Chagga homegardens with the snow-capped peak of Mt. Kilimanjaro in the background (Hanspeter Liniger (Centre for Development and Environment, University of Bern))

Chagga Homegardens (Tanzania, United Republic of)

DESCRIPTION

The Chagga homegardens are traditional, densely planted 'banana forests' with a scattered upper tree layer.

The complex multicropping system evolved over several centuries through a gradual transformation of the natural forest on the footslopes of Kilimanjaro. A Chagga homegarden has an average size of 0.68 ha and integrates numerous multipurpose trees and shrubs with food crops, and stall-fed animals, without a specific spatial arrangement. However, vertically, the following 4 stories/canopies can be distinguished: (1) food crops: taro, beans, vegetables and fodder herbs / grasses; (2) coffee: 500-1,400 plants/ha; (3) banana: primary crop; 50% cover; 330-1,200 clumps/ha; and (4) Trees, such as Cordia abyssinica, Albizia schimperiana and Grevillea robusta. The trees provide shade for coffee, act as live fences, provide medicines, firewood, fodder, mulching material, bee forage; and some have pesticidal properties (e.g. Rauwolfia caffra). This multilayer system maximizes the use of limited land in a highly populated area, making sustained production possible with a minimum of external inputs, minimizes risk (less production failure, increased resistance against droughts and pests) and ensures at the same time environmental protection. The large species diversity provides both subsistence and cash crops. Parts of the homegarden area are irrigated and drained by a network of over 1000 canals and furrows tapping runoff from the montane forest. However, many systems are now in disrepair.

Natural / human environment: Starting in the 1930s when coffee took more space from the food production, it became necessary to expand food production to the lowlands. Today, the Chagga highland homegarden works only in combination with a lowland field where maize, millet, beans, sunflower and groundnuts are grown to ensure food security.

LOCATION

Location: Mt. Kilimanjaro Region, Tanzania, United Republic of

No. of Technology sites analysed:

Geo-reference of selected sites
- 37.43, -3.27

Spread of the Technology:

In a permanently protected area?:

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

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

Land use
Land use mixed within the same land unit: Yes - Agroforestry

Cropland
- Annual cropping: fodder crops - grasses, fodder crops - other, vegetables - other, Taro
- Perennial (non-woody) cropping: banana/plantain/abaca
- Tree and shrub cropping: avocado, coffee, open grown

- [ ] 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

Forest/ woodlands Products and services: Fuelwood, Other forest products, Grazing/ browsing

Water supply

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

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

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

SLM group

- agroforestry
- home gardens

SLM measures

vegetative measures - V1: Tree and shrub cover

management measures - M5: Control/ change of species composition

TECHNICAL DRAWING

Technical specifications

Typical chagga homegarden on a 45% slope at 1400 m a.s.l. with 4 vegetation layers: open light upper canopy with Albizia schimperiana (up to 20 m high); upper shrub layer with banana (4-6 m); a lower shrub layer with coffee (1.5-2 m) and food crops such as taro (< 1.5 m) -2.5 m; 3-6 m; 5-30 m

Mt. Kilimanjaro Region

Date: 2009

Technical knowledge required for field staff / advisors: moderate

Technical knowledge required for land users: moderate

Main technical functions: control of raindrop splash, stabilisation of soil (eg by tree roots against land slides), increase in organic matter, increase in nutrient availability (supply, recycling,...), increase of infiltration, increase of biomass (quantity), promotion of vegetation species and varieties (quality, eg palatable fodder)

Scattered / dispersed
Vegetative material: T : trees / shrubs

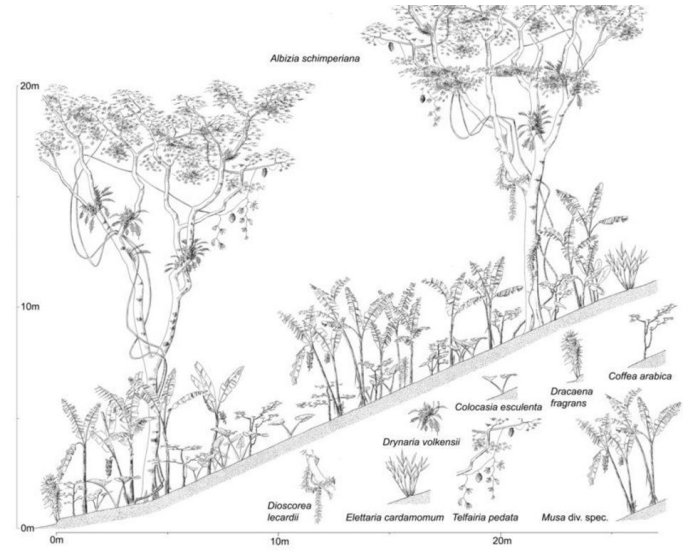
Trees/ shrubs species: Cordia abyssinica, Albizia schimperiana, Grevillea robusta, Rauwolfia caffra, Persea americana

Fruit trees / shrubs species: banana, avocado, mango

Perennial crops species: taro, coffee

Grass species: fodder herbs / grasses

Change of land use type: from natural forests to agroforest



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ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

Calculation of inputs and costs

- Costs are calculated: per Technology unit (unit: **homegarden**)
- Currency used for cost calculation: **USD**
- Exchange rate (to USD): 1 USD = n.a
- Average wage cost of hired labour per day: n.a

Most important factors affecting the costs

n.a.

