Photo showing improved tree nursery bed in Amuru District, Northern Uganda (Jalia Namakula)

Improved Tree Nursery Bed (Uganda)

Kayubu Kodi

DESCRIPTION

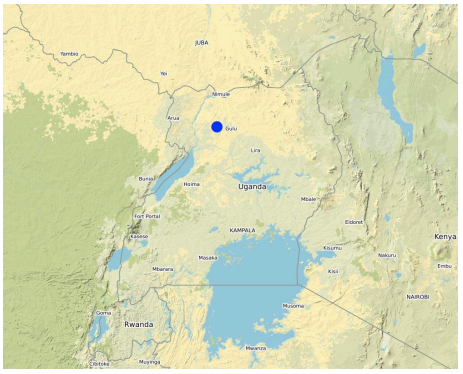
Improved fruit tree nursery is a technology comprising of grafted mangoes, grafted citrus, eucalyptus and pines, established with the aim of improving household income and promotion of agro-forestry farming systems within surrounding communities to achieve environmental conservation.

Tree nurseries are places where tree seedlings are propagated, managed, and grown to a transportable size. They are essential for producing quality seedlings in high quantities for rapid afforestation and sustainable land management.
In response to promoting this technology among farmers in Uganda, the Government of Uganda, through its initiatives such as Operation Wealth Creation (OWC), is promoting the growing of high value crops such as fruit trees to improve farmers' incomes and food security.
The technology is established on a gently sloping land lying on a plot of 1725 square meters, some 300 m away from a wetland used as a source of water for the nursery during the dry season. The soils here, on observation, have high clay content and are relatively deep.

The activities for establishing the nursery involved three stages:
1. clearing the bush on site, destroying all the termite mounds, ploughing the area, and levelling the mother beds established on flat or gentle rolling area to avoid water logging during the rainy season
2. preparation of the potting area and the potting medium which was done by mixing black soil with sand and manure in a ratio of 3-1-1 respectively. These activities took 2 person days to finish, followed by potting in 5cm × 12cm potting bags, taking 10 person days. The pots were then laid in a series of 1×10m long beds with paths of 0.75m between them. This activity took 2 persons days. Seeds were planted, watered and pots were covered with grass until germination after 14 days. After germination the seedlings are left for 4 months to mature until they are ready for grafting
3. grafting the then ready root stock with desired scion. The process involves cutting the root stock and scion at an angle and fitting the two together and holding them tightly with a wide plastic thread, the grafted seedlings are then placed in beds and placed in a closed housing unit with enough humidity only to be removed after 21 days. The seedlings are now placed again in rows where they are managed until ready for transportation

Maintenance activities included spraying fortnightly with pesticides and fungicides, watering with clean water twice every week, weeding and regular sorting of the seedlings to encourage proper growth. If any shade was put it is removed when the seedlings are well established to acclimatize them to open environmental conditions before they are transplanted or sold.
The tree varieties planted include improved mangoes, citrus, clonal eucalyptus and pines. Currently the nursery has over 10,000 citrus seedlings and 15,000 mango seedlings and a few seedlings of both pine and eucalyptus.
Tree nurseries are preferred by farmers because they use small land sizes, generate a lot of income, seedlings, when planted protect the environment and help in rapid production of genetically improved fruit trees in addition to offering employment to a wide spectrum of people including unskilled and skilled persons. There are notwithstanding, challenges such as lack of reliable water source and lack of skilled labor for grafting and high nursery establishment costs.
Limited market opportunities continue to be limiting factors to the tree nursery initiatives with the government being the only big buyer of tree seedlings in North Uganda.

LOCATION



Location: Pajak village, Amuru District, Northern Uganda, Northern Uganda, Uganda

No. of Technology sites analysed: single site

Geo-reference of selected sites
- 31.96157, 2.81253

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

Date of implementation: 2002

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

Photo showing Mango seedlings planted as root stock in Amuru District (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

Unproductive land - Specify: Bush surrounded by former brick making area

Water supply

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

Number of growing seasons per year: 1
Land use before implementation of the Technology: n.a.
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 water - Wt: loss of topsoil/ surface erosion

soil erosion by wind - Et: loss of topsoil

biological degradation - Bc: reduction of vegetation cover

SLM group

- tree nursery

SLM measures

vegetative measures - V1: Tree and shrub cover

TECHNICAL DRAWING

Technical specifications

The nursery is located on a 69m X 25 m (1725 m2) plot size
The nursery beds are a 1m x 10m, with a 75cm pathway between the beds
The beds contain 10,000 citrus seedlings 15,000 mango seedlings and a few clonal eucalyptus and pine trees
The pots used for growing mangoes are 5in x 7in, whereas citrus , eucalyptus and clonal are 4in X 7in
The rivets used to construct the shades are between 2m and1.5cm high. grass is used to shield the young seedlings from direct sunshine

ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology area (size and area unit: **1725 m2**)

Most important factors affecting the costs

Accessibility to quality seed, transportation of materials, drought

- Currency used for cost calculation: **UGX**
- Exchange rate (to USD): 1 USD = 3818.0 UGX
- Average wage cost of hired labour per day: 3000/=

Establishment activities

1. Determine water source (Timing/ frequency: June and July)
2. Mix soils with manure (Timing/ frequency: June and July)
3. Buy planting material (seeds and potting bags) and poles for constructing shelter shelter (Timing/ frequency: June and July)
4. Potting and planting seeds (Timing/ frequency: June and July)
5. Cover pots with grass (Timing/ frequency: June and July)
6. Put under shade (Timing/ frequency: June and July)

