REPORT ON THE
UPLAND FARMING/ SOIL &
WATER CONSERVATION
MISSION

for the period
June-December 2004

by
Kenneth R S Proud
Upland Farming /Soil & Water Conservation Specialist
14 December 2004

A partnership programme sponsored by
the European Commission (EC) and the Government of the Philippines (GoP)
and executed by the Department of Agriculture (DA)
REPORT ON THE UPLAND FARMING/ SOIL & WATER CONSERVATION MISSION
for the period
June-December 2004

by
Kenneth R S Proud
Upland Farming /Soil & Water Conservation Specialist
14 December 2004

Cover photo:  Land unit farming, Sitio Perduan, Barangay Poblacion, Tantangan, South Cotabato
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT</td>
<td>Agricultural Technician</td>
</tr>
<tr>
<td>BEW</td>
<td>Barangay Extension Worker</td>
</tr>
<tr>
<td>DA</td>
<td>Department of Agriculture</td>
</tr>
<tr>
<td>DENR</td>
<td>Department of the Environment and Natural Resources</td>
</tr>
<tr>
<td>DFS</td>
<td>Diversified Farming Systems</td>
</tr>
<tr>
<td>FA</td>
<td>Financial Agreement</td>
</tr>
<tr>
<td>ICRAF</td>
<td>International Centre for Research into Agro-Forestry</td>
</tr>
<tr>
<td>IDS</td>
<td>Integral Development Services</td>
</tr>
<tr>
<td>JICA</td>
<td>Japanese International Cooperation Agency</td>
</tr>
<tr>
<td>LGU</td>
<td>Local Government Unit</td>
</tr>
<tr>
<td>LPM</td>
<td>Large Planting Material</td>
</tr>
<tr>
<td>MSO</td>
<td>Municipal</td>
</tr>
<tr>
<td>MTR</td>
<td>Mid-Term Review</td>
</tr>
<tr>
<td>NVS</td>
<td>Natural Vegetative Strip</td>
</tr>
<tr>
<td>PMO</td>
<td>Project Management Office</td>
</tr>
<tr>
<td>PPO</td>
<td>Provincial Project Office</td>
</tr>
<tr>
<td>RFS</td>
<td>Rural Financial Services</td>
</tr>
<tr>
<td>RM</td>
<td>Resource Management</td>
</tr>
<tr>
<td>SAD</td>
<td>Sustainable Agricultural Development</td>
</tr>
<tr>
<td>SMC</td>
<td>San Miguel Corporation</td>
</tr>
<tr>
<td>STOP</td>
<td>Slope Treatment-Oriented Practices</td>
</tr>
<tr>
<td>SWC</td>
<td>Soil and Water Conservation</td>
</tr>
<tr>
<td>TA</td>
<td>Technical Assistance</td>
</tr>
<tr>
<td>TOU</td>
<td>Technical Operations Unit</td>
</tr>
<tr>
<td>UDP</td>
<td>Upland Development Programme</td>
</tr>
<tr>
<td>WAC</td>
<td>World Agro-forestry Centre (a.k.a. ICRAF)</td>
</tr>
</tbody>
</table>
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXECUTIVE SUMMARY</td>
<td>i</td>
</tr>
<tr>
<td>MAIN RECOMMENDATIONS</td>
<td>ii</td>
</tr>
<tr>
<td><strong>PART A</strong></td>
<td></td>
</tr>
<tr>
<td>INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>A. Background to the Upland Farming/SWC Specialist’s Mission</td>
<td>1</td>
</tr>
<tr>
<td>B. Rationale for the mission</td>
<td>1</td>
</tr>
<tr>
<td>C. Terms of Reference</td>
<td>1</td>
</tr>
<tr>
<td>D. Land Suitability Issues</td>
<td>2</td>
</tr>
<tr>
<td><strong>PART B</strong></td>
<td>3</td>
</tr>
<tr>
<td>IMPLEMENTATION OF THE TORs</td>
<td></td>
</tr>
<tr>
<td>1. Continue to strengthen the work of the SAD Component staff, LGU</td>
<td>3</td>
</tr>
<tr>
<td>Technicians, barangay extension workers and model farmers, through a</td>
<td></td>
</tr>
<tr>
<td>hands-on approach, to improve their performance in assisting upland</td>
<td></td>
</tr>
<tr>
<td>farmers to have good farms that address both conservation and income</td>
<td></td>
</tr>
<tr>
<td>concerns in a sustainable manner</td>
<td></td>
</tr>
<tr>
<td>1.1 Strengthen the work of SAD Component staff, LGU technicians, BEWs</td>
<td>3</td>
</tr>
<tr>
<td>1.1.1 Reinforcing training in STOP</td>
<td>3</td>
</tr>
<tr>
<td>1.1.2 Assisting upland farmers to have good farms</td>
<td>4</td>
</tr>
<tr>
<td>1.1.3 Address conservation and income concerns in a sustainable manner</td>
<td>4</td>
</tr>
<tr>
<td>1.2 Recommendations</td>
<td>5</td>
</tr>
<tr>
<td>2. Monitor the DFS activities in the provinces and give the necessary</td>
<td>6</td>
</tr>
<tr>
<td>feedback to all stakeholders, particularly the LGUs and UDP management</td>
<td></td>
</tr>
<tr>
<td>and recommend actions that would improve the performance of UDP’s</td>
<td></td>
</tr>
<tr>
<td>farmer co-operators and the extension workers</td>
<td></td>
</tr>
<tr>
<td>2.1 Field trips</td>
<td>6</td>
</tr>
<tr>
<td>2.2 Verification procedures for DFS</td>
<td>7</td>
</tr>
<tr>
<td>2.3 Recommendations</td>
<td>7</td>
</tr>
<tr>
<td>3. Conduct hands-on training to extension staff where appropriate and</td>
<td>7</td>
</tr>
<tr>
<td>feasible</td>
<td></td>
</tr>
<tr>
<td>3.1 Comparing incomes from corn with bananas</td>
<td>7</td>
</tr>
<tr>
<td>3.2 Promoting planting fruit trees as a pension plan</td>
<td>7</td>
</tr>
<tr>
<td>3.3 Recommendations</td>
<td>8</td>
</tr>
<tr>
<td>4. Assist with developing extension materials for the DFS programme</td>
<td>8</td>
</tr>
<tr>
<td>4.1 STOP 2: Multi-storey cropping</td>
<td>8</td>
</tr>
<tr>
<td>4.2 STOP 3: Zero-tillage and mulching for crop production in shallow</td>
<td>8</td>
</tr>
<tr>
<td>soils</td>
<td></td>
</tr>
<tr>
<td>4.3 Other Handouts produced by the Consultant</td>
<td>9</td>
</tr>
<tr>
<td>4.4 Recommendations</td>
<td>9</td>
</tr>
</tbody>
</table>
5. Jointly with PMO representatives, establish and strengthen contacts with appropriate government and non-government agencies regarding the introduction of improved planting material
  5.1 Limited availability of planting material for cross-slope barriers
  5.2 Proposals for bulking up material for cross-slope barriers
  5.3 Recommendations

