AGRICULTURAL LAND MANAGEMENT IN THE UPLANDS:
OPTIONS FOR LAND USE AT THE FARM LEVEL

Ben-Hur R. Viloria,
Sustainable Agriculture Development Coordinator
Upland Development Programme in Southern Mindanao
The Reality in the Uplands
(Southern Mindanao)

83,000 Has. Watershed
13,000 Households (UDP covered areas)

Degraded Slopes (58,000 has.)
due to unsustainable agriculture

Massive Soil Erosion
The current farming practices in the uplands (e.g. slash and burn farming, and corn monocropping on steep slopes) are not sustainable and economically viable.
The Need for a Rational and Sustainable Agriculture Land Use in the Uplands

- Urgent need to reverse the effects of destructive agriculture in sloping lands that leads to massive soil erosion not only in farm lands but also within the watersheds.
- The need for improved farm technologies for food sustenance & income needs of upland households
MAIN FOCUS

NATURAL RESOURCE MANAGEMENT & SUSTAINABLE AGRICULTURE

Protection and Conservation

Production & Income Generation
Barangay Land-use Based Development Plan

Barangay Forest Management

Forestlands

Sustainable Agricultural Land Management

Agricultural lands

Savings and Credit

Sustainable Agricultural Land Management

Village Enterprise & Marketing

Forest Protection Scheme

Forest Production Scheme

Diversified Farming System

Infrastructure

Natural Resource Management & Sustainable Agriculture

Income Generation

Extension Delivery Services
OBJECTIVE
to regulate land-use in the uplands and prevent further degradation of erodible lands used for agriculture production.
SALIENT FEATURES

- Regulates the use of agricultural lands through massive application of soil and water conservation measures.
- Encourages site-specific farm planning and development.
- Advocates slope treatment-oriented practices (STOP) which matches crops and SWC measures with slope consideration.
- Promotes permanent, multiple cropping and diversified farming.
- Supported by a barangay-based upland agricultural extension delivery system.
Basic Land Management Features For Farms Located in the Uplands

Conservation and protection of sloping lands

Farm diversification

Outputs:
- Sustainable productivity (better production)
- Profitability (more income)
Basic Elements

1. Slope Treatment Oriented Practices (STOP)

2. Soil and Water Conservation Measures

3. Diversified Farming Systems
Slope Treatment Oriented Practices (STOP)
- Land Capability Classification Tool
- Land Use Planning Tool at the Farm Level

A = Arable land (12-25% slope)
AF = Agroforestry (25-45%)
TC = Tree crops (45-55%)
F = Natural Forest (>55%)

Give no inputs for cultivating this land.
12- 24% - cash crop, contour cultivation, NVS grass strip/ hedgerow

25- 44% - NVS, hedgerow, permanent crops

45% - 55% - tree crops

55% above - forest production/protection

Backyard gardening
- **< 15% grade**
  - 75% annual crops
  - 25% perennial crops

- **15-30% grade**
  - 50% annual crops
  - 50% perennial crops

- **> 30% grade**
  - 100% perennial crops
STOP aids in farm planning by identifying land units and their limitations; and providing prescriptions.
OBJECTIVES OF STOP

To promote a change from:

- *unplanned* upland agriculture, in which annual and perennial crops are planted anywhere, regardless of slope or soil depth and texture,

*to*

- *planned* agriculture where crops are matched to the most appropriate slopes and soils
Promote dualistic cropping by growing short-term crops on the small areas with gentler slopes (small plateau, ridges, upper slopes). Plant tree crops on the steeper slopes.
Replace annual crops with tree crops and grass cover to reduce the high erosion risk on slopes with rapidly steepening convexity.
Support intensification of backyard gardening rather than waste scarce resources trying to develop very steep slopes
Proposed strategies

• **STOP 1:** *Land unit farming* - Restricts the area suitable for annual crops to upper slopes by using cross-slope barriers and contour ploughing to promote terracing;

• **STOP 2:** *Multi-storey tree cropping* - Mixtures of fruit trees of different heights replace annual crops on slopes too steep or too long for cross-slope barriers.

• **STOP 3:** *Mulching and Zero Tillage* - Used when soils are too shallow for STOP1.

• **STOP 4:** *Intensive production of annual crops on small, level plots* – Corn for home consumption is grown on a **corn patch** covering a few hundred sq metres, freeing 55-85 days of labour for more productive activities such as intensive vegetable gardening in **permanent raised beds**, planting fruit trees, etc.
STOP 1
Land Unit Farming

PRINCIPLE

MINIMISE THE PROBLEMS OF SOIL EROSION BY:

• RESTRICTING THE CULTIVATION OF ANNUAL CROPS TO MINOR VALLEYS AND FLAT TO GENTLE SLOPES,

• OR UPPER SLOPES WHERE CONTOUR BARRIERS REDUCE SLOPE GRADIENTS BY PROMOTING TERRACE FORMATION.