Establishment inputs and costs (per 1725 m2)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Potting and Planting	People	4.0	12000.0	48000.0	100.0
Arranging pots	People	1.0	50000.0	50000.0	100.0
Preparing mango seeds	people	4.0	10000.0	40000.0	100.0
					100.0
Equipment					
Water pump	Piece	1.0	1000000.0	1000000.0	100.0
Wheel barrow	Piece	2.0	80000.0	160000.0	100.0
Watering can	Piece	9.0	7500.0	67500.0	100.0
Potting bags	Roll	12.0	6000.0	72000.0	100.0
Water storage drum	Piece	1.0	70000.0	70000.0	100.0
Plant material					
Seeds (Eucalyptus)	Kg	5.0	30000.0	150000.0	100.0
Seeds (Pine)	Kg	10.0	10000.0	100000.0	100.0
Seeds (citrus)	Kg	4.0	60000.0	240000.0	100.0
Seeds (mangoes)	Bag	50.0	15000.0	750000.0	100.0
Cyons (mangoes)	Piece	15000.0	100.0	1500000.0	100.0
Cyons (citrus)	Piece	10000.0	20.0	200000.0	100.0
Soil	Truck	2.0	50000.0	100000.0	100.0
Sand	Truck	1.0	50000.0	50000.0	100.0
Fertilizers and biocides					
DAP	Kg	5.0	3500.0	17500.0	100.0
Liquid fertilisers	Litre	1.0	18000.0	18000.0	100.0
Construction material					
Construction poles	piece	50.0	3000.0	150000.0	100.0
Grass	piece	50.0	2500.0	125000.0	100.0
Nails	kg	3.0	1000.0	3000.0	100.0
Polythene bags (6inch)	kg	100.0	6500.0	650000.0	100.0
Polythene bags	kg	120.0	6500.0	780000.0	100.0
Total costs for establishment of the Technology				**6'341'000.0**	

Maintenance activities

1. Watering (Timing/ frequency: 2/week)
2. Pesticides application (Timing/ frequency: 2/season)
3. Sorting of seedlings (Timing/ frequency: 2/season)
4. Construction of shades (Timing/ frequency: 1/season)

Maintenance inputs and costs (per 1725 m2)

Specify input	Unit	Quantity	Costs per Unit (UGX)	Total costs per input (UGX)	% of costs borne by land users
Labour					
Watering	People	5.0	3000.0	15000.0	100.0
Weeding	People	5.0	15000.0	75000.0	100.0
Sorting	People	5.0	1000.0	5000.0	100.0
Strings	People	2.0	8000.0	16000.0	100.0
Construction material					
Poles	Piece	50.0	1500.0	75000.0	100.0
Grass	Bundle	25.0	2500.0	62500.0	100.0
Total costs for maintenance of the Technology				**248'500.0**	

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

Specifications on climate
Rainfall started late. First season rains started in April instead of late March, and second season started in September instead of late August
Name of the meteorological station: Gulu meteorology station

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

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

Altitude
- [ ] 0-100 m a.s.l.
- [ ] 101-500 m a.s.l.
- [ ] 501-1,000 m a.s.l.
- [ ] 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)
- [ ] moderately deep (51-80 cm)
- [x] 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%)
- [ ] 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
- [ ] Yes
- [x] No

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

Habitat diversity
- [ ] high
- [ ] medium
- [x] 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
- [ ] 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
- [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
- [x] communal/ village
- [ ] group
- [ ] individual, not titled
- [ ] individual, titled

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

health	poor		good
education	poor		good
technical assistance	poor		good
employment (e.g. off-farm)			

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

farm income

decreased ✓ increased

The farmer sold 25,000 seedlings and earned over UGX 37,500,000 (USD 9,868)

Socio-cultural impacts

Ecological impacts

Off-site impacts

water availability (groundwater, springs)

decreased ✓ increased

The water used in the dry season is drawn from the pond constructed in a wetland close. However this is affecting the water flow to other neighbours using this 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

Tree nurseries are very expensive to establish and take close to a year for the seedlings to be sold. Therefore, establishment costs surpass benefits in the short run, however when the trees are sold they fetch a lot of income. Maintenance costs, both in the short and long term are positve.

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

- [ ] 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?

- [ ] 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

- Optimal space utilisation
- Maintenance costs are low
- Nurseries generate high value crops

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

- Nurseries rehabilitate degraded land
- Environmental improvements
- They are used for aesthetic benefits

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

- Establishment costs are high Bulk purchases of inputs
- Grafting needs technical skills Hire skilled labour
- Markets are inaccessible Register company with the district and sub-county

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

- Labour intensive
- Markets are highly seasonal Sourcing from other buyers for examples NGOs promoting agro- forestry
- Trees do not grow at the same rate Application of fertilizers

REFERENCES

Compiler
Jalia Namakula

Editors
Kamugisha Rick Nelson

Reviewer
Drake Mubiru
Nicole Harari
Udo Höggel

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Resource persons
Julius Oyet - land user

Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_2797/
Video: https://player.vimeo.com/video/254834062

Linked SLM data
n.a.

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Project
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Key references

- Improving Sustainable Productivity in Farming systems and Enhanced livelihoods through Adoption of Evergreen Agriculture in Eastern Africa. Joy Buyinza and Vicent I Opolot: https://www.cgiar.org/research/publication/improving-sustainable-productivity-in-farming-systems-and-enhanced-livelihoods-through-adoption-of-evergreen-agriculture-in-eastern-africa-shortened-as-trees-for-food-security-project/

Links to relevant information which is available online
- Improving Sustainable Productivity in Farming systems and Enhanced livelihoods through Adoption of evergreen Agriculture in Eastern Africa: https://www.worldagroforestry.org