The Limits and potentials of slope lands

The limits

- Soil erosion
- Poor fertility and soil degradation
- Drought in dry season
- Plant covered decrease
- Isolated position
- Poor infrastructure
- High rate of poverty and low education
Development of indigenous technologies for sustainable sloping land use in Northern mountainous areas of Vietnam

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Potentials

- Expand areas for cultivation
- Forest potentials
- Potentials for commercial crops' development
- Energical potential
- Livestock development
Tendency of changing land use systems in upland areas

Traditional shifting cultivation to non-traditional shifting cultivation

<table>
<thead>
<tr>
<th>Traditional cultivation</th>
<th>Non-traditional cultivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hole and sowing <em>(minimum tillage)</em></td>
<td>• Careful land preparation <em>(maximum tillage)</em></td>
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<tr>
<td>• Longterm of fallow period <em>(Low cultivation coefficience)</em></td>
<td>• Shorten of fallow period <em>(High cultivation coefficience)</em></td>
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<tr>
<td>• Slow degradation of soil fertility</td>
<td>• Rapid degradation of soil fertility</td>
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</tbody>
</table>
**Expansion of permanent cultivation areas**

Number of cultivation years

Cultivation coefficient (R %) = \[ \frac{\text{Total years of cultivation cycle}}{\text{(Include cultivation and fallow period)}} \times 100 \]

Total years of cultivation cycle

(Include cultivation and fallow period)

<table>
<thead>
<tr>
<th>Year</th>
<th>Land use pattern</th>
<th>R (%)</th>
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<tbody>
<tr>
<td>Before 1954</td>
<td>Traditional shifting cultivation <em>(Long fallow period)</em></td>
<td>&lt;20</td>
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<tr>
<td>1965</td>
<td>Traditional shifting cultivation <em>(Long fallow period)</em></td>
<td>20-25</td>
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<tr>
<td>1980</td>
<td>Transfr from traditional shifting cultivation to non-traditional shifting cultivation</td>
<td>30-40</td>
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<tr>
<td>1985</td>
<td>Non-traditional shifting cultivation <em>(Short fallow period)</em></td>
<td>45-50</td>
</tr>
<tr>
<td>Present</td>
<td>Non-traditional shifting cultivation <em>(Very short fallow period)</em></td>
<td>50-100</td>
</tr>
</tbody>
</table>
Landuse systems in the past

- Streams
- Paddy field (1 crop/year)
- House
- Shifting cultivation (Upland rice)
- Pasture (Goat, buffalo, ...)
- Natural forest

Diversification of landuse system

Landuse systems in present

- Streams
- Paddy field (2 crops/year)
- House
- Home garden, Hill garden (Vegetable, Fruit tree, ...)
- Permanent cultivation (Bean, Maize, Cassava, ...)
- Shifting cultivation (Bean, Maize, cassava, ...)
- Pasture (Buffalo, Goat, ...)
- Upland rice
- Forest
Natural forest

Traditional shifting cultivation

Non-traditional shifting cultivation

Permanent cultivation for food crops

Permanent cultivation for cash crops

Mixed home garden

Hill garden

Population increase

Tendency of changing landuse systems by increase of cultivation coefficient

Cultivation coefficient (%)

0

15-30

50-60

100

100

Mixed home garden

Hill garden

Permanent cultivation for cash crops

Permanent cultivation for food crops

Non-traditional shifting cultivation

Traditional shifting cultivation

Natural forest
Indigenous knowledges
Apply green manure
Apply green manure
Intercrop maize with rice bean
Common situation of traditional slash and burn
Need to change the concept on the use and management of SL

• Although the farmers have tried their best to find ways for maintaining their lives and preserve their natural resources, but due to objective and subjective reasons, SL have become very fragile eco-systems, easily to be injured, causing constraints for agricultural and forestry production.

• To ensure sustainability as basis for maintaining and developing agricultural production on SL, we have to change our mind to build the new vision on the use and management of SL.

• Measures for maintenance and improvement of soil fertility must be highly systematic and diverse, ensuring integration of food production, animal husbandry and forestry development.
Basic principles of Technologies

Soil erosion control; soil fertility, chemical and physical improvement; Improvement of rain water use efficiency:

• **Permanent soil cover by dead or living vegetal mulch** (stop burning any vegetal residues from crops, weeds, litters, etc.),

• **Direct seeding on vegetal mulch with no- or mini-tillage** (minimum soil disturbance),

• **Improving cropping patterns** (intercropping, relay-cropping, crop rotation),

• **Promotion of soil biological activities**;
Basic principles of Technologies

- Diverse technology options to serve farmers with various conditions,
- The technologies must be simple, cheap, labor effective, easy to apply and sustainable,
- Integration of animal fodder production into crop production systems (reducing pressure on grazing land and on forest resources by less free grazing),
- Species adaptation and varietal improvement.
Using vegetal residues to cover the soil surface in sloping land
Maize sown directly into dead mulch
- Control soil erosion
- Maintain soil moisture
- Promote soil biological activities

Fully weed control
Yield increased 45 %
Difference between mulched and un-mulched plots
Maize and wheat sown directly into vegetal mulch
(Note: Complete suppression of weeds)
TOTAL IMPROVEMENT OF SOIL PRODUCTIVITY
Creation of living vegetal mulch
Arachis pintoi cover in maize field

- Maize yield increased 30%
- Improve soil fertility
- Reduces evaporation
- Provide animal feeds (60 tons/ha/year)
Arachis pintoi cover in plum garden (after 20 days)
Permanently mulching:
- Plum yield increased 25%
- Improve soil fertility
- Reduces weed-crop competition
- Provide 50-70 tons/ha/year as animal fodder or green manure
Miniterrace making combined
with the soil mulching and mini-tillage
Making mini-terraces
Maize on mulched miniterraces with *Brachiaria riziziensis*
Maize on mulched miniterrace with *arachis pintoi* cover

- Maize increased 50-80%
- Control soil erosion
- Improve soil fertility
- Provide manimal fodder
Intercropping of legumes in annual crop fields
Intercrop sugar cane with soybean

Intercrop sugar cane with mungbean
Intercrop sugar cane with soybean

- Reduce soil erosion
- Improve soil fertility
- Increase income from soybean (1.5 tons/ha)
Intercrop cassava with peanut

Mono cassava cultivation
Intercrop cassava with peanut

- Control soil erosion
- Improve soil fertility
- Increase income from peanut (1.5 – 2.0 tons/ha)
- And increase cassava yield