• RESERVE STEEPER AREAS FOR PLANTING TREE CROPS FROM SEED.
AN IMPROVED DESIGN OF CONTOUR BARRIERS

Natural Vegetative grass Strips (NVS)

Cash Crop at lower half of slope

Perennial/permanent Crop at upper half of slope
OBJECTIVES OF THE NEW DESIGN FOR CONTOUR BARRIERS

Terraces are produced by soil movement from erosion and contour ploughing over 3-4 years. The function of the cross slope barrier e.g. natural vegetative strips (NVS) is:

• to reduce the height of the bench terrace to avoid collapse

• to act as an alternative to planting additional hedgerows specially if these are widely spaced.

• to diversify the farming system by adding bananas or other fruit trees and pineapples which have higher returns than corn or cassava.
STOP 2
MULTI-STOREY TREE CROPPING

PRINCIPLE:
IMITATING THE MULTI-STOREY CANOPY OF THE ORIGINAL RAIN FOREST,

BY PLANTING A MIXTURE OF TREES OF DIFFERENT HEIGHTS,

PROTECTS THE SOIL FROM EROSION BY DISSIPATING THE ENERGY OF RAINDROPS,

AND THE FALLING LEAVES COVERING THE SOIL INCREASES INFILTRATION AND REDUCES RUN-OFF
B = Bananas  C = Coconuts
M = Mango    G = Ginger
STOP 3
MULCHING AND ZERO-TILLAGE

PRINCIPLE

SIMULATING THE ORIGINAL FOREST FLOOR BY COVERING THE SOIL WITH A THICK LAYER OF MULCH WHICH:

• PROTECTS IT FROM RAINDROP IMPACT,
• IMPROVES INFILTRATION OF RAINFALL,
• RETAINS SOIL MOISTURE,
• AND ENCOURAGES SOIL MICRO-ORGANISMS, SUCH AS MYCORRHIZA.

ZERO-TILLAGE INVOLVES PLANTING SHORT-TERM CROPS THROUGH THE MULCH WITHOUT TURNING THE SOIL
The objectives of STOP 3

• Boost organic matter production
• Keep the soil covered with a layer of mulch
• Keep soil disturbance to a minimum
• Diversify crop production
• Feed the crop through the mulch
STOP 4
INTENSIVE PRODUCTION OF ANNUAL CROPS ON SMALL LEVEL PLOTS

PRINCIPLE

SMALL INTENSIVELY CULTIVATED PLOTS OF ANNUAL CROPS YIELD HIGHER RETURNS PER HOUR OF WORK THAN LARGER, POORLY TENDED FIELDS.

EFFICIENT PRODUCTION OF FAMILY FOOD REQUIREMENTS FREES TIME TO PLANT AND CARE FOR PROFITABLE PERENNIAL CROPS, WHILE OFF-FARM INCOME CAN BE PUT TO MORE PRODUCTIVE USES.
OFFERING ALTERNATIVES TO FARMING ON STEEP SLOPES

When land is too steep to meet STOP 1 specifications:

• Recommend planting bananas and fruit tree seeds followed by field-grafting of scions.

• See if multi-storey tree cropping and intensive vegetable production are possible near the house.

• Identify small areas of flat land (600-1,200m²) and advise on setting up a Corn Patch and Vegetable Garden on Permanent Raised Beds.
THE CORN PATCH.
GROWING CORN FOR HOME CONSUMPTION
ON SMALL PLOTS

PRINCIPLE

USING IMPROVED SEED-CHEMICAL FERTILISER TECHNOLOGIES CONCENTRATES THE CULTIVATION OF CORN FOR HOME CONSUMPTION…

ONTO VERY SMALL AREAS OF BETTER SOILS AND SAVES 55-85 DAYS OF LABOUR.

MARGINAL LAND ON STEEP SLOPES AND ACID SOILS CAN BE PLANTED WITH TREE CROPS OR LEFT UNDER FORESTS
Farmer getting 400 kg of corn from 10,000 m² of hill land wonders how his neighbour is able to produce 600 kg from just 600 m²
VEGETABLE GARDENING IN PERMANENT RAISED BEDS

PRINCIPLE

GARDENING HAS BEEN THE TRADITIONAL SOLUTION TO THE PROBLEMS FACING PERMANENT CULTIVATION IN THE UPLANDS THROUGHOUT THE HUMID TROPICS.

