Agroforestry system (intercropping beans/maize) with contour ditches, strips of Napier grass, manure and organic fertilizers. (Kenya)

**DESCRIPTION**

The technology is a combination of agricultural (e.g. intercropping, manure/compost/mulching), vegetative (e.g. Napier grass strips, trees planting) and structural (e.g. ditches) measures which aim to maximise the overall land yield in a sustainable manner (e.g. reducing soil erosion and increasing soil quality).

The Agroforestry system combines trees plantation (Bananas, Grevillea and Avocados) for fruits and timber collection with cereal crop, maize (Zea mays). Indeed, in order to increase yields, strip intercropping is practiced: cereal crop (maize) is grown in association with pulse (food legumes): beans. Instead of using expensive commercial fertilizers, beans could facilitate maize growth due to the possible transfer of N during growth or after incorporation of the legume biomass, during the growth period of the cereal (Sangakkara et al., 2003). Furthermore, soil quality (e.g. soil structure) is improved because of the increased amount of humus and organic matter and a better soil cover helps in preventing splash erosion and increase soil moisture content and therefore fertility. Indeed, beans have a beneficial impact for weed control (probably due to the shadow effects) and soil moisture content (Worfswinkel, undated; Odhiambo and Ariga, 2001). Planting different crops helps to diversify production and family food supply.

Concerning SWC, hillside ditches have been created at the top of each 'terrace' and trees are also planted nearby and Cassava (a drought resistant plant) at the bottom. Manure/compost and organic fertilizers are supplied regularly both on maize/grass (twice a year) and Bananas (once), as good soil management practice. A higher level of organic matter in the soil indicates reduced bulk density, improved soil structure, aeration and higher water holding capacity (Olabode et al., 2007), which altogether improve the physical, chemical and biological properties of the soil (Haering and Evanylo, 2005). Bananas are planted in lines in the upper part of the land. The ditches, large 1m are excavated along the contour; they break slope into shorter segments 11 m long to intercept surface runoff. Ditches also help to prevent soil erosion and to avoid that nutrients and organic matter flow easily downwards into the river, instead they fall into the ditch. A live barrier of Napier grass is present above and below the edge of the five ditches, in two lines, to capture sediments and stabilize the structure, thus it is adequately protected. To conclude, a small area of the land is used to plant Napier grass only for fodder for grazing.

Purpose of the Technology: Maize and beans are cultivated for home consumption while Avocados and Bananas are planted for economic (commercial) purposes. Fruits are sold out to the middle-men directly from the house (not at the market), to reduce costs (e.g. transport) and time. Avocados are sold at about 2.5/3 Ksh and Bananas at 200 Ksh. Grevillea trees are considered as saving, and sold out for timber production when the farmer is in need of cash, earning between 800 up to 1500 Ksh, depending on the size-length of the tree and the costs for cutting-transportation (e.g. machine operator). In general the selling of timber occurs per feet (running feet). ‘Whole’ or standing tree is the preferred mode of selling trees from farms. Negotiation on sales is per tree ‘standing on farm’, with no processing or conversion. Buyers cut and cross cut, and carry timber from farms. Branches and slabs resulting from timber recoveries are left with the farmer depending on price negotiation; if the buyer carries these products then the price of the

**LOCATION**

- **Location:** Muthithi location, Kagurumo sublocation, Central, Kenya
- **Geo-reference of selected sites:** 37.09455, 0.85453
- **No. of Technology sites analysed:**
- **Geo-reference of selected sites**
  - 37.09455, 0.85453
- **Spread of the Technology:** evenly spread over an area (0.008 km²)
- **In a permanently protected area?:**
- **Date of implementation:** less than 10 years ago (recently)
- **Type of introduction**
  - through land users' innovation
  - ✓ as part of a traditional system (> 50 years)
  - during experiments/ research
  - through projects/ external interventions
tree is adjusted upwards (Carsan and Holding, 2006; Holding et al., undated).
Furthermore, the farmer underlined how ‘bad prunings’ at the top of the trees cause holes inside the trunks and thus a higher risk of fungi attacks and other diseases. The majority of the trees are planted along the boundaries of the land, for demarcation and only few are ‘dispersed’ on the cropland, to avoid excess of shadow to the cereal crop.

