Agro-silvo-pastoralisme on north facing slopes (Haiti)
Ti forè (engl.: little forest)

**DESCRIPTION**

Agroforestry is a way of incorporating agricultural land combining trees and crops and / or livestock. The technology increases and diversifies production, generating social, economic and environmental benefits. In addition, planted around houses, trees offer hurricane protection.

Agroforestry systems in Haiti are traditional land use practices characterised by a multi-storey arrangement of tall native trees, fruit species at various heights and a range of perennial and annual crops below. In Léogâne, large agroforestry systems are reduced to areas on less sun-exposed and more humid north-facing slopes. They are often agro-silvo-pastoralist systems, since while land users take their animals into small forests for grazing, their cattle also feed on old banana stems. In return, animal manure fertilizes the soil. In order to implement this technology, land users plant fruit trees and cash crops in the understory of conserved, mature trees, e.g. Samanea saman, a popular tree for agroforestry, as its characteristic umbrella shape protects the crops underneath from sun damage. The most common crops used for agroforestry in Léogâne are yam, mango, breadfruit, banana, pomelo and papaya. This system also provides an excellent environment for the cash crops of coffee and cacao. There is no particular layout in which agroforestry systems are established, but the trees and crops are equally distributed. For maintenance, land users remove weeds that compete with the crops, replace old trees/ crops with new ones (e.g. coffee bushed are replaced every 20 years) and distribute the banana suckers (lateral shoot that emerges from the soil usually near the parent plant).

Agroforestry systems combine economy with ecology. They enable the cultivation of edible products while at the same time conserving natural resources. In contrast to weeded/ ploughed crops (predominately found on sunnier and drier south-facing slopes), agroforestry mitigates soil erosion when applied on slopes. The vegetation cover hinders soil compaction and improves rainwater infiltration. Therefore, agroforestry reduces runoff, replenishes groundwater and improves the quality and quantity of springs. Moreover, agroforestry protects villages and cropland downstream from floods, landslides and siltation. Land users appreciate this technology for its great diversity of products, year-round harvest and the income of cash crops. However, land users are often troubled by the time required before receiving benefits from the first harvest from the trees. This is often the hindering factor for out-scaling this technology.

**LOCATION**

Location: Léogâne, Département d’Ouest, Haiti

No. of Technology sites analysed: 2-10 sites

Geo-reference of selected sites
-72.59102, 18.39474
-72.64129, 18.39852
-72.64047, 18.40198
-72.65365, 18.39821
-72.63619, 18.39858
-72.66942, 18.38859

Spread of the Technology: evenly spread over an area (approx. 0.1-1 km2)

In a permanently protected area?: No

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
The combination of agroforestry with livestock makes the soil more fertile. (Joana Eichenberger)

Agroforestry offers good soil cover. (Joana Eichenberger)

### CLASSIFICATION OF THE TECHNOLOGY

<table>
<thead>
<tr>
<th>Main purpose</th>
<th>✓</th>
</tr>
</thead>
<tbody>
<tr>
<td>improve production</td>
<td></td>
</tr>
<tr>
<td>reduce, prevent, restore land degradation</td>
<td></td>
</tr>
<tr>
<td>conserve ecosystem</td>
<td></td>
</tr>
<tr>
<td>protect a watershed/ downstream areas – in combination with other Technologies</td>
<td></td>
</tr>
<tr>
<td>preserve/ improve biodiversity</td>
<td></td>
</tr>
<tr>
<td>adapt to climate change/ extremes and its impacts</td>
<td></td>
</tr>
<tr>
<td>mitigate climate change and its impacts</td>
<td></td>
</tr>
<tr>
<td>create beneficial economic impact</td>
<td>✓</td>
</tr>
<tr>
<td>create beneficial social impact</td>
<td></td>
</tr>
</tbody>
</table>

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

#### Cropland
- Annual cropping: root/tuber crops - sweet potatoes, yams, taro/cocoyam, other
- Perennial (non-woody) cropping: banana/plantain/abaca
- Tree and shrub cropping: avocado, cacao, coffee, shade grown, mango, mangosteen, guava, papaya, pomelo, breadfruit (artocarpus altilis)

