Enhanced mulching in banana and coffee plantation

Tanzania, United Republic of - Okwalila ebinyasi omukibanja

Application of Thatch and Hyperrhenia Rufa grass mulch in banana and coffee plantation to reduce soil erosion, improve soil fertility and moisture and ensure high productivity

The technology is applied in coffee and banana fields in the sub humid climate. The technology objective is prevention of land degradation specifically nutrient improvement, erosion control, soil moisture and soil health (soil's living organisms) improvement. The materials applied are very variable perennial grass from 60-240 cm high. Panicle loose and narrow up to 50 cm long, with slightly spreading or contiguous racemes with shortly hairy or nearly glabrous spikelets 3.5-5 mm long. The materials are spreaded to 15cm thickness, manually across the slpoe, once per year, at the beginig of short rains.
The purpose of the technology is to retain moisture content in soil by promoting water infiltration during and after the rains, promoting water holding capacity through decay and formation of organic matter. Grass mulch control soil erosion by intercepting raindrops (splash erosion) that detach soil particles. Grass mulch technology improves soil nutrient through grass decomposition.
There is no establishment activities for the technology only maintenance activities (operational activities) are required once a year. Maintenance activities include collection of mulching grasses -The grass is cut and collected by household or hired labor. The quantity of grass required per hectar is 1,500 cubic metre equivalent to 375 bundles. To spread/apply mulching grasses -Grass is spread manually across the slope preferably to 15cm thickness. Dry grasses are spread across the slope with thickness of maximum 15cm. It is recommended to apply mulch grass around 15cm from the banana trunks.This is done once annually before the onset of short rains (during Augost and September)
The technology is applied on coffee/banaana fields. The Rainfall is 1000-1500mm, the subhumid climate (temp 26 -30 degree centigrade) and two growing seasons. The technology is meant for soil water evaporation contol and is tolerant in dry spell season while sensitive to excessive rains.

left: Mulching grasses are cut in the rangeland, dried and collected in bundles to be transported to banana and coffee plantation. (Photo: Godfrey Baraba)
right: Dry mulch grasses are spread manually across the slope, but there is a need of close visiting to emphasize the recomended space from the plant stem. (Photo: Godfrey Baraba)

Location: Tanzania
Region: Bukoba District (Karong village)
Technology area: 1 - 10 km2
Conservation measure: agronomic
Stage of intervention: prevention of land degradation
Origin: Developed through land user`s initiative, traditional (>50 years ago)
Land use type:
Cropland: Perennial (non-woody) cropping
Climate: subhumid, tropics
WOCAT database reference: T_TAN014en
Related approach: Spontaneous transfer of indigenous knowledge. (A_TAN004en)
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Classification

Land use problems:

- Soil erosion, excessive soil water evaporation, fertility decline and reduced organic matter content (expert's point of view)
Excessive weed invasions and reduced productivity (land user's point of view)

Land use

Perennial (non-woody) cropping
rainfed

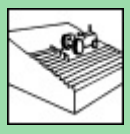
Climate

subhumid

Degradation

Soil erosion by water: loss of topsoil / surface erosion, Chemical soil deterioration: fertility decline and reduced organic matter content, Water degradation: aridification

Conservation measure



agronomic: Others (Grass mulching)

Stage of intervention

- Prevention
- Mitigation / Reduction
- Rehabilitation

Origin

- Land users initiative: traditional (>50 years ago)
- Experiments / Research
- Externally introduced

Level of technical knowledge

- Agricultural advisor
- Land user

Main causes of land degradation:
Direct causes - Human induced: soil management
Direct causes - Natural: Heavy / extreme rainfall (intensity/amounts)
Indirect causes: land tenure, poverty / wealth

Main technical functions:

- control of raindrop splash
- control of dispersed runoff: impede / retard
- increase of infiltration
- increase / maintain water stored in soil

Secondary technical functions:

- increase in organic matter
- increase in nutrient availability (supply, recycling,...)

Environment

Natural Environment

Average annual rainfall (mm)

- > 4000 mm
- 3000-4000 mm
- 2000-3000 mm
- 1500-2000 mm
- 1000-1500 mm
- 750-1000 mm
- 500-750 mm
- 250-500 mm
- < 250 mm

Altitude (m a.s.l.)