Establishment activities

1. Transforming the native forest: trees that provided fodder, fuel, fruits, medicines, shade, timber, bee forage, anti-pest properties are retained while the less useful species are eliminated (Timing/ frequency: None)
2. Introduction of new fruit and timber tree species, such as avocado, mango, Grevillea robusta, Persea americana (Timing/ frequency: None)

3. Planting crops species (banana, coffee, taro, beans, vegetables) (Timing/ frequency: None)
4. Establishment of irrigation/drainage channels (Timing/ frequency: None)
5. Terracing or building of bunds in steep places (Timing/ frequency: None)

Maintenance activities

1. Planting, tending and harvesting of bananas, taro, yams / Opening up the canopy to ensure better fruiting of the coffee (Timing/ frequency: all year round)
2. Spacing out the banana stools; Manuring crops (using dung from the stall-fed livestock and compost) (Timing/ frequency: None)
3. Lopping fodder trees/shrubs; Pruning and spraying against coffee berry disease and leaf rust (Timing/ frequency: None)
4. Maintaining irrigation furrows; Coffee harvest (Timing/ frequency: August to January)
5. Tending and milking the stall-fed cows (typically only one cow) / Mulching, terrace maintenance (soil erosion prevention in general) (Timing/ frequency: None)

Maintenance inputs and costs (per homegarden)

Specify input	Unit	Quantity	Costs per Unit (USD)	Total costs per input (USD)	% of costs borne by land users
Labour					
Planting, tending and harvesting	unit	1.0	300.0	300.0	100.0
Equipment					
Tools	unit	1.0	45.0	45.0	100.0
Fertilizers and biocides					
Compost / manure	unit	1.0	100.0	100.0	100.0
Total costs for maintenance of the Technology				**445.0**	
Total costs for maintenance of the Technology in USD				*445.0*	

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

depending on slope orientation and altitude
Thermal climate class: tropics

Tropical montane; bimodal: long rains in March-May, short rains in Nov-Dec

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)

Off-farm income

- ☐ less than 10% of all income
- ☐ 10-50% of all income

Relative level of wealth

- ☐ very poor
- ☑ poor

Level of mechanization

- ☑ manual work
- ☐ animal traction

- [x] mixed (subsistence/ commercial)
- [ ] commercial/ market

- [ ] > 50% of all income

- [ ] average
- [ ] rich
- [ ] very rich

- [ ] mechanized/ motorized

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

Individuals or groups
- [x] 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
- [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)
- [ ] communal (organized)
- [ ] leased
- [ ] individual

Access to services and infrastructure

IMPACTS

Socio-economic impacts

wood production	decreased	increased	Fuelwood production 1.5-3 m3/ha/year
risk of production failure	increased	decreased	
product diversity	decreased	increased	185 kg beans/ha; 410 kg coffee/ha; 400 bunches of banana /ha; ca. 30 kg honey/ha
workload	increased	decreased	increased labour efficiency
value of gene pool	decreased	increased	for breeding programmes to improve crop varieties for multistorey cropping systems

Socio-cultural impacts

food security/ self-sufficiency	reduced	improved
health situation	worsened	improved
preservation of traditional knowledge	reduced	improved

Ecological impacts

soil cover	reduced	improved	
soil loss	increased	decreased	
plant diversity	decreased	increased	over 500 plant species including 400 non-cultivated plants
animal diversity	decreased	increased	
pest/ disease control	decreased	increased	
micro-climate	reduced	improved	
biodiversity / crop diversity	reduced	improved	? land use change from natural forest to agroforest

Off-site impacts

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs

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

Climate-related extremes (disasters)

local rainstorm — not well at all ✓ very well
local windstorm — not well at all ✓ very well
drought — not well at all ✓ very well
general (river) flood — not well at all ✓ very well

Other climate-related consequences

reduced growing period — 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%
- [x] > 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%

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

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

- this system allows for maintaining high biodiversity at the same time with diversified production of fruits, vegetables, timber, medicinal products etc.

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

- High demand of wood, low coffee prices and the introduction of sun-tolerant coffee varieties endanger the homegardens incentive-based tree planting in the gardens to reduce the pressure on the forest
- None

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

- Productivity of Chagga homegardens is not optimal (1) Replace the less productive trees / shrubs with fast growing nitrogen fixing species; (2) improve animal husbandry (e.g. to increase lactation period), (3) improve apiculture,
- Productivity of Chagga homegardens is not optimal (4) introduce new crop varieties using the gene pool developed by natural and farmer selection, (5) use fertilizers,
- Productivity of Chagga homegardens is not optimal (6) improve coffee production: certified production (organic, fair trade) to fetch higher prices, (7) replace old coffee plants with new ones, (8) integrated pest management, (9) facilitate access to capital for farm investments
- Productivity of Chagga homegardens is not optimal (10) improve erosion control (terraces and bunds), (11) include productive fruit trees, (12) improve advisory services
- Water management causes nutrient loss in the gardens and water shortages on the lower slopes improve efficiency of furrows: Install pipes and surfacing by cement, protect river banks from cultivation

REFERENCES

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Full description in the WOCAT database
https://qcat.wocat.net/en/wocat/technologies/view/technologies_1337/

Linked SLM data
n.a.

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