<table>
<thead>
<tr>
<th>Is crop rotation practiced?</th>
<th>No</th>
</tr>
</thead>
</table>

| Animal type: cattle - dairy, cattle - non-dairy beef, goats |    |
| Is integrated crop-livestock management practiced? | Yes |

| Products and services: meat, milk |    |

#### Grazing land
- Cattle and goats are brought into the forest, tied to a tree or pole and fed with old banana trunks
- Animal type: cattle - dairy, cattle - non-dairy beef, goats

<table>
<thead>
<tr>
<th>Is integrated crop-livestock management practiced?</th>
<th>Yes</th>
</tr>
</thead>
</table>

| Products and services: meat, milk |    |

#### Forest/ woodlands
- (Semi-)natural forests/ woodlands: subtropical humid forest natural vegetation, tropical rain forest natural vegetation. Management: Selective felling, Non-wood forest use
- Tree types (deciduous): n.a.
- Products and services: Fruits and nuts, Other forest products, Grazing/ browsing, Nature conservation/ protection, Protection against natural hazards

<table>
<thead>
<tr>
<th>Water supply</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>rainfed</td>
<td></td>
</tr>
<tr>
<td>mixed rainfed-irrigated</td>
<td></td>
</tr>
<tr>
<td>full irrigation</td>
<td></td>
</tr>
</tbody>
</table>

#### Purpose related to land degradation
- 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, Wg: gully erosion/ gullyng, Wm: mass movements/ landslides, Wo: offsite degradation effects
- biological degradation - Bc: reduction of vegetation cover, Bh: loss of habitats, Bq: quantity/ biomass decline, Bs: quality and species composition/ diversity decline, Bl: loss of soil life
- water degradation - Ha: aridification, Hs: change in quantity of surface water, Hp: change in groundwater/aquifer level, Hp: decline of surface water quality

### Wocat SLM Technologies

<table>
<thead>
<tr>
<th>SLM group</th>
<th>• agroforestry</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLM measures</td>
<td>Agro-silvo-pastoralisme on north facing slopes</td>
</tr>
</tbody>
</table>
improved ground/vegetation cover
ecosystem-based disaster risk reduction

**Vegetative measures - V1: Tree and shrub cover**

**Management measures - M1: Change of land use type**

**Technical drawing**

**Technical specifications**

If possible, land users profit from groups of existing large trees (eg. Samanea Saman) to grow coffee, bananas, pomelo, yam, etc. underneath. An agroforestry system optimizes light, provides rich and abundant organic matter, and contributes greatly to maintaining the balance of the ecosystem. When applied on slopes, agroforestry systems are able to conserve soil. The deep roots of large trees stabilize the soil and allow better infiltration of water.

**Establishment and maintenance: activities, inputs and costs**

**Calculation of inputs and costs**

- Costs are calculated: per Technology area (size and area unit: 0.5ha)
- Currency used for cost calculation: HTG
- Exchange rate (to USD): 1 USD = 62.0 HTG
- Average wage cost of hired labour per day: 200

**Most important factors affecting the costs**

The price of seeds: If some seeds from the last harvest are kept, there is no need to buy (many) new ones the next season. The price of the seeds varies seasonally. At the time of the harvest prices are low, and in March (beginning of the planting season), they are higher. By planting crops that regrow every season or trees with a long economic life, money can be saved on the cost of seeds. If the land users take care of their tools, they can last up to 6 years.

**Establishment activities**

1. Plant fruit/forest trees around the house, if there are already some, all the better. (Timing/ frequency: March / April (before big rainy season))
2. Plant crops between the trees (Timing/ frequency: March / April (before big rainy season))

