Intercropping of wheat in an existing apricot orchard (Erik Bühlmann (Berne, Switzerland))

Orchard-based Agroforestry (intercropping) (Tajikistan)

DESCRIPTION

Intercropping of wheat in an existing orchard that was established during the Soviet period.

The technology involves intercropping wheat in an existing apricot orchard, that was established during soviet times to increase farm production, by integrating different resources in an environment protected from soil erosion. The intercropped area is ploughed by tractor. In general, farmers do not practice crop rotation since they usually allocate cereal production to the most fertile field plots of their farm. Along the trees aligned on contour, a three metre wide grass strip is left uncultivated to control runoff, and to protect the ground from splash erosion. Spacing between rows is 13 metres, which allows unhindered farm operations.

Most orchards in Faizabad Rayon were established during Soviet times. Tree rows were planted close together in order to obtain maximum yields from the orchard monoculture systems. Some of the tree rows were removed, allowing more space for intercropping.

Purpose of the Technology: The technology is applied in existing orchards which generally range between 10-25% in gradient. In existing orchards, intercropping alone is relatively cost intensive. Harvesting two crops at a time increases overall farm production and improves food security since harvests of intercropped food crops are found to be more reliable than those on exposed annual cropland. However, many orchards are still owned by state farms which usually do not practice intercropping. Since management of fruit trees require considerable labour and material inputs (e.g. chemicals for pest/disease control as well as fertilisers) which often cannot be met by farmers, yields of fruit trees have declined after the privatisation of these areas. Furthermore, farmers often lack knowledge of appropriate orchard management techniques and miss opportunities to gradually replace old trees by new seedlings.

LOCATION

Location: Faizabad Rayon, Tajikistan, Tajikistan

No. of Technology sites analysed:

Geo-reference of selected sites

Spread of the Technology: evenly spread over an area (approx. 1-10 km²)

In a permanently protected area?:

Date of implementation:

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
- 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 - Agroforestry

Cropland
- Annual cropping: legumes and pulses - peas, fibre crops - flax, hemp, other, cereals - wheat (spring), fodder crops - other, fodder crops - alfalfa, esparzet
- Perennial (non-woody) cropping
- Tree and shrub cropping: fruits, other, stone fruits (peach, apricot, cherry, plum, etc)

Is intercropping practiced? Yes

Water supply
- rainfed ✓
- mixed rainfed-irrigated
- full irrigation

Purpose related to land degradation
- prevent land degradation ✓
- reduce land degradation
- 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/ guliying
- chemical soil deterioration - Cn: fertility decline and reduced organic matter content (not caused by erosion)

SLM group
- agroforestry

SLM measures
- agronomic measures - A1: Vegetation/ soil cover, A7: Others
- vegetative measures - V5: Others
- management measures - M1: Change of land use type

TECHNICAL DRAWING

Technical specifications
Intercropping of wheat between apricot trees aligned on contour

Location: Chinoro, Faizabad Rayon, RRS

Technical knowledge required for field staff / advisors: moderate

Technical knowledge required for land users: moderate

Main technical functions: control of dispersed runoff: impede / retard, control of concentrated runoff: impede / retard, reduction of slope length
Secondary technical functions: increase in nutrient availability (supply, recycling,...), increase of infiltration, increase / maintain water stored in soil, reduction in wind speed, increase in soil fertility

Mixed cropping / intercropping
Material/ species: winter wheat
Quantity/ density: 150kg/ha
Remarks: intercropping between tree rows

Mineral (inorganic) fertilizers
Material/ species: superphosphate, silitra
Quantity/ density: 200kg
Remarks: only for intercropped wheat

Contour tillage
Remarks: between tree rows

Aligned: -contour
Vegetative material: F : fruit trees / shrubs
Number of plants per (ha): 200
Vertical interval between rows / strips / blocks (m): 2
Spacing between rows / strips / blocks (m): 13
Vertical interval within rows / strips / blocks (m): 4

Vegetative measure: aligned: contour
Vegetative material: G : grass
Vertical interval between rows / strips / blocks (m): 2
Spacing between rows / strips / blocks (m): 10
Width within rows / strips / blocks (m): 3

Vegetative measure: Vegetative material: G : grass
Vegetative measure: Vegetative material: G : grass
Vegetative measure: Vegetative material: G : grass
Fruit trees / shrubs species: apricot trees
Slope (which determines the spacing indicated above): 18.00%
Gradient along the rows / strips: 0.00%