6. Jointly with the marketing, agri-business and RFS staff make an assessment and categorise tree crops according to their present and possible future profitability (costs and benefits) and make recommendations on financing investment in tree crops by small holder beneficiaries and/or groups of farmer beneficiaries, coops etc.
  6.1 Bananas give higher returns than corn
  6.2 Projected returns from other fruits
  6.3 Recommendations

7. Conduct any other assignments given by the Co-Directors
  7.1 Report on the Causes and Consequences of a Reduction in Soil Depths in the Uplands of Southern Mindanao
    7.1.1 Background to the Study
    7.1.2 Evidence for the reduction in soil depths
    7.1.3 Recommendations
  7.2 Problems with Cassava production in the uplands of Southern Mindanao
    7.2.1 Background to the Study
    7.2.2 Soil losses are excessively high under cassava cultivation
    7.2.3 Recommendations

8. CONCLUSIONS OF THE JUNE-DECEMBER 2004 UF/SWC MISSION

9. MAIN RECOMMENDATIONS

<table>
<thead>
<tr>
<th>Photo 1</th>
<th>Triangular layout of mulched planting sites. Mabini. ComVal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>Prices of fruit tree seeds compared with seedlings</td>
</tr>
<tr>
<td>Table 2</td>
<td>Handouts produced by the Upland farming/ SWC Consultant</td>
</tr>
<tr>
<td>Table 3</td>
<td>Comparison of incomes from corn with bananas</td>
</tr>
</tbody>
</table>
### List of Annexes

<table>
<thead>
<tr>
<th>Annex</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annex A</td>
<td>Land Suitability Issues</td>
</tr>
<tr>
<td>Annex 1.1</td>
<td>Davao del Norte, Tibulao Demo Farm. Land Unit Prescriptions and Inputs</td>
</tr>
<tr>
<td>Annex 2.1</td>
<td>Field Trip Reports (Jun-Dec 2004)</td>
</tr>
<tr>
<td>Annex 3.1</td>
<td>Form to compare inputs and yields of Corn with Bananas</td>
</tr>
<tr>
<td>Annex 4.1</td>
<td>STOP 1. Land Unit Farming</td>
</tr>
<tr>
<td>Annex 4.2</td>
<td>STOP 2. Multi-Storey Cropping</td>
</tr>
<tr>
<td>Annex 4.3</td>
<td>STOP 3. Zero-tillage and Mulching for Crop Production on Shallow Soils</td>
</tr>
<tr>
<td>Annex 4.4</td>
<td>An Improved Design for Cross-slope Barriers</td>
</tr>
<tr>
<td>Annex 4.5</td>
<td>A Guide to Rehabilitating and Managing Cross-slope Barriers (Hedgerows, Grass strips, NVS)</td>
</tr>
<tr>
<td>Annex 4.6</td>
<td>Bolo Hygiene against Banana Bunchy Top Disease</td>
</tr>
<tr>
<td>Annex 4.7</td>
<td>Using Cogon to Control Cogon</td>
</tr>
<tr>
<td>Annex 4.8</td>
<td>Take the pressure off your carabao’s neck with a Goyod</td>
</tr>
<tr>
<td>Annex 5.1</td>
<td>Setaria splendida. Another species for use as a cross-slope barrier</td>
</tr>
<tr>
<td>Annex 6.1</td>
<td>Land unit prescription form comparing incomes from bananas and fruits with corn</td>
</tr>
<tr>
<td>Annex 7.1</td>
<td>Report on the Causes and Consequences of a Reduction in Soil Depths in the Uplands of Southern Mindanao</td>
</tr>
<tr>
<td>Annex 7.2</td>
<td>Report on Problems with Cassava Production in Southern Mindanao</td>
</tr>
</tbody>
</table>
This report covers the period 9 June to 21 December 2004. The Consultant built on his previous inputs as Tree Crops Consultant, Vegetative Soil and Water Conservation Specialist, and Diversified Upland Farming/VSWC Consultant to further refine and develop the Slope Treatment-Oriented Practices (STOP) technologies for sloping land management.