- > 4000
- 3000-4000
- 2500-3000
- 2000-2500
- 1500-2000
- 1000-1500
- 500-1000
- 100-500
- <100

Landform

- plateau / plains
- ridges
- mountain slopes
- hill slopes
- footslopes
- valley floors

Slope (%)

- flat
- gentle
- moderate
- rolling
- hilly
- steep
- very steep

Soil depth (cm)

- 0-20
- 20-50
- 50-80
- 80-120
- >120

Growing season(s): 120 days (September (mid)- January (mid)), 65 days (March-May)
Soil texture: coarse / light (sandy)
Soil fertility: low
Topsoil organic matter: low (<1%)
Soil drainage/infiltration: medium

Soil water storage capacity: medium
Ground water table: 5 - 50 m
Availability of surface water: medium
Water quality: good drinking water
Biodiversity: medium

Tolerant of climatic extremes: temperature increase, seasonal rainfall increase, seasonal rainfall decrease, wind storms / dust storms, droughts / dry spells, decreasing length of growing period
Sensitive to climatic extremes: heavy rainfall events (intensities and amount)

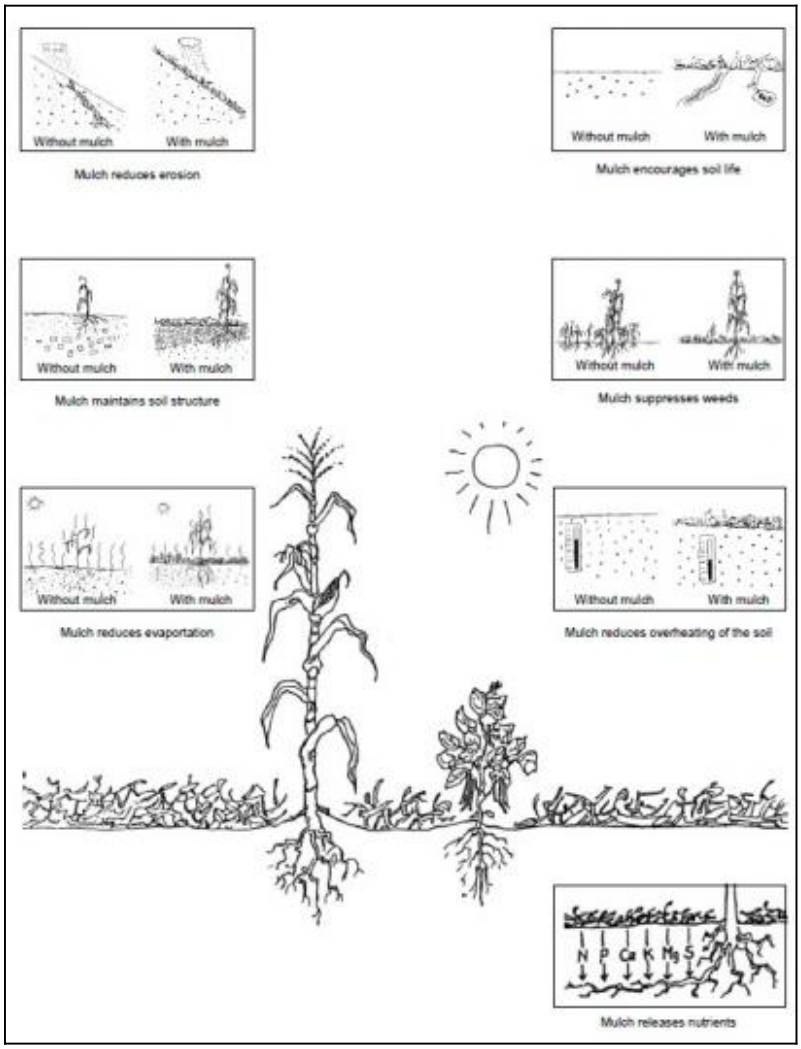
Human Environment

Cropland per household (ha)

	<0.5
	0.5-1
	1-2
	2-5
	5-15
	15-50
	50-100
	100-500
	500-1,000
	1,000-10,000
	>10,000