**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 number of trees influences costs considerably, since orchard management is labour and input intensive</td>
</tr>
<tr>
<td>Currency used for cost calculation: USD</td>
<td></td>
</tr>
<tr>
<td>Exchange rate (to USD): 1 USD = n.a</td>
<td></td>
</tr>
<tr>
<td>Average wage cost of hired labour per day: 3.00</td>
<td></td>
</tr>
</tbody>
</table>

**Establishment activities**
1. establishment of apricot orchard by state enterprise (Timing/ frequency: established in 1989)
2. acquiring land use rights for existing orchard lands from local authorities (Timing/ frequency: None)
3. thinning and clearing of tree rows (Timing/ frequency: None)

**Establishment inputs and costs**

<table>
<thead>
<tr>
<th>Specify input</th>
<th>Unit</th>
<th>Quantity</th>
<th>Costs per Unit (USD)</th>
<th>Total costs per input (USD)</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>thinning and clearing of tree rows</td>
<td>ha</td>
<td>1.0</td>
<td>6.0</td>
<td>6.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tools</td>
<td>ha</td>
<td>1.0</td>
<td>25.0</td>
<td>25.0</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total costs for establishment of the Technology</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31.0</td>
</tr>
<tr>
<td><strong>Total costs for establishment of the Technology in USD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>31.0</td>
</tr>
</tbody>
</table>

**Maintenance activities**
1. disc ploughing (area for intercropping) (Timing/ frequency: before sowing / annual)
2. sowing (winter wheat) (Timing/ frequency: None)
3. applying of fertiliser (Timing/ frequency: early spring / each cropping season)
4. harvesting (Timing/ frequency: summer / each cropping season)
5. pruning of fruit trees (Timing/ frequency: autumn/winter / annual)
6. cutting of grass strip (Timing/ frequency: summer / annual)
7. applying manure for fruit trees (Timing/ frequency: winter/early spring / annual)
8. removal of twigs affected by insects/deseases (Timing/ frequency: spring /weekly)

**Maintenance inputs and costs**
### Natural Environment

<table>
<thead>
<tr>
<th>Average annual rainfall</th>
<th>Agro-climatic zone</th>
<th>Specifications on climate</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 250 mm</td>
<td>humid</td>
<td>growing period between 180-210 days</td>
</tr>
<tr>
<td>251-500 mm</td>
<td>sub-humid</td>
<td></td>
</tr>
<tr>
<td>501-750 mm</td>
<td>semi-arid</td>
<td></td>
</tr>
<tr>
<td>≥ 751-1,000 mm</td>
<td>arid</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Landforms</th>
<th>Soil depth</th>
<th>Soil texture (topsoil)</th>
<th>Soil texture (&gt; 20 cm below surface)</th>
<th>Topsoil organic matter content</th>
</tr>
</thead>
<tbody>
<tr>
<td>plateau/plains</td>
<td>very shallow (0-20 cm)</td>
<td>coarse/ light (sandy)</td>
<td>coarse/ light (sandy)</td>
<td>high (&gt;3%)</td>
</tr>
<tr>
<td>ridges</td>
<td>shallow (21-50 cm)</td>
<td>medium (loamy, silty)</td>
<td>medium (loamy, silty)</td>
<td>medium (1-3%)</td>
</tr>
<tr>
<td>mountain slopes</td>
<td>moderately deep (51-80 cm)</td>
<td>fine/ heavy (clay)</td>
<td>fine/ heavy (clay)</td>
<td>low (&lt;1%)</td>
</tr>
<tr>
<td>hill slopes</td>
<td>deep (81-120 cm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>foothills</td>
<td>very deep (&gt;120 cm)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Groundwater table</th>
<th>Availability of surface water</th>
<th>Water quality (untreated)</th>
<th>Is salinity a problem?</th>
<th>Occurrence of flooding</th>
</tr>
</thead>
<tbody>
<tr>
<td>on surface</td>
<td>excess</td>
<td>good</td>
<td>good drinking water</td>
<td>Yes</td>
</tr>
<tr>
<td>&lt; 5 m</td>
<td>good</td>
<td>medium</td>
<td>poor drinking water</td>
<td>No</td>
</tr>
<tr>
<td>5-50 m</td>
<td>poor/ none</td>
<td></td>
<td>(treatment required)</td>
<td></td>
</tr>
<tr>
<td>&gt; 50 m</td>
<td></td>
<td></td>
<td>for agricultural use only (irrigation)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>unusable</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Species diversity</th>
<th>Habitat diversity</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>low</td>
<td>low</td>
</tr>
</tbody>
</table>