BY APPLYING INTENSIVE GARDENING TECHNIQUES, VEGETABLES CAN BE CULTIVATED SUCCESSFULLY IN UPLAND SITES...

EVEN ON POORLY DRAINED INFERTILE SOILS DESPITE INTENSE SUNLIGHT AND HEAVY UNRELIABLE RAINFALL
ADVANTAGES OF GARDENING IN PERMANENT RAISED BEDS

Properly managed raised garden beds can produce 1.4 to 2 times more vegetables per square meter than ordinary beds because they:

- avoid soil compaction
- prevent waterlogging
- increase soil depths
- improve soil conditions
- use inputs more efficiently
LAYOUT OF PERMANENT RAISED BEDS

Diagram showing the layout of permanent raised beds with measurements indicated as 60 cm.
MAKING THE FRAMEWORK FOR A PERMANENT RAISED BED
Mosquito screen over crowned beds converts raindrops into a fine spray
Farm planning using STOP field measurements

- Mapping out farm landscapes/land units using slope steepness
- Determining soil texture and soil depth/presence of top soil
- Assessing crop suitability and matching
- Suggesting STOP restrictions in lands with erosion hazards
Farm planning using STOP emphasize site specific recommendations e.g. reduction of soil steepness, soil and water conservation measures & land use options- alley cropping, agroforestry/tree farming and preservation of existing forest cover.
Field Work on STOP

Using the slope indicator, land unit prescription form and a graphing paper, agriculture technicians together with farmer extensionists (BEWs and FTGs) and the farm owner do a farm walk through or go to a site that has good view of the farm land.
Refer slope estimates to the Land Capability Classification table for conservation treatments and land use options.
A bird’s eye view map is produced highlighting the various land units with slope as major consideration.
The group discuss with the farmer the existing farm resources, land unit features and agro-ecological conditions (e.g. soil, weather) that affects his farm activity.

The group members then take turns in measuring the slopes, classifying the soil types, and digging the soil to determine soil depths.
HAND TESTS TO DETERMINE SOIL TEXTURE IN THE FIELD

The soil remains loose and single grained and can only be heaped into a pyramid:

\[\text{SAND (1)}\]
The soil contains sufficient silt and clay to become cohesive and can be shaped into a ball that easily falls apart:

The soil can be rolled into a short thick cylinder:

\[\text{SILT LOAM (3)}\]
The soil can be rolled into a cylinder about 15 cm long:

\[\text{LOAM (4)}\]
The soil can be bent into a U:

\[\text{CLAY LOAM (5)}\]
The soil can be bent into a circle that shows cracks:

\[\text{LIGHT CLAY (6)}\]
The soil can be bent into a circle without showing cracks:
Locate the appropriate *conservation treatment* and *intensity of land-use* on the STOP table. Note that with STOP, as slopes get steeper and soils become sandier:

- annual crops are replaced by agroforestry and forestry.
- the spacing of cross-slope barriers gets closer.
- on 45-55% slopes: plant tree crops in micro-basins, preferably using seeds, to encourage a long taproot. No hedgerows needed.
- only forest cover is to be developed from seed above 55%. Tap-rooted species preferred.
### STOP Recommendations Following Slopes and Soil Types

<table>
<thead>
<tr>
<th>Max. slope (%)</th>
<th>Min. soil depth (cm)</th>
<th>Sandy – Loam soils</th>
<th>Clay loam– Clay soils</th>
</tr>
</thead>
</table>
| 12% | 50 cm | Contour cultivation | Any. Fallow with forage peanut.
| 25% cm* | 100 cm | Contour hedgerows or lines of Vetiver or Napier grass with 2-m wide NVS and 3-m wide cultivable strip². Contour cultivation³. | Relay planting with rice/maize-root crops-beans-peanuts to suppress weeds. Contour ploughing to form terraces ³. |
| 35% | 100 cm | No hedgerows. Vetiver or Napier grass lines with 2-m wide NVS, and 2.5 m wide cultivable strip². Zero tillage. Heavy mulching. | Gradually replace maize and root crops with fruit trees planted among close cover crops and semi-perennials. Vetiver or Napier grass lines with 2-m wide NVS and 3 m wide cultivable strip². Contour ploughing to form terraces ³. Mulching. |
| 45% | 100 cm | No hedgerows. Vetiver or Napier lines with 2-m wide NVS. And 2-m wide cultivable strip². Zero tillage, Heavy mulching | Replace maize and root crops with agroforestry model of semi-perennials and fruit trees. No cultivation of beans and peanuts after 3 years. Vetiver or Napier grass lines with 2-m wide NVS and 3 m wide cultivable strip². Contour ploughing to form terraces³. Heavy mulching. As above. If ploughing is not possible, replace corn and root crops with agroforestry model of fruit trees planted among close cover crops and semi-perennials, over three years. |
| 55% | 100 cm | No hedgerows. Grass cover. Direct seeding and mulching around young trees | No cultivation Tree crops and grass cover Vetiver or Napier grass lines with 2-m wide NVS and 2 m wide cultivable strip². Contour ploughing to form terraces³. Heavy mulching Agroforestry model of semi-perennials and fruit trees. |
Encourage the farmer to use an A-frame to lay out and plant appropriately spaced cross-slope barriers (hedges plus NVS) on the upper slopes and hilltops of his farm, and intensify and diversify annual crop production there.