Hands-on training was given to project staff and extension workers and recommended actions that assist upland farmers address both conservation and income concerns in a sustainable manner. Extension materials were produced for the DFS programme and the need for the introduction of improved planting material, particularly for cross-slope barriers, discussed with relevant people. Tree crops were categorized according to their present and possible future profitability, particularly in relation to corn as a cash crop.

The Consultant prepared reports on reductions in soil depths resulting from the continuous cultivation of corn and cassava on sloping land. The findings were that cultivation of these annual crops has reduced soil depths in some areas to as little as 22 cm compared to 80 cm on nearby land with tree cover. Shallow soil depths (less than 50 cm) have been recorded in many upland farms throughout the UDP area. This is cause for alarm because under similar circumstances in Vietnam, i.e. the continuous cultivation of hill rice and cassava, more than a one million hectares of sloping land have become eroded skeleton soils with no value for agriculture or forestry.

With respect to agricultural production in Southern Mindanao, the Project is close to achieving the RM component objective of developing farm models aimed at substituting the corn-based mixed farming to perennial crops and agroforestry, with grassland being converted to agroforestry and mixed farming (Financing Proposal (IB/1037/97-EN)).

Farmers are starting to realise that corn as a cash crop on sloping land is a loser in all senses: it reduces incomes, it is an inefficient use of labour, and it reduces the soil depth so that yields decline further, and it lowers the potential of the land to support other more valuable crops.

Throughout the UDP project area there is now a discernible trend of farmers wanting to switch from corn to tree crops. Farmers are finally beginning to appreciate that fruit trees not only give much higher returns than corn, but they give increasing returns as the trees get older. The value of a plantation of fruit trees is being seen as attractive substitute for a pension. The STOP logic of restricting the cultivation of annual crops to gentle or terraced slopes and minor valleys where SWC interventions are effective, is gaining acceptance, but still needs reinforcing and should be extended to a wider audience. Extension workers need greater exposure to implementing the technologies.

It is crucial that this momentum be maintained by continued extension efforts during the next two years. Stopping now risks wasting the investments of the last four years, leading to the continued cultivation of corn on slopes and the formation of unproductive skeletal soils over extensive areas. Corn crops are already failing due to insufficient rain and shallow soil depths.

It should be noted that the Monitoring Report of the UDP, dated 10/09/04, undertaken by Frans Geilfus, expressed concern that “the upland development model to be achieved and replicated by the project has been scaled down to its adoption by a few municipalities, while it was clearly the intention of the FA to promote a model that might be advocated at all levels of development policy” (see Annex 8.1).
The Report points out that although the project is supporting ‘replications’, replicability is properly measured by how the activities may be implemented without the project’s help. While the monitoring mission praises the excellence of many practices promoted by the project in the field, it cautions that many promising initiatives might quickly peter out “if no further support and coaching are ensured after 2005”.

* * * * *

MAIN RECOMMENDATIONS

- One effective way of meeting the Monitoring mission’s concerns is to set up show case farms demonstrating the STOP interventions on different upland terrain types, in municipalities adjacent to the Project area. Groups of farmers should choose one of their members to be the contact farmer on the understanding that the only the farm of the selected candidate will be developed with inputs provided by the Project. Neighbouring farmers will be invited to attend training sessions on the show case farm, and their constraints to adopting innovations examined and dealt with appropriately. This will enable the Project to leave behind something that farmers outside the project area can replicate. Experience from other projects shows that adoption of interventions may occur many years after a project has ended – but all too often there is no model or trainer around to provide advice.

- The Project should continue to support ICRAF/WAC to develop and manage the learning sites and demonstrate how STOP technologies (cross-slope barriers, multi-storey cropping, and zero-tillage/mulching) can improve incomes within the current project area. Similarly, efforts should be made to tackle the relevant constraints affecting the farmers’ ability to adopt the technologies.

- The Project should turn the effects of the coming El Niño, expected to last until May 2005, to advantage by encouraging more farmers to change their cropping practices. This can be achieved through discussions with UBAs and UCOs, FTGs etc on the differences in incomes between growing corn and bananas and other fruit trees.

- Material for cross-slope barriers (i.e. splits of Napier and Vetiver grass, *Setaria*, etc) should be acquired and bulked up at municipal and community nurseries, and on farms where supplementary watering is possible. Supplies of splits should be available for planting when sufficient rain has fallen at the start of the cropping season.

- Encourage LGUs to collect fruit tree seeds for sale to upland farmers. These are cheaper than seedlings, easier to transport, and less of a financial risk. The move away from growing corn can be accelerated if LGUs follow the example of the Municipal Agriculturist of Laak, ComVal, by providing 160 banana corms to each farmer on a plant now, pay later basis.

- Encourage LGUs to promote multi-storey cropping on sloping land by providing fruit tree seeds, banana corms and suckers for under-planting coconut plantations.