### Characteristics of Land Users Applying the Technology

<table>
<thead>
<tr>
<th>Market orientation</th>
<th>Off-farm income</th>
<th>Relative level of wealth</th>
<th>Level of mechanization</th>
</tr>
</thead>
<tbody>
<tr>
<td>subsistence (self-supply)</td>
<td>less than 10% of all income</td>
<td>very poor</td>
<td>manual work</td>
</tr>
<tr>
<td>mixed (subsistence/commercial)</td>
<td>10-50% of all income</td>
<td>poor</td>
<td>animal traction</td>
</tr>
<tr>
<td>commercial</td>
<td>&gt; 50% of all income</td>
<td>average</td>
<td>mechanized/ motorized</td>
</tr>
</tbody>
</table>

<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>Semi-nomadic</td>
<td>groups/ community</td>
<td></td>
<td>youth</td>
</tr>
<tr>
<td>Nomadic</td>
<td>cooperative</td>
<td></td>
<td>middle-aged</td>
</tr>
<tr>
<td></td>
<td>employee (company, government)</td>
<td></td>
<td>elderly</td>
</tr>
</tbody>
</table>
### Access to services and infrastructure

#### IMPACTS

**Socio-economic impacts**

- **Crop production**
  - Decreased
  - Increased
  - Hindered
  - Simplified

- **expenses on agricultural inputs**
  - Increased
  - Decreased

- **farm income**
  - Decreased
  - Increased

- **fruit production**
  - Decreased
  - Increased

- **fruit yields**
  - Decreased
  - Increased

**Socio-cultural impacts**

- **conflict mitigation**
  - Worsened
  - Improved

**Ecological impacts**

**Off-site impacts**

### COST-BENEFIT ANALYSIS

**Benefits compared with establishment costs**

- **Short-term returns**
  - Very negative
  - Very positive

- **Long-term returns**
  - Very negative
  - Very positive

**Benefits compared with maintenance costs**

- **Short-term returns**
  - Very negative
  - Very positive

- **Long-term returns**
  - Very negative
  - Very positive

### CLIMATE CHANGE

- **ADOPTION AND ADAPTATION**

- **Percentage of land users in the area who have adopted the Technology**
  - Single cases/ experimental
  - 1-10%
  - 11-50%
  - > 50%

- **Number of households and/ or area covered**
  - NA

- **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**

- Two harvests at a time

**Weaknesses/ disadvantages/ risks: land user's view → how to overcome**

---

Area used per household

<table>
<thead>
<tr>
<th>Area used per household</th>
<th>Scale</th>
<th>Land ownership</th>
<th>Land use rights</th>
<th>Water 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>
<td>open access (unorganized)</td>
</tr>
<tr>
<td>0.5-1 ha</td>
<td>medium-scale</td>
<td>company</td>
<td>communal (organized)</td>
<td>communal (organized)</td>
</tr>
<tr>
<td>✓ 1-2 ha</td>
<td>large-scale</td>
<td>communal/ village</td>
<td>individual</td>
<td>leased</td>
</tr>
<tr>
<td>✓ 2-5 ha</td>
<td></td>
<td>group</td>
<td>individual, not titled</td>
<td>individual</td>
</tr>
<tr>
<td>5-15 ha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-50 ha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50-100 ha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100-500 ha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>500-1,000 ha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,000-10,000 ha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 10,000 ha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
How can they be sustained / enhanced? Increase in farm production
- Good wheat harvests in intercropping systems

Strengths: compiler's or other key resource person's view
- Low costs for establishment (intercropping only)
- Wheat production with very little soil erosion
- Intercropping can improve food security of low income families

Weaknesses/ disadvantages/ risks: compiler's or other key resource person's view
- How to overcome
  - Productive orchard systems require considerable amounts of recurrent inputs (e.g., chemicals for pest/disease control, fertiliser) which locals often cannot afford → avoiding intercropping of sparsely growing crops in vulnerable intercropping systems; improving ground cover by mulching
  - In comparison to orchards with an intact grass cover, intercropping of sparsely growing plant species increases the risk of soil erosion
  - Intercropped wheat hinders maintenance activities of fruit trees

yield of fruit trees insufficient because required inputs are not affordable → gradually replace old trees by new seedlings
- Insufficient yields of intercropped plants because of shadow of old/large fruit trees
- Orchard systems vulnerable to pests, late frost and strong winds

REFERENCES

Compiler
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Reviewer
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Resource persons
Erik Bühlmann - SLM specialist
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Full description in the WOCAT database

Linked SLM data
n.a.

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