On the steeper areas, start to replace corn and root crops by planting bananas and fruit trees such as mango, durian and lanzones.
Fill in a land unit prescription form detailing the proposed crops and SWC measures for each land unit. If necessary, indicate the number of NVS inputs (Napier grass or vetiver splits) needed, and the expected incomes for different fruit trees and annual crops from the land unit.
## STOP Land Unit Prescription Forms

<table>
<thead>
<tr>
<th>Land Units</th>
<th>Site factors</th>
<th>Prescriptions/Recommendations</th>
<th>Projected Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 * Ridge Convex</strong>&lt;br&gt;Slope: %&lt;br&gt;Soil texture: Sandy clay loam&lt;br&gt;Soil depth (cm): 50&lt;br&gt;Erosion: Carabao track&lt;br&gt;Stoniness: Small stones&lt;br&gt;Land use: Cogon&lt;br&gt;Area: m² (W x L) 80 x 640</td>
<td><strong>13-25</strong>&lt;br&gt;Clay loam&lt;br&gt;Sheet&lt;br&gt;None&lt;br&gt;Bananas</td>
<td>• Contoured leguminous hedgerows/Napier or Vetiver grass strips, using improved design for cross-slope barriers (Barrier of 0.5 m hedgerow + 1.7 m wide grass riser, and terrace of 3.8 m).&lt;br&gt;• Plant peanuts, munggo, beans, pineapples. Mulch well with cogon from side slopes.</td>
<td>Vetiver splits 1100 OR Napier splits 2200 OR Fleming/Rinson 106m Pineapple suckers 180</td>
</tr>
<tr>
<td><strong>2 * Crest/Plateau Flat</strong>&lt;br&gt;Slope: %&lt;br&gt;Soil texture: Clay loam&lt;br&gt;Soil depth (cm): &gt;60&lt;br&gt;Erosion: Sheet&lt;br&gt;Stoniness: None&lt;br&gt;Land use: Bananas&lt;br&gt;Area: m² (W x L) 70 x 3500</td>
<td><strong>0-12</strong>&lt;br&gt;Sandy clay loam&lt;br&gt;Sheet&lt;br&gt;None&lt;br&gt;Mango, banana</td>
<td>• Contoured Napier grass or Vetiver grass barrier at plateau/side slope interface.&lt;br&gt;• Ring weed the existing fruit trees and mulch with cogon.&lt;br&gt;(Note: Bananas are recommended for planting on flat areas, as farmers will be prepared to cut them down should there be a need to open up land for corn cultivation in future. E.g. in 20 years time, when Vietnam and Thailand no longer have surplus rice to export).</td>
<td>Vetiver splits 500 OR Napier splits 1000</td>
</tr>
<tr>
<td><strong>3 Ridge Convex</strong>&lt;br&gt;Slope: %&lt;br&gt;Soil texture: Sandy clay&lt;br&gt;Soil depth (cm): &gt;100 cm&lt;br&gt;Erosion: Sheet&lt;br&gt;Stoniness: None&lt;br&gt;Land use: Mango, banana&lt;br&gt;Area: m² (W x L) 80 x 480</td>
<td><strong>13-25</strong>&lt;br&gt;Sandy clay&lt;br&gt;Sheet&lt;br&gt;None&lt;br&gt;Cogon</td>
<td>• Ring weed the existing fruit trees and mulch with cogon.&lt;br&gt;• Apply 200 g complete fertilizer per tree.&lt;br&gt;• Plant more trees in gaps as required.</td>
<td>2 kg Complete</td>
</tr>
<tr>
<td><strong>4 * Side Slope Convex</strong>&lt;br&gt;Slope: %&lt;br&gt;Soil texture: Sandy clay&lt;br&gt;Soil depth (cm): &gt;50 cm&lt;br&gt;Erosion: Sheet&lt;br&gt;Stoniness: None&lt;br&gt;Land use: Cogon&lt;br&gt;Area: m² (W x L) 100 x 3000</td>
<td><strong>&gt;55</strong>&lt;br&gt;Sandy clay&lt;br&gt;Sheet&lt;br&gt;None&lt;br&gt;Cogon</td>
<td>• Lay out triangular planting arrangement with spacing according to fruit trees to be planted.&lt;br&gt;• Cut cogon on slope and pile 30-40 cm deep in 300 cm diameter circles on planting area to kill the cogon rhizomes in the soil.&lt;br&gt;• After 5-6 weeks (provided it has rained) plant seeds of fruit trees in 30 cm diameter cleared area in middle of cogon mulch. Graft scions later.</td>
<td>Fruit seeds Scions</td>
</tr>
</tbody>
</table>
Draw a second map showing the layout of the proposed SWC measures.
<table>
<thead>
<tr>
