffee trees are pruned to create space for onions to grow is done every three days by one person).
Labor costs are 5000 Uganda shillings per person a day.
Coffee takes three years for the first harvest to happen, onions take four months to grow - here harvesting is continuous.

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **3.4 hectares**)
- Currency used for cost calculation: **US Dollars**
- Exchange rate (to USD): 1 USD = 3600.0
- Average wage cost of hired labour per day: 1.39

Most important factors affecting the costs

Fertilizers are very expensive to be applied monthly

Establishment activities

1. Digging/ Garden preparation (Timing/ frequency: 1 week before the rains)
2. Fertilizer Application (Timing/ frequency: 2 days)
3. Planting (Timing/ frequency: Before onset of rains)
4. Spraying (Timing/ frequency: Every after two weeks)
5. Prunning (Timing/ frequency: monthly)
6. Harvesting (Timing/ frequency: Seasonal)

Establishment inputs and costs (per 3.4 hectares)

Specify input	Unit	Quantity	Costs per Unit (US Dollars)	Total costs per input (US Dollars)	% of costs borne by land users

Labour					
Digging/Garden preparations	man days	4.0	1.39	5.56	100.0
Planting	man days	4.0	1.39	5.56	100.0
Spraying	man days	1.0	1.39	1.39	100.0
Pruning	man days	1.0	1.39	1.39	100.0
Equipment					
Hoes	Piece	4.0	2.78	11.12	100.0
Pangas	Piece	2.0	2.78	5.56	100.0
Wheelbarrow	Piece	1.0	33.4	33.4	100.0
Sprayer pump	Piece	1.0	13.9	13.9	100.0
Plant material					
Onions Seeds	kilograms	2.0	1.94	3.88	100.0
Coffee seedlings	pieces	2000.0	0.83	1660.0	100.0
Banana suckers	pieces	2000.0	0.83	1660.0	100.0
Fertilizers and biocides					
Animal Manure	Trip	1.0	22.3	22.3	100.0
NPK Mineral fertiliser	Kilograms	5.0	0.84	4.2	100.0
Herbicides	litres	2.0	3.34	6.68	100.0
Pesticides	litres	2.0	4.17	8.34	100.0
Total costs for establishment of the Technology				**3'443.28**	

Maintenance activities

1. Weeding (Timing/ frequency: weekly)
2. Spraying (Timing/ frequency: weekly)
3. Pruning (Timing/ frequency: monthly)

Maintenance inputs and costs (per 3.4 hectares)

Specify input	Unit	Quantity	Costs per Unit (US Dollars)	Total costs per input (US Dollars)	% of costs borne by land users
Labour					
Weeding	Man Days	2.0	2.8	5.6	100.0
Spraying	Man Days	1.0	2.8	2.8	100.0
Equipment					
Spray Pump	piece	1.0	1.39	1.39	100.0
Hoes	pieces	2.0	2.78	5.56	100.0
Fertilizers and biocides					
NPK Fertiliser	Kilograms	8.0	1.39	11.12	100.0
Dudu cyper (pesticide)	litres	2.0	1.39	2.78	100.0
Dythene (herbicide)	kilograms	2.0	6.95	13.9	100.0
Total costs for maintenance of the Technology				**43.15**	

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-model pattern of rainfall
Name of the meteorological station: Buginyanya zonal Agricultural Research and Development Institute

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)

Soil texture (topsoil)

- ☐ coarse/ light (sandy)
- ☑ medium (loamy, silty)
- ☐ fine/ heavy (clay)

Soil texture (> 20 cm below surface)

- ☐ coarse/ light (sandy)
- ☑ medium (loamy, silty)

Topsoil organic matter content

- ☐ high (>3%)
- ☑ medium (1-3%)
- ☐ low (<1%)

- [ ] very deep (> 120 cm)
- [ ] fine/ heavy (clay)

Groundwater table
- [x] on surface
- [ ] < 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?
- [ ] Ja
- [x] Nee

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

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
- [ ] women
- [x] men

Age
- [ ] children
- [ ] youth
- [ ] middle-aged
- [x] 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
- [ ] individual, not titled
- [x] 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

wood production — decreased … ✓ increased

The pruned trees or brunches are used as wood for firewood at home.

risk of production failure — increased … ✓ decreased

There is no total crop failure as the farmer gains at least from one crop.

land management — hindered … ✓ simplified

The land user grows many crops on the same land hence the available space is utilized.

Socio-cultural impacts

food security/ self-sufficiency — reduced … ✓ improved

There is increased food production as the farmer grows more than one crop

SLM/ land degradation knowledge

reduced ✓ improved

The land user improved land management skills.

Ecological impacts
evaporation

increased ✓ decreased

Through inter-cropping less soil is exposed to the sun hence reduced soil moisture loss.

Off-site impacts
damage on neighbours' fields

increased ✓ reduced

The land user has trenches which prevent water and soil damage on the neighbor's 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

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)

local rainstorm: 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%

Number of households and/ or area covered

Three farmers in the area.

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?

- ☑ Ja
- ☐ Nee

To which changing conditions?

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

CONCLUSIONS AND LESSONS LEARNT

Strengths: land user's view

- The technology suppresses weed growth
- The technology reduces soil erosion.
- Yield and income advantage as the farmer gains from more than one crop from the same plot. Income recived is invested in buying tree seedlings
- Reduced crop failure as there is no total crop failure

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

- The technology helps the farmer to grow many crops on a small piece of land.
- Technology can be promoted by other farmers with same pieces of land or more.
- It increases crop yield which generates more income and food for consumption.

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

- The technology has too much shade, so other crops cannot grow for example maize and beans. The farmer should continue to grow onions instead of maize and beans
- The technology is expensive to establish because high investments need to be made. The land user should find financial assistance like savings co-operatives.
- The technology is a long term investment since it involves coffee and banana. The farmer should buy or rent some other land to be in position to grow other crops.

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

- Competition between the crops for nutrients and sunlight. Proper selection of crops to inter-crop for example inter-crop deep rooted with shallow rooted crops.

- The soil is highly depleted of its nutrients as more than one crop is planted. Inter cropping with some nutrient fixing crops and addition of manure.
- There is also more work required at the start of the cultivation and harvesting. Proper selection of crops to inter-crop and the right spacing.

REFERENCES

Compiler
Babirye Irene

Editors
Kamugisha Rick Nelson

Reviewer
Nicole Harari
Udo Höggel

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Resource persons
Wilson Wogudunya - land user

Full description in the WOCAT database
https://qcat.wocat.net/af/wocat/technologies/view/technologies_3378/
Video: https://player.vimeo.com/video/261291111

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
- Annual Weather in Bulambuli District: https://weatherspark.com/y/98128/Average-Weather-in-Bulambuli-Uganda-Year-Round