Climate Smart Agricultural Practices for Food Security in the Mountain Areas of Eastern Himalayas

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Eastern Himalayas: Case Studies
Some features

- Rainfed upland/hill (high slope land) agro-ecosystem
- Area: 90% hills & 10% valley
- Climate: Mild tropical to temperate
- Rainy season: May to October
- Rainfall: 1500 mm (Annual average)
- Temperature: 0.5 to 35°C
- Humidity: 40 to 100%
- Soil: Clay to clay loam (valley), Red lateritic soil (hills)
- pH: 4.5 to 6.5
- Severe soil erosion
Sand deposit over highly fertile lowlands
Some major farming systems in Mountain Areas of Eastern Himalayas

• Jhum cultivation system (clearing-burning-cultivating for 6-7 years-abandoning for 4-5 years and coming back there again)

• Maize, Potato, Pastoral, Tree crops, and Rice based farming
Issues related to the target environment/ecosystem

* No income during initial one and half year
* Degradation of forest/vegetation in *jhum* system due to shortening of *jhum* cycle
* In-situ depletion of soil productivity due to surface soil erosion, and at ex-situ due to sand deposits
* Lack of moisture during dry season
* Flooding due to excessive run off during rains
* Unavailability of appropriate technology for sustainable productivity
Manipur, India and Salamjee, Bhutan
Discussion and diagnosis camps at pilot villages
Participating farmers at Kairembikhok village
Benefits of working in group

- Solution to labor shortage
- Sharing of indigenous knowledge
- Completing work within shorter time period
- Sharing of harder part of the work by stronger and weaker populace
- Strengthened social relations and improved cooperation and cohesion
- Equity for the weaker sections of society to be taken on-board
- Capacity to extend their efforts through coordinated effort and united decision making process
The group decided that the interventions:

- **Cover entire landscape**
- **Provide early income, increase with time**
- **Be regular source of income**
- **Focus on crops farmers are familiar with**
- **Build capacity on specific aspects**
Technology adoption to be accelerated for the target site

- **Agro-horti-silviculture farming**
- **Intercropping between horticultural and silvicultural plants with adapted varieties of suitable crop species as filler crop**
- **Agronomic measures for soil and water conservation, such as the contour planting, mixed cropping, etc.**
Agro-horti-silvicultural farming system adopted

*Timber crops -
1. Teak (*Tectonia grandis*)
2. Champa (*Michelia champaka*)
3. Wang (*Gmelina arborea*)

*Fruit crops -
1. Citrus sp. (*Citrus raticulata*, *C. aurantifolia*, *C. macrotera*)
2. Pineapple (*Ananas comosus*)
3. Jackfruit (*Autocarpus heterophyllus*)
4. Passion fruit (*Passiflora edulis* Sims.)

* Field crops -
1. Arhar (*Cajanus cajan*)
2. Ricebean (*Vigna umbellata*)
3. Groundnut (*Arachis hypogae*)
4. Soybean (*Glycine max*)
5. Rice and Wheat
Start of income

• Field crops, including tubers  -  4-6 months

• Pineapple  -  18 months onwards

• Passion fruit  -  24 months onwards

• Grafted citrus  -  24 months onwards

• Jackfruit  -  5 years onwards

• Timber trees  -  After 10 years
Cultivation system of agro-horti-silviculture

1. Timber crops as pure crops at the uppermost crest (upper slopes)

2. Pineapple, citrus, Jackfruit and some timber planted on mid slopes as pure as well as inter-crop with pulses/oilseeds and other crops

3. Bottom lands are grown to rice and upland crops
New crops introduced by farmers themselves

1. Passion fruit in eroded lands.

2. Ginger, turmeric and colocassia as inter-crops in between pineapple.

3. Mustard and peas in bottom lands after rice.
Forest resource mapping, and citrus nursery raising
Citrus Patch and T-budding, and backyard kitchen gardening
Nursery raisin and tree plantation and management
# Performance of timber crops

<table>
<thead>
<tr>
<th>Tree species</th>
<th>Planted</th>
<th>%Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teak (<em>Tectonia grandis</em>)</td>
<td>1,000</td>
<td>67.6</td>
</tr>
<tr>
<td></td>
<td>(1,980)</td>
<td>(60.2)</td>
</tr>
<tr>
<td>Champa (<em>Michelia champaka</em>)</td>
<td>1,000</td>
<td>68.9</td>
</tr>
<tr>
<td></td>
<td>(545)</td>
<td>(58.2)</td>
</tr>
<tr>
<td>Wang (<em>Gmelina arboria</em>)</td>
<td>1,000</td>
<td>63.4</td>
</tr>
<tr>
<td></td>
<td>(765)</td>
<td>(65.4)</td>
</tr>
<tr>
<td>Total</td>
<td>3,000</td>
<td>66.6</td>
</tr>
<tr>
<td></td>
<td>(3,290)</td>
<td>(61.3)</td>
</tr>
</tbody>
</table>