<th>LAND UNIT</th>
<th>Site factors</th>
<th>Prescriptions / Recommendations</th>
<th>Projected yields/ incomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 * UPPER SLOPE</td>
<td>Slope: &gt;70%</td>
<td>TOO STEEP FOR PROJECT INPUTS, BUT ADVISE FARMER TO:</td>
<td>1.6 t/ha of corn twice/yr = 3.2 t/ha/yr = 3.2 kg/10 m² @ P14/kg = P45</td>
</tr>
<tr>
<td>Shape+ Straight</td>
<td>Soil texture: Clay loam</td>
<td>• REPLACE CORN WITH BANANAS AT 3 METRE SPACING (Triangular layout) FOR REGULAR MEDIUM TERM INCOME. TREES WILL NEED TO BE PROPPED UP WITH BAMBOO.</td>
<td>1 hill banana/10 m² yields 30 kg @ P4/kg = P120/yr</td>
</tr>
<tr>
<td>Width 20 m</td>
<td>Soil depth: cm</td>
<td>• PLANT SMALL-CROWNED TREES (to minimise risk of toppling at maturity) E.G. COFFEE, LANZONES, RAMBUTAN ETC FROM SEED (in case bananas affected by bunchy top virus at later stage). ALIGN IN EAST-WEST DIRECTION.</td>
<td>Income from Land Unit 1</td>
</tr>
<tr>
<td>Length 40 m</td>
<td>Erosion: Rill</td>
<td>• TRAIN FARMER IN GRAFTING ON SUITABLE SCIONS.</td>
<td>CORN: 800/10 * P45 = P3,600</td>
</tr>
<tr>
<td>Area: (W x L) 800 m²</td>
<td>Stoniness: None</td>
<td>AS ABOVE.</td>
<td>BANANAS: 800/10 * P120 = P9,600</td>
</tr>
<tr>
<td></td>
<td>Land use: Corn</td>
<td></td>
<td>LANZONES: 800/10 * P186 =P14,880</td>
</tr>
<tr>
<td>2 * RIDGE</td>
<td>Slope: &gt;70%</td>
<td></td>
<td>(see below)</td>
</tr>
<tr>
<td>Shape+ Convex</td>
<td>Soil texture: Clay loam</td>
<td>AS ABOVE.</td>
<td>Income from Land Unit 2</td>
</tr>
<tr>
<td>Width 15 m</td>
<td>Soil depth: cm</td>
<td></td>
<td>CORN: 525/10 * P45 = P2,362.50</td>
</tr>
<tr>
<td>Length 35 m</td>
<td>Erosion: Rill</td>
<td></td>
<td>BANANAS: 525/10 * P120 = P6,300</td>
</tr>
<tr>
<td>Area: (W x L) 525 m²</td>
<td>Stoniness: None</td>
<td></td>
<td>LANZONES: 525/10 * P186 =P9,765</td>
</tr>
<tr>
<td></td>
<td>Land use: few fruit trees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 * MID-SLOPE (a)</td>
<td>Slope: 35-45%</td>
<td>PLANT MANGO AND DURIAN SEEDLINGS OR SEEDS AT 10 m SPACING (triangular layout) IN 1.5 M DIAMETER MICRO-BASINS, ALIGNED IN EAST-WEST DIRECTION.</td>
<td>156 Lansones/ha yielding 40 kg/tree after 8 years @ P30/kg = P186/10 m²/yr</td>
</tr>
<tr>
<td>Shape+ Concave</td>
<td>Soil texture: Clay loam</td>
<td>HEAVILY MULCH MICRO-BASINS.</td>
<td>Income from Land Unit 3</td>
</tr>
<tr>
<td>Width 40 m</td>
<td>Soil depth: cm</td>
<td>APPLY COMPLETE FERTILISER AT RECOMMENDED RATES WITH ANNUAL INCREMENTS.</td>
<td>CORN: 1,200/10 * P45 = P5,400</td>
</tr>
<tr>
<td>Length 30 m</td>
<td>Erosion: Rill</td>
<td>INTERPLANT WITH BANANAS TO GET EARLY INCOME.</td>
<td>BANANAS: 1,200/10 * P120 = P14,400</td>
</tr>
<tr>
<td>Area: (W x L) 1200 m²</td>
<td>Stoniness: None</td>
<td></td>
<td>LANZONES: 1,200/10 * P186 =P22,320</td>
</tr>
<tr>
<td></td>
<td>Land use: Corn with a few mango trees</td>
<td></td>
<td>MANGOES: 1,200/10 x P120 =P14,400</td>
</tr>
<tr>
<td>4 * MID-SLOPE (b)</td>
<td>Slope: 35-45%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape+ Straight</td>
<td>Soil texture: Clay loam</td>
<td>AS ABOVE.</td>
<td>Income from Land Unit 4</td>
</tr>
<tr>
<td>Width 15 m</td>
<td>Soil depth: cm</td>
<td></td>
<td>CORN: P1,350/yr</td>
</tr>
<tr>
<td>Length 20 m</td>
<td>Erosion: Land</td>
<td></td>
<td>BANANAS: P3,600 @ 1.5years</td>
</tr>
<tr>
<td>Area: (W x L) 300 m²</td>
<td></td>
<td></td>
<td>LANZONES: P5,580 @ 8 years</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MANGOES: P3,600 @ 8 years</td>
</tr>
</tbody>
</table>
Crop yields vs prices & area needed to generate 1 month's income of P 4,800 (prodn. costs not included).

