Enhanced mulching in banana and coffee plantation
Tanzania, United Republic of - Okwalila ebinyasi omukibanja

Application of Thatch and Hyperrenia 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 slope, once per year, at the beginning 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 hectare 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 August and September).

The technology is applied on coffee/banana 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 control and is tolerant in dry spell season while sensitive to excessive rains.

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,...)

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**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
- Foottops
- Valleys
- Flat
- Gentle
- Moderate
- Rolling
- Hilly
- Steep
- Very steep

**Slope (%)**

- Flat
- Gentle
- Moderate
- Rolling
- Hilly
- Steep
- Very steep

**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

**Soil depth (cm)**

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

**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

<table>
<thead>
<tr>
<th>Cropland per household (ha)</th>
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<tbody>
<tr>
<td>&lt; 0.5</td>
<td></td>
</tr>
<tr>
<td>0.5 - 1</td>
<td></td>
</tr>
<tr>
<td>1 - 2</td>
<td></td>
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<tr>
<td>2.5</td>
<td></td>
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<tr>
<td>5 - 15</td>
<td></td>
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<tr>
<td>15 - 50</td>
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<tr>
<td>50 - 100</td>
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<td>100 - 500</td>
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<tr>
<td>500 - 1,000</td>
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<tr>
<td>1,000 - 10,000</td>
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<tr>
<td>&gt; 10,000</td>
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**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 trash

**Maintenance/recurrent inputs and costs per ha per year**

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Costs (US$)</th>
<th>% met by land user</th>
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</thead>
<tbody>
<tr>
<td>Labour</td>
<td>20.00</td>
<td>100%</td>
</tr>
<tr>
<td>Agricultural</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Mulch grasses</td>
<td>117.10</td>
<td>100%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>137.10</strong></td>
<td><strong>100.00%</strong></td>
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</table>
**Remarks:**
Cost of purchasing mulch grass is the most determinate factor. Mostly due to long distance to fetch the grass and the scattered 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**

<table>
<thead>
<tr>
<th>Production and socio-economic benefits</th>
<th>Production and socio-economic disadvantages</th>
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</thead>
<tbody>
<tr>
<td>+ + + reduced risk of production failure</td>
<td>+ + + increased expenses on agricultural inputs</td>
</tr>
<tr>
<td>+ + increased crop yield</td>
<td></td>
</tr>
<tr>
<td>+ + reduced demand for irrigation water</td>
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<table>
<thead>
<tr>
<th>Socio-cultural benefits</th>
<th>Socio-cultural disadvantages</th>
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<tbody>
<tr>
<td>+ + improved conservation / erosion knowledge</td>
<td>+ + Working in distant unconducive environment</td>
</tr>
<tr>
<td>+ + improved food security / self sufficiency</td>
<td></td>
</tr>
<tr>
<td>+ + improved situation of disadvantaged groups</td>
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</table>

<table>
<thead>
<tr>
<th>Ecological benefits</th>
<th>Ecological disadvantages</th>
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<tbody>
<tr>
<td>+ + + increased soil moisture</td>
<td></td>
</tr>
<tr>
<td>+ + + reduced surface runoff</td>
<td></td>
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<tr>
<td>+ + reduced evaporation</td>
<td></td>
</tr>
<tr>
<td>+ + + increased soil organic matter / below ground C</td>
<td></td>
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<tr>
<td>+ + reduced soil compaction</td>
<td></td>
</tr>
<tr>
<td>+ + reduced hazard towards adverse events</td>
<td></td>
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<tr>
<td>+ + increased beneficial species</td>
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<table>
<thead>
<tr>
<th>Off-site benefits</th>
<th>Off-site disadvantages</th>
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</thead>
<tbody>
<tr>
<td>+ + reduced damage on neighbours fields</td>
<td>+ + Nutrient transfer from grassland to crop land</td>
</tr>
<tr>
<td></td>
<td>+ + reduced sediment yields</td>
</tr>
</tbody>
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**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**

<table>
<thead>
<tr>
<th>Benefits compared with costs</th>
<th>short-term:</th>
<th>long-term:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment</td>
<td>not specified</td>
<td>not specified</td>
</tr>
<tr>
<td>Maintenance / recurrent</td>
<td>slightly negative</td>
<td>positive</td>
</tr>
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</table>

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

<table>
<thead>
<tr>
<th>Strengths and → how to sustain/improve</th>
<th>Weaknesses and → how to overcome</th>
</tr>
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<tbody>
<tr>
<td>Easy to implement and maintain → Promote extended use of the technology (knowledge sharing)</td>
<td>Grass mulch available only to farmers with grassland → Other measures should be encouraged (use of chopped banana, pseudo stem, leaves and sheaths)</td>
</tr>
<tr>
<td>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</td>
<td>Degradation of grassland → Promotion of SLM Technologies for grassland conservation</td>
</tr>
<tr>
<td>Prevent soil erosion → Combine other conservation technologies e.g. contour construction with mulching.</td>
<td>Does not stay longer, it can persist for one season, hence requires twice application → Apply the correct quality and quantity material.</td>
</tr>
<tr>
<td>Increase in soil moisture especially during the dry season → Perform regularly maintenance activities</td>
<td>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</td>
</tr>
<tr>
<td>Reduced weeds → Apply mulch grasses at the depth of 15 cm twice a year for the first 3 years consecutively</td>
<td>Increased manual labour (cutting, transportation spreading) → Plant grasses like vertiva</td>
</tr>
<tr>
<td>Fertility increase → Soft loan of livestock to be provided to farmers</td>
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