Land user: Individual / household, Small scale land users, common / average land users, men and women
Annual population growth: 0.5% - 1%
Land ownership: individual, not titled
Land use rights: individual
Water use rights: open access (unorganised)
(The technology is highly adopted by well to do farmers, either having off farm source of income or old farmer after achieving reasonable savings. This is because the communal range land has encroached by protected forest.)
Relative level of wealth: average, which represents 80% of the land users; 60% of the total area is owned by average land users

Importance of off-farm income: less than 10% of all income:
Access to service and infrastructure: low: health, technical assistance, employment (eg off-farm), market, energy, Church; moderate: education, roads & transport, drinking water and sanitation, financial services
Market orientation: mixed (subsistence and commercial)
Mechanization: manual labour
Livestock grazing on cropland: yes little



Technical drawing

What is the use of mulching?; Source: Müller-Sämann and Kotschi (1994) (Godfrey Baraba)

Implementation activities, inputs and costs

Establishment activities

- There are no establishment activities

Maintenance/recurrent activities

- Collection of mulching materials
- Application of mulching materials (spreading)
- Weeding
- De trashing

Maintenance/recurrent inputs and costs per ha per year

Inputs	Costs (US$)	% met by land user
Labour	20.00	100%
Agricultural		
- Mukch grasses	117.10	1000%
TOTAL	**137.10**	**100.00%**

Remarks:
Cost of purchasing mulch grass is the most determinate factor. Mostly due to long distance to fetch the grass and the scatered nature due to degradation and encroachment by tree planting.
per hectar of land protected; cost of purchasing 375 bundles of grass and their spread to be $0.3 per bundle and 20 mandays at $ 1.2

Assessment

Impacts of the Technology

Production and socio-economic benefits

+++ reduced risk of production failure
++ increased crop yield
++ reduced demand for irrigation water

Production and socio-economic disadvantages

+ increased expenses on agricultural inputs

Socio-cultural benefits

++ improved conservation / erosion knowledge
++ improved food security / self sufficiency
+ improved situation of disadvantaged groups

Socio-cultural disadvantages

++ Working in distant unconducive environment

Ecological benefits

+++ increased soil moisture
+++ reduced surface runoff
++ reduced evaporation
++ increased soil organic matter / below ground C
++ reduced soil compaction
+ reduced hazard towards adverse events
+ increased beneficial species

Ecological disadvantages

Off-site benefits

+ reduced damage on neighbours fields

Off-site disadvantages

++ Nutrient transfer from grassland to crop land
+ reduced sediment yields

Contribution to human well-being / livelihoods

++ Improved coffee/banana mulching increases farm income. Additional revenue is spent for child's education and health services

Benefits /costs according to land user

Benefits compared with costs	short-term:	long-term:
Establishment	not specified	not specified
Maintenance / recurrent	slightly negative	positive

No establishment costs, recurrent costs for mulching Technology for three years consecutively, can increase productivity in two folds and be maintained for more than ten years.

Acceptance / adoption:

68% of land user families have implemented the technology voluntary. There are farmers who apply dried banana leaves and pseudo stem as mulch.
There is moderate trend towards (growing) spontaneous adoption of the technology. The adoption is moderate simply because of increasing cost of mulching grasses compared to produce farm gate price increase. Furthermore the labour force is dominated by the elderly.

Concluding statements

Strengths and → how to sustain/improve	Weaknesses and → how to overcome
Esy to implement and maintain → Promote extended use of the technology (knowledge sharing)	Grass mulch available only to farmers with grassland → Other measures should be encouraged (use of chopped banana,pseudo stem, leaves and sheaths)
Multiple ecological benefits: improved soil organic matter, soil moisture and soil biodiversity → Educate farmers on diversified mulching materials and systems e.g. intercropping, cover crops, minimum tillage	Degradation of grassland → Promotion of SLM Technologies for grassland conservation
Prevent soil erosion → Combine other conservation technologies e.g. contour construction with mulching.	Does not stay longer, it can persist for one season, hence requires twice application → Apply the correct quality and quantity material.
Increase in soil moisture especially during the dry season → Perform regularly maintenance activities	Not readily available to all farmers simply because range land has been allocated to well to do farmers. → Land tenure system and land use planning should be revisited
Reduced weeds → Apply mulch grasses at the depth of 15 cm twice a year for the first 3 years consecutively	Increased manual labour (cutting, transportation spreading) → Plant grasses like vertiva
Fertility increase → Soft loan of livestock to be provided to farmers	