<table>
<thead>
<tr>
<th>Crop (year of data)</th>
<th>Ave. Yield Mt/ha/yr</th>
<th>Farmgate price (PhP/ kg)</th>
<th>Av. Yield (kg/10m²/yr)</th>
<th>Income (PhP/10m²)</th>
<th>Area of UNIT needed to earn one month’s income of PhP 4,800 (sq m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava (2000) ¹</td>
<td>6.42 *</td>
<td>3.55</td>
<td>1.93 (dry roots)</td>
<td>5.78 (SMC price)</td>
<td>8,307</td>
</tr>
<tr>
<td>Cotton (2003) ²</td>
<td>0.9</td>
<td>19</td>
<td>0.9</td>
<td>17.1</td>
<td>2,807</td>
</tr>
<tr>
<td>Corn (2004) ²</td>
<td>4.0 (from 2 harvests)</td>
<td>7.0</td>
<td>4.0</td>
<td>28.0</td>
<td>1,710</td>
</tr>
<tr>
<td>Lanzones (2003) ¹</td>
<td>3.04</td>
<td>20.53</td>
<td>3.04</td>
<td>62.41</td>
<td>769</td>
</tr>
<tr>
<td>Eggplant (2000) ¹</td>
<td>8.31</td>
<td>8.34</td>
<td>8.31</td>
<td>69.31</td>
<td>693</td>
</tr>
<tr>
<td>Papaya (2003) ¹</td>
<td>14.67</td>
<td>5.85</td>
<td>14.67</td>
<td>85.82</td>
<td>559</td>
</tr>
<tr>
<td>Okra (2003) ¹</td>
<td>9.00</td>
<td>9.58</td>
<td>9</td>
<td>86.22</td>
<td>557</td>
</tr>
<tr>
<td>Banana (2003) ¹</td>
<td>13.1</td>
<td>6.70 (lakatan)</td>
<td>13.1</td>
<td>87.77</td>
<td>547</td>
</tr>
<tr>
<td>Mango (2003) ¹</td>
<td>6.42</td>
<td>18.55 (carabao)</td>
<td>6.42</td>
<td>120.02</td>
<td>400</td>
</tr>
<tr>
<td>Durian (2003) ¹</td>
<td>3.45</td>
<td>42.65</td>
<td>3.45</td>
<td>147.14</td>
<td>326</td>
</tr>
<tr>
<td>Pineapple (2003) ¹</td>
<td>35.61</td>
<td>6.73 (Hawaiian)</td>
<td>35.61</td>
<td>239.66</td>
<td>200</td>
</tr>
</tbody>
</table>
SALt 1 to 4 hedgerow/alley cropping

Sloping Agricultural Land Technologies - alley cropping in sloping lands placing cash crops, fruit and forest trees in between contoured hedgerows.