Figures in parenthesis are for previous year.
## Performance of fruit crops

<table>
<thead>
<tr>
<th>Fruit species</th>
<th>Planted</th>
<th>% Survival</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Citrus sp.</strong></td>
<td>3,690</td>
<td>68.5</td>
</tr>
<tr>
<td></td>
<td>(3,250)</td>
<td>(57.7)</td>
</tr>
<tr>
<td><strong>Pineapple</strong></td>
<td>1,20,000</td>
<td>91.9</td>
</tr>
<tr>
<td></td>
<td>(1,39,000)</td>
<td>(100)</td>
</tr>
<tr>
<td><strong>Jackfruit</strong></td>
<td>300</td>
<td>81.1</td>
</tr>
<tr>
<td></td>
<td>(447)</td>
<td>(48.8)</td>
</tr>
<tr>
<td><strong>Passion fruit</strong></td>
<td>570</td>
<td>74</td>
</tr>
</tbody>
</table>

Figures in parenthesis are for the year before
## Performance of intercrops with pineapple

<table>
<thead>
<tr>
<th>Intercrop</th>
<th>Productivity (kg/ha)</th>
<th>Current yr.</th>
<th>Previous yr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arhar (<em>Cajanus cajan</em>)</td>
<td>1,450</td>
<td>665</td>
<td></td>
</tr>
<tr>
<td>Ricebean (<em>Vigna umbellate</em>)</td>
<td>1,635</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Groundnut (<em>Arachis hypogaeae</em>)</td>
<td>1,055</td>
<td>678</td>
<td></td>
</tr>
<tr>
<td>Soybean (<em>Glycine max</em>)</td>
<td>683</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
Pineapple intercropped with ground nuts and pigeon pea
Pineapple – ginger and Pineapple – soybean intercropping in old tree systems, Manipur
Kairenbikhok Awang hill in Saram hill range, Thoubal Dist. (Manipur), then
Kairenbikhok Awang hill in Saram hill range, Thoubal Dist. (Manipur), Now
Agro-horti-silviculture system, now
Salamjee, Bhutan then
Salamjee, Bhutan Birds eye view now
Salamjee, Bhutan at present
Locally fabricated equipment for measuring soil erosion
## Soil erosion loss under different land uses

<table>
<thead>
<tr>
<th>Land use</th>
<th>Soil erosion loss</th>
<th>Mild slope</th>
<th>Steep slope</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>up to 30%</td>
<td>&gt; 30%</td>
</tr>
<tr>
<td>Jhum (Traditional)</td>
<td>140 t/ha/year</td>
<td>170 t/ha/year</td>
<td></td>
</tr>
<tr>
<td>Agroforestry (Adopted)</td>
<td>15 t/ha/year</td>
<td>27 t/ha/year</td>
<td></td>
</tr>
</tbody>
</table>
Key results so far

1. Area covered by the adopted technologies is increasing
2. Productivity of introduced crops is increasing
3. Farm level biodiversity is increasing
4. Cropping intensity is increasing
5. Soil losses are decreasing
6. System is providing regular income; seasonal, yearly, after two years and so on
7. Farm income is increasing with the progress of time
8. Employment opportunities are increasing

The introduced agro-horti-silvi culture system as chosen and modified by the farmers is increasingly contributing to the livelihoods of these farmers
Problems faced in the implementation of the project

1. Lack of seedlings and quality planting material of desired species.

2. Farmer’s new interventions making the comparison difficult.
Lessons learnt

- Land degradation issues can better addressed through community-based approach
- Manageable group size is between 20-25 HH
- A start up fund support is a must
- Capacity building should be the integral component
- Committed leadership required (to start and to take it further)
- HH be in dire need for implementing SLM
Lessons learnt

• Farmers wanted a high level of biodiversity at the farm level and were interested in mixed planting rather than pure crop block planting (minimizing risk from failure)

• Joint planning with multi-stakeholders made the implementation easy

• Providing support for weakest input (seedlings) was essential for accelerating the technology adoption

• The participation of entire village community was a key to the success of the project, e.g. protecting from stray cattle and stealing, etc.
Thank you