Establishment / maintenance activities and inputs: High initial input to construct ditches and planting crop; manure also requires regular work: feeding cows and collect droppings and distribute them twice during the year, also over Napier grass. Dry planting is the preferred practice and the seeds are soaked the night before planting; this practice is advisable especially when the growing period is very short (Schmidt et al., 1983); organic fertilizers are applied over maize after 1 week and during the growing period (after about 18 days). Further maintenance is necessary after every rainy season to remove the sediments accumulated into the ditch and for pruning Grevillea, every three seasons. As mentioned above, pruning requires skills and knowledge to avoid plant diseases and labour is expensive because it is high risk work. The farmer trees plantation account for: 15 Avocados (from 4 seedlings), 100 Bananas (from cutting new suckers) and 50 Grevillea trees.

Natural / human environment: The area is characterized by rolling-hilly slope and highly exposed to erosion and land degradation: planting trees protect the soil from nutrients leaching and create a litter which reduces evaporation during dry seasons. Concerning the variety of the trees, (e.g. Avocado) the farmer by grafting with better quality branches, improve the quality of the stock trees with certified varieties: out of 4 seedlings of Avocado (10 Ksh each), he has now 15 seedlings of the better (certified) variety called HASS, which performs well at 800-2100 m asl with well distributed annual rainfall of 1000-1200 mm (Youth Agro-environmental initiative website).

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
- adapt to climate change/ extremes and its impacts
- mitigate climate change and its impacts
- create beneficial economic impact
- create beneficial social impact

Land use
Land use mixed within the same land unit: Yes - Agro-silvopastoralism

<table>
<thead>
<tr>
<th>Cropland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual cropping: cereals - maize, fodder crops - grasses, legumes and pulses - beans</td>
</tr>
<tr>
<td>Perennial (non-woody) cropping: banana/plantain/abaca</td>
</tr>
<tr>
<td>Tree and shrub cropping: avocado</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grazing land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut-and-carry/ zero grazing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Forest/ woodlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tree plantation, afforestation</td>
</tr>
<tr>
<td>Tree types: Grevillea robusta</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Water supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfed</td>
</tr>
</tbody>
</table>

Legume interplanting: Maize (Zea mays) and beans (Phaseolus vulgaris). On the background: Bananas and Grevillea trees. On the right, it is possible to note a portion of the Napier grass strip (red arrow). (Laura D’Aietti (QT6: 2.1.3 (and QT22: 2.5.3)))

Legume intercropping: Maize (Zea mays) and beans (Phaseolus vulgaris); Living fences: on farm boundaries: Euphorbia tirucalli (Kariaria, milk bush) has been planted; Napier grass. (Laura D’Aietti (QT6: 2.1.3 Fig. 2a, b (and QT19: 2.5.2)))
mixed rainfed-irrigated
full irrigation

<table>
<thead>
<tr>
<th>Purpose related to land degradation</th>
<th>Degradation addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ prevent land degradation</td>
<td>soil erosion by water</td>
</tr>
<tr>
<td>✓ reduce land degradation</td>
<td>- Wt: loss of topsoil</td>
</tr>
<tr>
<td>restore/ rehabilitate severely</td>
<td>chemical soil deterioration</td>
</tr>
<tr>
<td>degraded land</td>
<td>- Cn: fertility decline</td>
</tr>
<tr>
<td>adapt to land degradation</td>
<td>reduced organic matter content (not caused by erosion)</td>
</tr>
<tr>
<td>not applicable</td>
<td>water degradation</td>
</tr>
<tr>
<td></td>
<td>- Hp: decline of surface water quality</td>
</tr>
</tbody>
</table>

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)
- water degradation - Hp: decline of surface water quality

SLM group

- n.a.