**Establishment inputs and costs (per 0.5ha)**

<table>
<thead>
<tr>
<th>Specify input</th>
<th>Unit</th>
<th>Quantity</th>
<th>Costs per Unit (HTG)</th>
<th>Total costs per input (HTG)</th>
<th>% of costs borne by land users</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Labour</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour person-days</td>
<td>person-days</td>
<td>10.0</td>
<td>200.0</td>
<td>2000.0</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoe pieces</td>
<td>pieces</td>
<td>1.0</td>
<td>5.0</td>
<td>5.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Pickaxe pieces</td>
<td>pieces</td>
<td>1.0</td>
<td>5.0</td>
<td>5.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Machete pieces</td>
<td>pieces</td>
<td>1.0</td>
<td>5.0</td>
<td>5.0</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Plant material</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banana tree cutting</td>
<td>cutting</td>
<td>10.0</td>
<td>75.0</td>
<td>750.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Cacao tree seeds milk powder tin</td>
<td></td>
<td>0.25</td>
<td>500.0</td>
<td>125.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Coffee tree seeds milk powder tin</td>
<td></td>
<td>0.25</td>
<td>500.0</td>
<td>125.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Coconut tree cutting</td>
<td>cutting</td>
<td>3.0</td>
<td>500.0</td>
<td>1500.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Mango tree cutting</td>
<td>cutting</td>
<td>1.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Papaya tree cutting</td>
<td>cutting</td>
<td>3.0</td>
<td>30.0</td>
<td>90.0</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coffee for labourers</td>
<td>cup</td>
<td>10.0</td>
<td>25.0</td>
<td>250.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Total costs for establishment of the Technology**

| Total cost for establishment of the Technology in USD | 4'955.0 |

**Total costs for establishment of the Technology in USD**

| Total cost for establishment of the Technology in USD | 79.92 |
### Maintenance activities
1. Weeding during the first 2 years (Timing/ frequency: First 2x a year and after 2 years only when necessary (about 1 once a year))
2. Harvest (Timing/ frequency: throughout the year)
3. Cut banana trunks to give cattle (Timing/ frequency: throughout the year)
4. Plant new fruit trees (Timing/ frequency: March / April, frequency depends on the plant)

### Maintenance inputs and costs (per 0.5ha)

<table>
<thead>
<tr>
<th>Specify input</th>
<th>Unit</th>
<th>Quantity</th>
<th>Costs per Unit (HTG)</th>
<th>Total costs per input (HTG)</th>
<th>% of costs borne by land users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour</td>
<td>person-days</td>
<td>50.0</td>
<td>200.0</td>
<td>10000.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machete</td>
<td>pieces</td>
<td>1.0</td>
<td>5.0</td>
<td>5.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Hoe</td>
<td>pieces</td>
<td>1.0</td>
<td>5.0</td>
<td>5.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Pickaxe</td>
<td>pieces</td>
<td>1.0</td>
<td>5.0</td>
<td>5.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Plant material</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cacao tree (economic lifetime +/- 20yrs)</td>
<td>milk powder tin</td>
<td>0.5</td>
<td>500.0</td>
<td>250.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Coffee tree (economic lifetime +/- 20yrs)</td>
<td>milk powder tin</td>
<td>0.5</td>
<td>500.0</td>
<td>250.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Papaya tree (economic lifetime +/- 4yrs)</td>
<td>cutting</td>
<td>3.0</td>
<td>30.0</td>
<td>90.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Coconut tree (economic lifetime +/- 15-60yrs)</td>
<td>cutting</td>
<td>3.0</td>
<td>500.0</td>
<td>1500.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Mango tree (economic lifetime &gt;100yrs)</td>
<td>cutting</td>
<td>1.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

### 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
- semi-arid
- arid

#### Specifications on climate
- Léogâne has a tropical climate with a rainy season ranging from April to November (with two peaks in April-May and August-October) and a dry season from the end of November to March. The relative decrease in rainfall in June and July is called the “mid-summer drought”. Due to climate change, the rainy season tends to start later than it used to. Mean annual temperature: 25-27°C

#### 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)
- less than 10% of all income
- very poor
- manual work

Wocat SLM Technologies  Agro-silvo-pastoralisme on north facing slopes
### Mixed (subsistence/commercial) or commercial/market

<table>
<thead>
<tr>
<th>Income Share</th>
<th>Subsistence/commercial</th>
<th>Commercial/market</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-50% of all income</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>&gt; 50% of all income</td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

### Animal traction

- Sedentary or nomadic
  - Sedentary
  - Semi-nomadic
  - Nomadic
- Individuals or groups
  - Individual/household
  - Groups/community
  - Cooperative
  - Employee (company, government)