- Give refresher courses in grafting to BEWs and ATs so they can train farmers in field-grafting of scions. The Project should provide farmers who receive training with grafting knives so they can assist their neighbours in future.
A. Background to the Upland Farming/SWC Specialist’s Mission

The Upland Development Programme in Southern Mindanao (UDP) is designed to develop and implement an extension process together with local government and community based extension workers for sustainable management of agriculture and the natural resource base in the uplands. The programme has adopted a participatory approach in assisting upland communities. Ownership of supported initiatives by the community organisations and the LGUs in respect of sustainable agriculture and community-based resource management in the uplands is the basic concept of UDP. This implies that capacity building of LGUs and community organisations in respect of upland development are key activities of UDP.

Sustainable upland development by the upland communities requires multiple but integrated support by LGUs and other relevant institutions. One of these is sustainable agricultural development suitable for sloping uplands. The Programme has adopted for this purpose the Diversified Farming Systems approach, which includes support for farmers to grow tree crops, mainly fruit trees, as well as to invest in short term commercial crops to sustain farmers’ income till the time the tree crops give sufficient revenue. Major support is also give for soil and water conservation measures to maintain and increase productivity of the farmland. The Programme’s experience is that its objectives can only be achieved if an effective and quality extension mechanism is in place and can be sustained in the future.

B. Rationale for the mission

In September 2003, the Mid Term Review (MTR) mission criticised UDP’s strategies and implementation quality regarding the promotion of diversified farming systems in the uplands. The MTR recommended that more has to be done to increase economic development in the upland areas if the Programme wants to achieve the income-generating objective to be met with its farmer co-operators by the end of 2005. It also identified a number of shortcomings under the DFS programme detrimental to soil and water conservation and maintaining and increasing productivity of upland farms. Mainly frequently farmers apparently grow their crops on too steep slopes unsuitable for such crops. The quality of UDP’s extension services mechanism, which depends on the performance of LGU extension workers, was also questioned.

Hence the Programme in 2004 will address these concerns regarding soil conservation and crop selection and slope matching through improved extension mechanisms and quality of services.

C. Terms of Reference

The Consultant’s Terms of Reference are given below. He is required to document his experiences and submit a final report at least one week before departure to allow for a workshop to further disseminate recommendations on improving and expanding the DFS programme.

<table>
<thead>
<tr>
<th>TORs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Continue to strengthen the work of the SAD Component staff, LGU Technicians, barangay extension workers and model farmers, through a hands-on approach, to improve their performance in assisting upland farmers to have good farms that address both conservation and income concerns in a sustainable manner. For that purpose he will work closely with and give his technical advice to the Institution to be contracted for improving UDP’s extension services and other partners involved</td>
</tr>
<tr>
<td>2. Monitor the DFS activities in the provinces and give the necessary feed back to all stakeholders, particularly the LGUs and UDP management, and recommend actions that would improve the performance of UDP’s farmer co-operators and the extension workers</td>
</tr>
</tbody>
</table>
D. Land Suitability Issues

Due to the fragile, infertile soils and rugged terrain of the uplands, the 1999 Planning Atlas for Region XI produced by JICA\(^1\), considered the general land development suitability of much of the UDP project areas either as forest conservation areas or not suitable for upland crops or for orchard development (see Annex A).

Despite this blanket assessment, the Consultant identified several extensive areas within the uplands of Southern Mindanao, where diversified cropping systems can be undertaken sustainably and profitably. For this to succeed, certain soil and water conservation interventions have to be carefully laid out and maintained according to specified designs, and recommended cropping practices must be adopted and strictly adhered to.

These areas are mainly restricted to slopes below 55%, with loam and clay-textured soils over 100 cm deep. Within these areas the Consultant has identified a number of low-cost, low risk, soil and water conservation interventions involving slope management, yield-increasing cropping strategies, and tree planting techniques. If followed correctly, these should promote a more sustainable agriculture, and improve farmers’ incomes.

On slopes above 55% slope the best protection of the soil is to revert back to a multi-storey tree cover (e.g. fruit trees, bananas, coffee, cacao, etc) with a good grass ground cover. Direct seeding in the hills, and grafting on scions, is within the capabilities and budget of upland farmers, and ensures a deeper penetrating root system than the fibrous roots found in nursery raised trees. Farmers who are aware of the higher incomes per unit area to be earned from fruit trees are planning to expand the area under tree crops by reducing the area under corn.

The intended outcome is for upland communities to purchase staples such as corn and rice from the sale of fruits, copra, coffee, cacao, etc. as is already happening in parts of Davao del Sur (e.g. Barangay Coronan, Santa Cruz), and in much of Davao del Norte. However, local staff and farmers must be trained to an acceptable level of competency essential for developing sound agricultural practices on these fragile landscapes.

However, there are many areas where soil and water conservation interventions cannot be safely implemented without increasing the erosion hazard, due to the configuration of the land (slope length and shape), highly erodible lahar soils, or truncated soil profiles. The DA and UDP should leave the decision to the DENR as to whether it is in the public interest that upland farmers be permitted to continue to try to these lands.

It is becoming evident that the continuous cultivation of corn and cassava has reduced soil depths to very shallow levels so that crop yields are declining and crop failures are more likely. Unfortunately, the soils may now be too shallow to store enough moisture to support tree crops, which require soil moisture in the root zone throughout the year. Strategies need to be identified and tested to mitigate this serious problem that threatens to make many parts of the uplands unproductive.

PART B

IMPLEMENTATION OF THE TERMS OF REFERENCE

1. Continue to strengthen the work of the SAD Component staff, LGU Technicians, barangay extension workers and model farmers, through a hands-on approach, to improve their performance in assisting upland farmers to have good farms that address both conservation and income concerns in a sustainable manner

On field visits with UDP staff, the Consultant provided technical advice and training to ICRAF staff, the Institution contracted for improving UDP’s extension services. In addition he briefed service providers (e.g. IDS) contracted to replicate UDP models on the Project’s approach to slope management, agricultural diversification and intensification techniques, as well as the arguments for persuading farmers to switch from corn-based farming systems to medium- and long-term crops.