SLM measures

- agronomic measures
- vegetative measures
  - V1: Tree and shrub cover, V2: Grasses and perennial herbaceous plants
- structural measures
  - S4: Level ditches, pits

TECHNICAL DRAWING

Technical specifications

Agroforestry system, which covers an area of 2 acre. The plot is bordered by Euphorbia tirucalli (Kariaria, milk bush) and Grevillea trees. The ditches are characterized by barriers of Napier grass. Intercropping of maize and beans: the distance from one line of maize and the other is of 1m.

Technical knowledge required for land users: moderate

Main technical functions: control of dispersed runoff: retain / trap, control of dispersed runoff: impede / retard, reduction of slope angle, reduction of slope length, improvement of ground cover, increase of infiltration, increase / maintain water stored in soil, water harvesting / increase water supply, sediment retention / trapping, sediment harvesting

Secondary technical functions: improvement of topsoil structure (compaction), stabilisation of soil (eg by tree roots against land slides), increase in organic matter, increase in nutrient availability (supply, recycling,...), improvement of water quality, buffering / filtering water, increase of biomass (quantity)

Mulching
Material/ species: Organic residues around Banana trees
Quantity/ density: undefined

Legume inter-planting

Quantity/ density: 4 kg

Manure / compost / residues

Material/ species: Leftovers and manure from two cows
Quantity/ density: 8 tonnes
Remarks: (for 1 year). The mix of organic material is left decomposed in a big hole.

Agronomic measure: organic fertilizers

Material/ species: Acid humic and N, P, K, microelements (Biodeposit Elixir: small bags (sachets) of 12 ml)
Remarks: 5 bags (1×12 litre), applied only on maize

Aligned: -graded strips

Vegetative material: T : trees / shrubs, F : fruit trees / shrubs, G : grass
Number of plants per (ha): 100 a strip
Vertical interval between rows / strips / blocks (m): few cm
Spacing between rows / strips / blocks (m): 1
Vertical interval within rows / strips / blocks (m): 0.25
Width within rows / strips / blocks (m): 1

Trees/ shrubs species: Grevillea (Grevillea robusta)

Fruit trees / shrubs species: Avocados (Persea americana - Mũkorobia), Bananas (Musa sapientum- Irigũ)

Grass species: Pennisetum pyramidalis (Napier grass or elephant grass)

Slope (which determines the spacing indicated above): 10%

If the original slope has changed as a result of the Technology, the slope today is (see figure below): 15%
Gradient along the rows / strips: 5-8%

Diversion ditch/ drainage
Spacing between structures (m): 1
Depth of ditches/pits/dams (m): 40/50
Width of ditches/pits/dams (m): 0.6/1

Slope (which determines the spacing indicated above): 5-8%

Lateral gradient along the structure: 15-20%

### ESTABLISHMENT AND MAINTENANCE: ACTIVITIES, INPUTS AND COSTS

<table>
<thead>
<tr>
<th>Calculation of inputs and costs</th>
<th>Most important factors affecting the costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Costs are calculated:</td>
<td>The main environmental constrain is water, in particular during dry season; An important cost is labour required to maintain all the SWC measures.</td>
</tr>
<tr>
<td>- Currency used for cost calculation: <strong>Kenyan Schellings</strong></td>
<td></td>
</tr>
<tr>
<td>- Exchange rate (to USD): 1 USD = 85.9 Kenyan Schellings</td>
<td></td>
</tr>
<tr>
<td>- Average wage cost of hired labour per day: 2.00</td>
<td></td>
</tr>
</tbody>
</table>

#### Establishment activities

1. Digging holes (1 feet ×1 feet) and planting trees (e.g. Grevillea trees along the boundaries and in line below the bunds of the ditches) (Timing/ frequency: March (before rains), 1 year)
2. Establishment of the ditches(digging ditch and creating soil bunds downward) and terracing. For 1 (in tot. are 5) : 2 p.d. * 1 day at 200 Ksh a day each. (Timing/ frequency: 2 times per year)
3. Digging the hole (3m×3m×1.5m) where to compost (Timing/ frequency: None)
4. Machine to grill/mill maize leftovers (chap cutter) (Timing/ frequency: None)
5. Purchase 2 cows (Timing/ frequency: None)
6. Purchase generator (Timing/ frequency: None)