SALT also incorporates livestock in the system by taking advantage of the forage quality of hedgerow plants through the cut and carry system.
Natural Vegetative Strips (NVS)/Grass Strips

similar to SALT but utilizes indigenous plants and grasses as buffer strips to soil erosion. Although grass strips has less soil amelioration value as Nitrogen Fixing Trees, these are applied in acid soil areas where NFTs can not grow and when SALT establishment is considered to costly or labor intensive.
Multi-Storey Farming maximize utilization of every square unit of area by intercropping shade tolerant/compatible trees and crops in between and underneath the canopy of dominant trees. These also simulate the original forest canopy and provides vegetative cover to soils prone to erosion.
Bench Terraces are soil and water conservation measures used on sloping land with relatively deep soils to retain water and control erosion. They are normally constructed by cutting and filling to produce a series of level steps or benches.
Water availability for upland agriculture can be improved by small-scale impoundment to capture and store rainwater for irrigation.
Simple structure that can stop gully erosion by slowing down water flow in the drainage system.

Soil traps are structures constructed to harvest soil eroded from the upper slopes of the catchment. The most common types of soil traps are check dams and trenches, built in diversion ditches or waterways.
Diversion ditches are constructed along the contour lines and across slopes for the purpose to intercept surface runoff and divert it to suitable outlets.
Other Soil and Water Conservation Technologies

Mulching is a practice in which a covering of cut grass, crop residues or other organic materials is spread over the ground, between rows of crops or around the trunks of trees. This practice helps to retain soil moisture, prevents weed growth and enhances soil structure. It is commonly used in areas subject to drought and weed infestation.

Cover crops are grown to protect the soil from erosion and to improve it through green manuring (the plowing-under of a green crop other fresh organic material). These are usually short-term (less than two years), planted in fields or under trees during fallow periods. Cover crops are also interplanted or relay-planted with grain crops such as maize, or planted once in a cropping cycle.
Regular farming activities that promote soil and water conservation

Crop Rotation

Relay Planting

Contour Cultivation/Planting

Use of Organic Matter

Laying of crop residues at the contour

Cut and Carry System of Livestock Raising
Agroforestry

A sustainable land management system which increases the overall yield of the land: combines the production of agricultural components (including fruit-tree crops) and forest plants simultaneously or sequentially on the same unit of land, and applies management practices that are compatible with the cultural practices of the local population” (ICRAF, 1978).
In support to soil and water conservation activities like agroforestry, farmers are encouraged to establish their own individual and community nurseries. The nurseries can also be avenues for income generation.
The DFS is a sustainable farming system that maximize production per unit area by adding and integrating more crops both sequentially or spatially.
DFS highlights the function and integration of its components

- Farm household
- Food lot
- Cropping area for short, medium and long term
- Livestock and fisheries
- Tree components
- Soil and water conservation measures
Various technologies that are similar and containing DFS principles

- Sloping Agricultural Land Technologies (SALT 1 to 4)
- Agroforestry Land Care and Natural Vegetative Filter Strips (NVS) technologies
- Conservation Farming
- Integrated Farming Systems
Criteria for a functional DFS

Production that would address various household needs-

- Clean and safe food for the family
- Additional Income
- Shelter
- Fodder for livestock
- Fuel wood and even medicine (through herbal gardens)
Environmental service which has long term impact and benefits

• Establishment of barriers that would arrest soil erosion/land degradation
• Soil amelioration and restoration of soil fertility
• Establishment of more trees and vegetation that provides shade and soil cover facilitates cooling and even micro climate change
• Tree establishment not only as boundary markers/fence but function also as windbreaks
Other Criteria for a functional DFS

Environmental service which has long term impact and benefits

- Establishment of barriers that would arrest soil erosion/land degradation
- Soil amelioration and restoration of soil fertility
- Establishment of more trees and vegetation that provides shade and soil cover facilitates cooling and even micro-climate change
- Tree establishment not only as boundary markers/fence but function also as windbreaks
Other Criteria for a functional DFS

Socio-economic benefits specifically for securing land tenure and proper land management that could assure technical and financial assistance in the future.
Other Criteria for a functional DFS

Facilitates the ready adoption by other farmers not only of its economic and environmental benefits but also:

• Suitability to existing culture and traditions
• Promotes participatory approaches from farm planning to community self-help activities (bayanihan, alayon etc.)

Highlights indigenous knowledge and local farmer initiatives
Activities that promote DFS and proper agriculture land mgt.

- Crop matching that emphasize integration and crop suitability to existing soil characteristics and other agro-ecological factors (e.g. weather, slope limitation etc.)

- Establishment of appropriate soil and water conservation measures

Proper land cultivation and soil management that helps in moisture retention, nutrient regeneration and improvement of soil pH

- Use of improved quality of planting materials and livestock/fish breeds
Activities that promote DFS and proper agriculture land mgt.