1.1 Strengthen the work of SAD Component staff, LGU technicians, BEWs, etc

1.1.1 Reinforcing training in STOP

Whenever possible, the Consultant reviewed the principles of slope management and land care in the field with project staff and field technicians, and reinforced past training courses in slope treatment-oriented practices (STOP). This involved either formal training on STOP and crop matching with flip charts, or in-field discussions when visiting farms or setting up demonstrations.

Emphasis was given to identifying and mapping land units near the tops of hills or ridges that can be terraced over time through a combination of cross-slope barriers, contour ploughing and natural soil erosion. BEWs had to produce maps showing the distribution of the land units within a farm, the proposed layout of SWC measures, and the land use prescriptions for each land unit. (See Annex 1.1 for an example of farm maps and land use prescriptions).

Developing learning centres

Some of the proposed learning centers posed a number of problems, particularly when hedgerows were too far apart and/or on slopes steeper than recommended in STOP, or were misaligned. Ways were found to correct these (see Section 4).

The ATs and BEWs were asked to consider what the centres would show farmers, that they didn’t already know, when they visited the centres. For example, at Mabini (PPO1) the improved design for cross-slope barriers and the use of mulched micro-basins (eyebrow terraces) are demonstrated.

At the Upoh Learning Centre, Sarangani, the history of the site was taken as a good starting point. When corn was grown on the site the annual harvest only gave an income of P28/10m², despite applying fertiliser and high inputs of labour. On the other hand, one hill of banana, which occupies 10m², produces an income of 66-143 kg/10m², depending on whether the bananas had been bagged or not. The learning centre should highlight the benefits of switching to bananas from corn, and emphasise the higher incomes to be obtained from investing a few pesos in bagging the bananas. In addition, the site could also explain the advantages of triangular spacing to increase the number of trees per unit area; and demonstrate eyebrow basins and mulching.

The Sitio Gintalos learning centre near Don Marcellino, Davao del Sur, appeared to be nothing special except a mixture of coconuts, bananas, various fruit trees and some medicinal plants on a hillside. However, this is ideal for explaining the principles of multi-storey cropping (see Section 4 on developing extension materials for the DFS programme).
1.1.2 Assisting upland farmers to have good farms

The Consultant was required to evaluate first line farms, as these had to be up to standard before second line farms could be funded. All the first line farms were established before the STOP guidelines were developed and hedgerows were frequently planted without using the A-frame, so they were off the contours increasing the risk of erosion.

Consequently, the spacing of hedgerows on most farms is too wide to provide effective SWC protection, or they were well off the contour. Properly contoured hedgerows create level benches that make mechanization of farm operations possible and increase the value of the land.

The Consultant developed an improved design for cross-slope barriers (see Section 4) that incorporates a Natural Vegetative Strip (NVS) below the hedgerow. The widths of the cultivated area remain as given in STOP but a two-metre wide strip, which is left uncultivated to develop a grass cover, is added below the hedgerow or cross-slope barrier to act as a riser. The improved design reinforces the SWC aspects for the slope while reducing the number of hedgerows needed.

Diversification of cropping is promoted by planting bananas and other fruit trees in the NVS; a line of pineapples to separate the NVS from the terrace; and restricting the cultivation if erosion-inducing annual crops such as corn, root crops, peanuts etc, to the 2-4 m wide terrace behind the hedgerow which intercepts eroding soil, and where a level bench should develop over time.

The limited and seasonal availability of hedegrow seeds and splits of Vetiver and Napier grass or Setaria splendida etc., as well as having to wait to harvest the crops currently in the ground, means action to rectify the hedgerows cannot be taken immediately (see Section 5).

1.1.3 Address conservation and income concerns in a sustainable manner

Possibly as a result of comparing the returns from corn with fruit trees (see Section 3 below), and appreciating the logic of planting fruit trees as a “pension plan”\(^2\), many farmers are indicating they wish to switch from corn to tree crops. This must be encouraged, especially as an El Niño dry spell forecast to last until May 2005 will cause corn crops to fail, particularly on slopes with truncated soil profiles.

Giving the farmer disease-free banana corms or suckers is a good way to switch from corn to fruit trees and raise incomes. The price reportedly varies from P2 to P5 for corms, while suckers are P5 each. In PPO 1, at least one municipality is giving each farmer 160 banana corms. After planting bananas, which start producing after 18 months, the farmer should diversify his fruit production by planting at least two types of fruit trees among the bananas.