#### Establishment inputs and costs

<table>
<thead>
<tr>
<th>Specify input</th>
<th>Unit</th>
<th>Quantity</th>
<th>Costs per Unit (Kenyan Schellings)</th>
<th>Total costs per input (Kenyan Schellings)</th>
<th>% of costs borne by land users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digging the hole (3m×3m×1.5m) where to compost</td>
<td>person/days</td>
<td>2.0</td>
<td>3.5</td>
<td>7.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Digging holes (1 feet ×1 feet) and planting trees</td>
<td>person/days</td>
<td>2.0</td>
<td>3.5</td>
<td>7.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Establishment of the ditches (digging ditch and creating soil bunds downward) and terracing</td>
<td>person/days</td>
<td>10.0</td>
<td>23.3</td>
<td>233.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machine to grill/mill maize leftovers (chap cutter)</td>
<td>piece</td>
<td>1.0</td>
<td>1164.0</td>
<td>1164.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Generator</td>
<td>piece</td>
<td>1.0</td>
<td>582.0</td>
<td>582.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Cow</td>
<td>piece</td>
<td>2.0</td>
<td>349.0</td>
<td>698.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Plant material</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seedlings Grevillea</td>
<td>pieces</td>
<td>54.0</td>
<td>0.1111</td>
<td>6.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

#### Total costs for establishment of the Technology

| Total costs for establishment of the Technology | 2'697.0 |
| Total costs for establishment of the Technology in USD | 31.4 |

#### Maintenance activities

1. Prepare and apply fertilizers (organic) (See Annex 3, Fig. 9&comments) (Timing/ frequency: Ferlizer application: after 1 week and 18 days, on maize only)
2. Prepare manure+compost/mulch (Summary 2.1.2 QT4): Labour (to grill/mill leftovers - 300 Ksh for fuel- leftovers to prepare food for cows-3 person days) rest, the farmer by himself feed cows on daily basis (3 times in a day). Fuel: 1litre×1 day (×3 days) (Timing/ frequency: compost/manure: 2 times/year in the field+grass; once on Bananas (where also added mulch))
3. Harvesting maize/beans (around Feb/March and Ag/Sept) (Timing/ frequency: 2 times)
4. Apply manure, mulch and compost (during March/April-long rains+Sept) just before the rains, when nutrients infiltrate into the soil with rainwater) (Summary 2.1.2 QT4) (Timing/ frequency: Compost/manure: 2 times/year in the field+grass; once on Bananas (where also added mulch))
5. Tilling-soil (digging holes to plant maize/beans: 7 inches deep (17cm), spaced 1 feet (0.30 m) in contours: dry planting (before rains starts) (Timing/ frequency: Once a year, before rainy season (around March/Sept))
6. Digging planting holes and planting grass (2 persons × 3 days; 200 Ksh) (Timing/ frequency: Every season (March/April and Sept/Oct))
7. Maintenance (weed control and cutting Napier grass and collecting fodder) (Fig. 11 Annex 3) (Timing/ frequency: Every season (March/Sept); cutting Napier: 3/4 times in a season)
8. Pruning branches and let them dry for firewood (Timing/ frequency: Every 3 seasons (and when shortage of firewood))
9. Clearing the tree for selling timber (the price depends also of the use of the chainsaw (or saw) or not (Timing/ frequency: When in need of cash (not regularly), not less than 5 years after planting)
10. Repairing the ditches and remove excess of soil/leaves accumulated during the rainy season (Timing/ frequency: After rains (every season))

#### Maintenance inputs and costs
### 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
- Thermal climate class: subtropics. June, July and August