• Relay cropping, crop rotation technologies and multi-storey farming technologies
• Judicious use of inorganic fertilizers (as a fast acting nutrient source) in complement with organic fertilizers (for improving soil texture and long term quality) for improved crop production.
• Practice of integrated pest and weed management technologies
• Improved farm practices from land preparation, grow-out to, harvest, post-harvest and mktng.
STEPS TOWARDS ESTABLISHING DFS

Farm set up using grass strips/NVS for contoured hedgerow + Cash Crops

Developed farm with SWC + Cash Crops + Annual Crops + Long Term Crops

Enriched contoured farm + Cash Crops + Annual Crops
Processes in Implementing DFS

1. Farm Planning utilizing Slope Treatment Oriented Practices including Crop Matching.
2. Establishment of appropriate soil and water conservation measures
   1. Planting short, medium and long term crops
   2. Practicing nature friendly technologies- organic farming and integrated pest management.
      1. On farm research, trial/techno demo for commodities
      2. Enterprise Farm (Entrefarm) Planning
      3. Specialization for market led crops
ACTIVITIES PROMOTED WITHIN THE DFS

• Intercropping, crop rotation, relay planting and integrated pest management technologies

• Other Tree- Crops and Livestock Combinations/ Agroforestry- these employ compatible species to maximize the utilization of the unit area of land and also ensure resource conservation by considering the natural growth cycle

• Integrated Farming Systems- which emphasize the inter-action and interdependency of each farm component contributing to improved production
Organic Farming Technologies

Utilization of recyclable resources like waste materials within the farms as substitute and supplements to expensive commercial fertilizers. Encouraging farmers to adopt biological intensive technologies like composting, Korean Farming methods, vermiculture and other nature friendly approaches.
DFS involves non-cropping activities

In addressing the needs for food sustenance of the upland household and diversifying from the traditional crop production systems...

DFS encourage other activities like fish production and livestock raising.

These could be opportunities for nutrient and waste recycling and also emerging enterprises.
Through better planning and management, within 7 to 10 years farmers who practice DFS could realize the fruits of their labor and ensure the sustainability of their farm. They could consider their tree farms as education and pension plans.
This is also true for their vegetable and high value crop production. By establishing market links, the farmers are properly informed of market needs and trends thus they can schedule their production without becoming victims of the vagaries of market fluctuations.
The DFS also provides opportunities for commercial tree farming/agroforestry and high value crop production so long as they follow land management principles.
## Possible Land Use Options for Agricultural Lands in the Uplands

<table>
<thead>
<tr>
<th>Watershed Management &amp; Land Use Planning Framework</th>
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<tbody>
<tr>
<td><strong>PRESENT LAND USE</strong></td>
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<tr>
<td>Non-tree crops</td>
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<tr>
<td>Annual and Perennial</td>
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<tr>
<td>Mostly no soil conservation</td>
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<td>Mostly no water conservation</td>
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<tr>
<td>Tree crops</td>
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<tr>
<td>Coconut</td>
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<tr>
<td>Grassland with Crops (settlement areas)</td>
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<tr>
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<tr>
<td>PRESENT LAND USE</td>
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<tr>
<td>Grassland with Crops (settlement areas) Mostly no soil conservation</td>
</tr>
<tr>
<td>Grassland (without crop)</td>
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<tr>
<td>Shrubland with Crops Mostly no soil conservation</td>
</tr>
<tr>
<td>Shrubland (without crop)</td>
</tr>
<tr>
<td>Forest with Agricultural settlements Mostly no SWC</td>
</tr>
<tr>
<td>Forest (without settlement) Mostly no SWC</td>
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</table>

<table>
<thead>
<tr>
<th>SLOPE</th>
<th>(downstream)</th>
<th>(upstream)</th>
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<tbody>
<tr>
<td>&lt; 3 %</td>
<td>3-18 %</td>
<td>18 - 30 %</td>
</tr>
<tr>
<td>30 - 50 %</td>
<td>&gt; 50 %</td>
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</tbody>
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Agro Forestry Module 5
A-F1 scheme Grassland Livestock Stripcropping Hedgerows
Community-Based Reforestation/ Fuelwood Prd.
Community-Based Forestation Development
Community-Based Forestation Development

Agro Forestry Module 5
A-F2 scheme Grassland Livestock
Community-Based Reforestation/ Fuelwood Prd.
Community-Based Forestation Development
Community-Based Forestation Development

Community-Based Forest Productivity Enhancement Dev. Schemes 30% - Fruit, 70% - Forest
Community-Based Forest Productivity Enhancement Dev. Schemes 30% - Fruit, 70% - Forest

SLOPE
< 3 %
3-18 %
18 - 30 %
30 - 50 %
> 50 %
Daghang Salamat