A problem is the seeds of fruit trees such as mangoes and durians are currently in short supply as the fruiting season has ended. The good news for farmers is that seeds, when they are available, are cheap compared to the price of large planting material (LPM) seedlings (see Table 1):

<table>
<thead>
<tr>
<th>Fruit tree</th>
<th>No. of seeds/kg</th>
<th>Price/kg</th>
<th>Price/seedling (LPM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durian</td>
<td>55-60</td>
<td>P25</td>
<td>P50</td>
</tr>
<tr>
<td>Lanzones</td>
<td>150-200</td>
<td>P25</td>
<td>P50</td>
</tr>
<tr>
<td>Rambutan</td>
<td>150-200</td>
<td>P25</td>
<td>P60</td>
</tr>
<tr>
<td>Mango</td>
<td>100</td>
<td>P25</td>
<td>P50-100</td>
</tr>
</tbody>
</table>

\(^2\) See Section 7.6 of the Consultant’s Final Report of the Third Tree Crop Mission. October 2003

\(^3\) Prices of seeds were obtained by a BEW in Don Marcellino. They can be purchased from the LGU.
The benefits of planting fruit trees from seed include: lower cost and lower financial risk to the farmer, and better survival due to the development of the tap root. For example, for an outlay of P25 a farmer can buy one kilo of mango seeds (100 pieces) and plant them directly on his land. With an 80% survival rate he would need to buy 80 scions for field grafting @ P5 each (assuming he doesn’t have his own source of scions). Assuming a 25% failure of the grafts, the result is a grove of 60 established seedlings, with well-developed tap roots, for a cost of P425 (not counting labour). This takes out 1.35 ha of land from corn production at 15m spacing.

The same outlay will only buy eight mango seedlings (assuming a cost of P50 each), which would occupy only 0.18 ha, if they can all survive despite losing their tap roots. Farmers have told the Consultant that in their experience, directly-seeded fruit trees are healthier and live longer.

At P2 per banana corm, the P3,000 allocated for inputs will provide enough material to convert 1.5 ha of corn field to banana plantation. On the other hand, 30 fruit tree seedlings will only cover 0.3 to 0.675 ha (and be at risk from future droughts), and the farmer will doubtless continue to grow corn on the spare land.

It is estimated that four mango trees will generate between P4,000-5,000 after eight years. If this represents one month’s income, then 50 mango trees should more than cover the farmer’s annual needs. Combining this with income from bananas and 50 other trees planted from seeds (e.g. lanzones, durian etc), the farmer should be much better off.

Pineapples can generate high returns from small areas. A plot of 10m$^2$ (3.16 x 3.16) planted with 28-40 pineapple suckers (i.e. P200 (@P5/sucker) can produce P400-600 worth of pineapples. This small plot can be doubled each year to almost 100 m$^2$ in four years using the suckers produced by the crop. This generates one month’s income from a small investment.

The same can be done for other small units of land. The farm maps and prescription forms help facilitate the concept of monthly income generators

1.2 Recommendations

- Try to identify a theme based on STOP for each learning centre, and demonstrate the principles on the ground.

- Instead of providing seedlings of fruit trees as part of the DFS inputs, give the farmers seeds to plant and encourage them to obtain scions from within their areas.

- Encourage diversified farming by demonstrating how small outlays of funds for a bag of fruit tree seeds, scions; or suckers of bananas, and developing small plots of land (e.g. for pineapples) as monthly income generators, can result in incomes in excess of their annual requirements, while reducing the area and soil erosion under corn.

- Give out seedlings in limited numbers only for the purpose of introducing new varieties of fruit trees, such as Chinese Pomelo, to an area. These should be planted near the homestead where supplementary watering can be given. If appropriate, these will be a source of scions in the future.

- Provide farmers with seeds, banana suckers or corms once sufficient rain has fallen to wet the soil to a depth of at least 50 cm.

- Before being given the seeds, banana suckers or corms, each farmer must lay out the planting sites (at the appropriate spacing for the species) in a triangular layout on sloping
land (see Photo 1). This allows 15% more trees to occupy the site than with square planting layouts with the same spacing.

- On slopes of 45% or above, a 30 cm depth of mulch in a 3.0 m diameter ring should be applied on each planting site, to suppress weeds, protect the soil and improve soil moisture conditions.
- On slopes below 45%, 90 cm diameter eyebrow basins need to be constructed and mulched. This will also deter ploughing.

**Photo 1. Triangular layout of mulched planting sites. Mabini, Compostela Valley**

- The ATs and BEWs should be given refresher training courses in grafting.
- When seeds of fruit trees become available, the farmers should be reminded of the benefits of planting these by direct seeding in the field and be trained in grafting on the scions of certified trees. A grafting knife should also be included in the inputs – to be given when the farmer has been trained in field grafting.

2. **Monitor the DFS activities in the provinces and give the necessary feedback to all stakeholders, particularly the LGUs and UDP management, and recommend actions that would improve the performance of UDP’s farmer co-operators and the extension workers**

2.1 **Field trips**

Field trips were made to first and second line farms in all five provinces to verify that the farms met DFS requirements. Whenever possible the SAD or RM Coordinator accompanied the Consultant, with the PPO SAD specialists, ICRAF staff, and LGU technicians joining the visits in the provinces (see field trip reports in Annex 2.1).

The principles of the improved design for cross-slope barriers on steep slopes were explained to the Technical chiefs, SAD specialists, MSOs, ICRAF staff, ATs and BEWs. Whereas the terrace spacing stays the same for the particular slope, as outlined in the STOP table, the main difference is that a 2.0 m wide NVS is added immediately below the hedgerow.

---

4 For example: Low cost and low risk, while a more vigorous rooting system with a deep tap root develops enabling the tree to survive droughts and get nutrients and moisture from deeper in the soil. Directly seeded trees also live longer.
As crops are currently in the ground on most of the farms, putting in SWC measures will have to wait until the crops have been harvested. This is likely to be in January or February 2005. The availability of planting material such as seeds for leguminous hedgerows, splits of Napier, Vetiver or Guinea grass, etc is a limiting factor.