#### 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)

#### 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
- 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)
- mixed (subsistence/commercial)
- commercial/ market

#### Off-farm income
- less than 10% of all income
- 10-50% of all income
- > 50% of all income

#### Relative level of wealth
- very poor
- poor
- average
- rich
- very rich

#### Level of mechanization
- manual work
- animal traction
- mechanized/ motorized

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**Wocat SLM Technologies**  
**Agroforestry system (intercropping beans/maize) with contour ditches...**  
**5/8**
<table>
<thead>
<tr>
<th>Sedentary or nomadic</th>
<th>Individuals or groups</th>
<th>Gender</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary</td>
<td>individual/ household</td>
<td>women</td>
<td>children</td>
</tr>
<tr>
<td>Nomadic</td>
<td>community</td>
<td>men</td>
<td>youth</td>
</tr>
<tr>
<td></td>
<td>cooperative</td>
<td></td>
<td>middle-aged</td>
</tr>
<tr>
<td></td>
<td>employee (company,</td>
<td></td>
<td>elderly</td>
</tr>
<tr>
<td></td>
<td>government)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area used per household</th>
<th>Scale</th>
<th>Land ownership</th>
<th>Land use rights</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ &lt; 0.5 ha</td>
<td>small-scale</td>
<td>state</td>
<td>open access (unorganized)</td>
</tr>
<tr>
<td>0.5-1 ha</td>
<td>medium-scale</td>
<td>company</td>
<td>communal (organized)</td>
</tr>
<tr>
<td>✓ 1-2 ha</td>
<td></td>
<td>communal/ village</td>
<td>leased</td>
</tr>
<tr>
<td>2-5 ha</td>
<td></td>
<td>group</td>
<td>individual</td>
</tr>
<tr>
<td>5-15 ha</td>
<td></td>
<td>individual, not titled</td>
<td></td>
</tr>
<tr>
<td>✓ 1-2 ha</td>
<td></td>
<td>individual, titled</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Access to services and infrastructure</th>
<th>poor</th>
<th>good</th>
</tr>
</thead>
<tbody>
<tr>
<td>health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>education</td>
<td></td>
<td></td>
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<tr>
<td>technical assistance</td>
<td></td>
<td></td>
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<tr>
<td>employment (e.g. off-farm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>markets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>roads and transport</td>
<td></td>
<td></td>
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<tr>
<td>drinking water and sanitation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>financial services</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>IMPACTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-economic impacts</td>
</tr>
<tr>
<td>Crop production</td>
</tr>
<tr>
<td>wood production</td>
</tr>
<tr>
<td>expenses on agricultural inputs</td>
</tr>
<tr>
<td>farm income</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Socio-cultural impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>situation of socially and economically disadvantaged groups (gender, age, status, ethnicity etc.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ecological impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>surface runoff</td>
</tr>
<tr>
<td>evaporation</td>
</tr>
<tr>
<td>soil moisture</td>
</tr>
<tr>
<td>soil cover</td>
</tr>
<tr>
<td>soil loss</td>
</tr>
<tr>
<td>biomass/ above ground C</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Off-site impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>water availability (groundwater, springs)</td>
</tr>
<tr>
<td>buffering/ filtering capacity (by soil, vegetation, wetlands)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COST-BENEFIT ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits compared with establishment costs</td>
</tr>
<tr>
<td>Short-term returns</td>
</tr>
<tr>
<td>Long-term returns</td>
</tr>
</tbody>
</table>

| Benefits compared with maintenance costs |
| Short-term returns | very negative | very positive |
| Long-term returns | very negative | very positive |

<table>
<thead>
<tr>
<th>CLIMATE CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gradual climate change</td>
</tr>
<tr>
<td>annual temperature increase</td>
</tr>
<tr>
<td>Climate-related extremes (disasters)</td>
</tr>
<tr>
<td>local rainstorm</td>
</tr>
</tbody>
</table>