### Gender

- Men
- Women

### Age

- Youth
- Middle-aged
- Elderly

### Area used per household

- < 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

- Small-scale
- Medium-scale
- Large-scale

### Land ownership

- State
- Company
- Communal/village group
- Individual, not titled
- Individual, titled

### Land use rights

- Open access (unorganized)
- Open access (organized)
- Leased
- Individual

### Access to services and infrastructure

- Health
- Education
- Technical assistance
- Employment (e.g., off-farm)
- Markets
- Energy
- Roads and transport
- Drinking water and sanitation
- Financial services
- None

### IMpactS

#### Socio-economic impacts

- Crop production
- Crop quality
- Risk of production failure
- Product diversity
- Production area (new land under cultivation/use)
- Drinking water availability
- Drinking water quality
- Expenses on agricultural inputs
- Farm income

#### Socio-cultural impacts

- Food security/self-sufficiency
- SLM/land degradation
- Knowledge

#### Ecological impacts

- Water quantity
- Water quality
- Surface runoff
- Evaporation
- Soil moisture
- Soil cover
- Soil loss
- Soil accumulation
- Soil crusting/sealing
- Vegetation cover
- Biomass/above ground C
- Plant diversity
- Flood impacts
- Landslides/debris flows
- Drought impacts
- Impacts of cyclones, rainstorms
- Emission of carbon and greenhouse gases
- Micro-climate

---

**Wocat SLM Technologies**

**Agro-silvo-pastoralisme on north facing slopes** 5/7
Off-site impacts

- water availability (groundwater, springs): decreased
- reliable and stable stream flows in dry season (incl. low flows): reduced
- downstream flooding (undesired): increased
- downstream siltation: increased
- buffering/filtering capacity (by soil, vegetation, wetlands): reduced
- damage on neighbours’ fields: increased
- damage on public/private infrastructure: decreased

COST-BENEFIT ANALYSIS

Benefits compared with establishment costs
- Short-term returns: very negative (not well at all) → very positive (very well)
- Long-term returns: very negative (not well at all) → very positive (very well)

Benefits compared with maintenance costs
- Short-term returns: very negative (not well at all) → very positive (very well)
- Long-term returns: very negative (not well at all) → very positive (very well)

CLIMATE CHANGE

- tropical storm: not well at all (not well at all) → very well (very well)
- local rainstorm: not well at all (not well at all) → very well (very well)
- drought: not well at all (not well at all) → very well (very well)
- landslide: not well at all (not well at all) → very well (very well)

ADOPTION AND ADAPTATION

Percentage of land users in the area who have adopted the Technology
- single cases/experimental: Yes (✓)
- 1-10%: 0-10%
- 11-50%: 11-50%
- > 50%: > 50%

Of all those who have adopted the Technology, how many have done so without receiving material incentives?
- 0-10%: 0-10%
- 11-50%: 11-50%
- 51-90%: 51-90%
- 91-100%: 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
- Year-round production
- Diversity of production
- Increased income through cash crops (coffee, cocoa)

Strengths: compiler’s or other key resource person’s view
- Conservation of biodiversity
- Creation of microclimate
- CO2 sequestration
- Soil and water conservation
- Protecting homes against strong winds
- Protection of downstream areas from flooding and siltation

Weaknesses/disadvantages/risks: land user’s view → how to overcome
- The first harvest is late. → This is a big challenge because land users in the area live from hand to mouth. This can be overcome by planting fruit or forest tree seedlings when implementing progressive terraces with vetiver hedges (see documented technology in WOCAT database). In this way, the land user can plant and harvest other crops while waiting for the trees to grow.

Weaknesses/disadvantages/risks: compiler’s or other key resource person’s view → how to overcome
- Difficult to convince land users because the benefits are rather in the long-term. → It’s necessary to raise the land users’ awareness on all the benefits of this technology.

REFERENCES

Compiler
Joana Eichenberger
Date of documentation: Feb. 1, 2019

Reviewer
Hanspeter Liniger
Last update: June 16, 2020
Resource persons
Jean Carls Dessin - SLM specialist
Laurore Dieufort - land user

Full description in the WOCAT database

Linked SLM data

Documentation was facilitated by
Institution
• Swiss Red Cross (Swiss Red Cross) - Switzerland
Project
• n.a.

Links to relevant information which is available online