2.2 Verification procedure for DFS

Farm maps and prescriptions produced by the BEWs, showing the arrangement of land units and proposed SWC layouts, were used when available and the slope measurements checked. The verification/validation procedure for DFS comprises:

- Approval by the SAD Coordinator or other agreed person of the planned SWC layouts as indicated on the farm maps; and the prescriptions for land use for each land unit identified on the farm.

- After any changes have been made as deemed necessary, the verifying officer signs each page of the prescription form and the maps to show it has been approved.

- Although the proposals have been approved, the PPO must only release funds for inputs once the beneficiary has put in place the SWC measures stated in the prescription forms.

This procedure enables the PPO managers to inform LGU officials that the projects have been approved, but funds cannot be released until the farmers have fulfilled their SWC requirements.

2.3 Recommendations

- When hedgerows have been planted too wide apart to comply with STOP, then the cultivated area follows the width of the terrace for that particular slope, as given in STOP, and the remainder of the land up to the next hedgerow becomes an NVS in which bananas or other fruit trees are planted.

- Proposals for neighbouring farms can be approved without site visits if based on the prescriptions and maps, provided the SAD Specialist vouches they are situated on recognisably identical terrain, and the approving officer is familiar with the area.

3. Conduct hands-on training to extension staff where appropriate and feasible

3.1 Comparing incomes from corn with bananas

Extension staff were briefed how to ask the cooperator to compare the income from growing corn with that from bananas on a comparable area. A form has been prepared to simplify this (see Annex 3.1). In all cases the farmers found that bananas generate 2-8 times the income from corn with less labour (see Table 3 in Section 6). The extension message is that bananas outperform corn every time – even in the extreme case of three crops of corn a year with six tons/ha/harvest (i.e. 18 tons/ha/year) planting hybrid corn and inorganic fertilisers. The cash earned from bananas could be used to buy the household staples of corn, rice etc, and still leave money to spare for purchasing some inputs to boost banana yields still further.

3.2 Promoting planting fruit trees as a pension plan

To offset the risk of loss of income in the event that the banana plants become infected with bunchy top disease, the Consultant suggested that extension staff advise farmers to plant fruit
trees such as mango, durian and lanzones. Since upland farmers rarely have any savings, and will not have a cash retirement fund when they are older, the benefits of planting trees as a form of pension plan were explained to the extension staff.

Farmers should be asked to consider what would happen when they are too old or unable to cultivate fields, dig up root crops, etc. When the benefits of allocating 2-3 days a month to planting and maintaining fruit trees as a pension plan for the future were explained to the farmers, they found the concept attractive.

An example from the SMAP project was cited, where a farmer planted 40 mango trees 10 years ago, to the amusement of his neighbours. Over the years he expanded the orchard to about 3-4 hectares. The value of that farmer’s recent harvest of mangoes was P 350,000. His neighbours wished they had done the same. The UDP farmers were told that in China there is a saying that the best time to plant trees was yesterday, but the next best time is today. It is only too late to plant trees if the farmer adopts the attitude of Mañana banana.

3.3 Recommendations

- Extension workers should promote the concept that devoting 2-3 days a month to planting and looking after fruit trees provides the farmer and his family with a pension plan.

- Extension workers should encourage farmers to look at small plots on their land as monthly income generators (see Section 1.1.3 above). This will enable them to estimate whether their annual needs can be met or exceeded.

4. Assist with developing extension materials for the DFS programme

4.1 STOP 2: Multi-storey cropping

The Consultant followed up STOP 1: Land Unit Farming (see Annex 4.1), which promotes the formation of terraces near the tops of hills and ridges, using a combination of cross-slope barriers and contour ploughing or hand-cultivation, with handouts on STOP 2 and STOP 3.

STOP 2, which relates to planting tree crops on steep slopes, is based on the principle of planting a mixture of fruit trees of different heights to imitate the multi-storey canopy of the original rain forest. This helps protect the soil from erosion by dissipating the energy of raindrops (Annex 4.2).

As mentioned above in Section 1.1.1, the Sitio Gintalos learning centre near Don Marcellino, Davao del Sur, appears to be an ideal site for explaining the principles of multi-storey cropping.

A barangay at Santa Cruz, Davao del Sur, could also be used to demonstrate the ideal “End-of-Project” situation. The owners of well-established multi-storey canopy tree gardens use some of the cash from the sale of copra and fruits to buy all the household staples such as corn and rice etc). This leaves them free to seek employment elsewhere and boost their incomes still further.

4.2 STOP 3. Zero-tillage and mulching for crop production on truncated soils

Whereas STOP 1 requires a minimum soil depth of 100 cm to develop terraces at the recommended spacings for satisfactory crop growth, STOP 3 seeks to address the problems of growing crops when soils have been truncated to well below 100 cm depth by soil erosion. Heavy mulching of crops, to imitate the leaf litter and humus covering the original forest floor, conserves soil moisture and supports soil micro-organisms, while zero tillage practices should be used to plant the seeds of
annual crops through the mulch without exposing the soil. The aim is to maintain soil depths by minimizing the movement of soil (see Annex 4.3).

4.3 Other handouts produced by the Consultant

The improved design for cross-slope barriers on steep slopes when applying STOP on undeveloped land incorporates a two-metre wide NVS immediately below the hedgerow. This dissipates the energy of run-off dropping from the terrace above so it doesn’t undermine the terrace (Annex 4.4). The spacings given in STOP apply only to the width of the cultivable strip. The cross-slope barrier therefore consists of a combination of a leguminous hedgerow, or Napier/Vetiver grass strip, and the NVS. This also forms the basis for rehabilitating farms where the hedgerow spacing does not meet STOP recommendations.