Wocat SLM Technologies | Agroforestry system (intercropping beans/maize) with contour ditches... | 6/8
Other climate-related consequences
- local windstorm: very well
- drought: very well
- general (river) flood: very well
- reduced growing period: not well at all

ADOPTION AND ADAPTATION

<table>
<thead>
<tr>
<th>Percentage of land users in the area who have adopted the Technology</th>
<th>Of all those who have adopted the Technology, how many have done so without receiving material incentives?</th>
</tr>
</thead>
<tbody>
<tr>
<td>single cases/ experimental</td>
<td>0-10%</td>
</tr>
<tr>
<td>1-10%</td>
<td>11-50%</td>
</tr>
<tr>
<td>11-50%</td>
<td>&gt; 50%</td>
</tr>
</tbody>
</table>

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
- Better yields thanks to the intercropping measures taken.

Strengths: compiler’s or other key resource person’s view
- Intercropping is a commonly known practice which improves the overall conditions of the soil and provide better yields.

How can they be sustained / enhanced?
- Besides ‘companion planting’ there are plants which can be grown as forerunner plants (Storey, 2002). Depending also on the type of soil, attention could be given to some sps. which accumulate concentration of e.g. mineral accumulators, phosphorus, potassium, calcium, silica and sulphur.
- Another way to perhaps enhance the yields is relay intercropping. It is undersowing the next crop into the present crop, so that the present crop is a nurse crop and time and water is saved in the establishment of the following crop (Storey, 2002).
- Green manure as a way to add organic nutrients and combine more than one green manure and rotate, both legume (e.g. cowpeas, soybeans, annual sweet clover, vetch, sesbania, and velvet beans) and not legume (e.g. sudangrass, millet, sorghum, and buckwheat).

Weaknesses/ disadvantages/ risks: land user’s view
- The technologies in place require maintenance and monitoring, especially during rainy seasons
- Eventually subsides or be part of a CBO’s (Community Based Organizations) or SHG (Self Help Groups); Still the measures already in place could be improved: diversification of trees (e.g. indogenous) and trainings (e.g. pruning etc) could help the farmer in avoiding tree diseases and allocate more efficiently resources.
- The amount of work required to carry out all the activities is too much.

Agroforestry (Dispersed trees on cropland): The technology is simple to adopt and improves a sustainable land management as well as diversification of income sources and food supply.

How can they be sustained / enhanced?
- How can they be sustained / enhanced? It could be implemented by increasing the number of trees planted (e.g. along the boundaries) and with sps. characterised by deeper root systems, to avoid further water competition. More Avocadoe trees could increase the opportunities for the farmer to be part of a CBO (Community Based Organization) addressed to marketing of Avocados for oil production. This could help the farmer to earn more money and invest more in SWC implementation and new methods, in the long run.
- The option of alley cropping (hedgerow Intercropping) with leguminous plants e.g. Sesbanian sesban (Ramachandran Nair-ICRAF, 1993) could be considered as another option.
- Napier grass has very good properties in holding soil; also for ditch stabilization and fodder production

How can they be sustained / enhanced?
- Other herbaceous vegetation could be also planted in the field: e.g. Thithonia diversifolia (Mexican sunflower), an excellent (high quality-N, P, K concentration) green manure /nutrient release and medicinal plant, or could be also used as a major component of compost manure.
- It is an annual weed that can be used for several purposes: fodders, poultry feed, fuel, compost, land demarcation, soil erosion, building materials, shelter for poultry. It is characterized by adaptability to different environment, rapid growth, fast rate of decomposition. Nevertheless, there is the
need to ascertain the extent to which this weed sps. could be used for soil improvement and to determine the best mode of application of the weed sps., (Olabode et al., 2007, Olubukola et al., 2013) and the fact that is a invasive weed (with an aggressive growth) it requires a good knowledge in the land management and weed control.

- The attention to certified varieties give also more value to the production itself and at market level: an increase of the bargaining power creates more opportunities for better income and chances to explore new and bigger markets, (e.g. Avocados for oil production).

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Full description in the WOCAT database

Linked SLM data
n.a.

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