A Guide to Rehabilitating and Managing Cross-slope Barriers (Hedgerows, Grass strips, NVS) explains how to correct hedgerows that are too widely spaced, or which are off the contour, as well as planting and managing contour strips of Vetiver grass and Napier grass (see Annex 4.5).

As Banana bunchy top disease is prevalent in the UDP area a handout was prepared for extension staff on bolo (machete) hygiene to prevent passing the disease onto uninfected plants (Annex 4.6).

Other extension materials produced include a short description on using cogon grass as a mulch to kill itself (Annex 4.7), and adapting used rubber car tyres as more efficient yokes for carabaos (Annex 4.8). A full list of handouts prepared in this Consultancy is shown in Table 2.

Table 2. Handouts produced by the Upland farming/ SWC Consultant Mr K R S Proud

<table>
<thead>
<tr>
<th>Handout Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form to compare inputs and yields of Corn with Bananas</td>
</tr>
<tr>
<td>STOP 1. Land Unit Farming</td>
</tr>
<tr>
<td>STOP 2. Multi-Storey Cropping</td>
</tr>
<tr>
<td>STOP 3. Zero-tillage and Mulching for Crop Production on Shallow Soils</td>
</tr>
<tr>
<td>An Improved Design for Cross-slope Barriers</td>
</tr>
<tr>
<td>A Guide to Rehabilitating and Managing Cross-slope Barriers (Hedgerows, Grass strips, NVS)</td>
</tr>
<tr>
<td>Bolo Hygiene against Banana Bunchy Top Disease</td>
</tr>
<tr>
<td>Using Cogon to Control Cogon</td>
</tr>
<tr>
<td>Take the pressure off your carabao’s neck with a Goyod</td>
</tr>
<tr>
<td>Setaria splendida. Another species for use as a cross-slope barrier</td>
</tr>
</tbody>
</table>

Farmers are getting lower yields than is possible, because they have crops too widely spaced, and are using incorrect cultivation techniques. More information on the spacing and management of individual crops is needed. Handouts on planting crops such pineapples, ginger, and mungo beans are being collated.

4.4 Recommendations

- Another flip chart on slope management practices (e.g. STOP 2 and STOP 3) should be produced. A series of posters showing the benefits in labour savings and increased incomes from switching from corn and cassava production to bananas and other fruit trees would also be a useful extension tool.

- Produce or obtain handouts on the recommended ways to plant and grow crops such as ginger, gabii, and pineapples. Provide farmers with advice on how to increase yields of bananas, e.g. optimum spacing, fertilizer management, etc.
5. Jointly with PMO representatives, establish and strengthen contacts with appropriate government and non-government agencies regarding the introduction of improved planting material

5.1 Limited availability of planting material for cross-slope barriers

The limited and seasonal availability of planting material, such as seeds of *Flemingia* and *Rinsonia*, and splits of *Vetiver*, *Napier* grass, *Setaria splendida* etc., is preventing farmers from adopting slope management treatments. Farmers with leguminous hedgerows (e.g. *Flemingia* and *Rinsonia*), should be encouraged to allow a metre at each end of every hedgerow to produce seeds for sale.

Whereas Napier grass and *Setaria splendida* are more effective at intercepting eroding soil than leguminous hedgerows, and can be used on slopes > 25%, they are not as effective as *Vetiver* grass. When planted in a single row the gaps between their stems are too wide to control the flow of soil and water after a heavy rainstorm. Double rows of Napier or *Setaria* are therefore advisable. A disadvantage of Napier grass, compared with *Vetiver* grass, is that it depletes the soil of macronutrient elements, and its roots compete with nearby crops. *Setaria* can make horses sick due to the build up of oxalates (Annex 5.1).

5.2 Proposals for bulking up material for cross-slope barriers

*Vetiver* grass is reportedly available from Bukidnon. This should be investigated and several sacks of splits purchased and bulked up. Plots for this purpose need establishing on suitable sites on farms where supplementary watering is possible. This would provide readily accessible supplies of material for SWC barriers, and could stimulate adoption of these interventions.

After discussions with Chiefs of the TOUs and MSOs, it was concluded that bulking up of material for grass strips could be done at municipal nurseries, community nurseries, and even around the community water supply outlets where watering of the stocks can be done. Basic supplies of Napier and *Vetiver* can be sourced from Bukidnon, while *Setaria* is available in Rio del Pilar.

This should be started as soon as possible so that supplies will be available by May 2005, when the anticipated drought is expected to end, and farmers will be planting their farms.

5.3 Recommendations

- During the coming dry months (January to May 2005) acquire and distribute splits of vetiver grass, Napier grass and *Setaria* to municipal and community nurseries, with available water, bulking up. UDP cooperators with access to water should also be given splits to bulk up.

- Where necessary, ensure some of the UDP budget of P 3,000 for farm inputs is used to purchase splits of Napier grass, Vetiver grass or *Setaria splendida* to establish properly spaced and contoured cross-slope barriers.
6. Jointly with the marketing, agri-business and RFS staff make an assessment and categorise tree crops according to their present and possible future profitability (costs and benefits) and make recommendations on financing investment in tree crops by small holder beneficiaries and/or groups of farmer beneficiaries, coops etc.

6.1 Bananas give higher returns than corn

The economic as well as ecological advantages for growing fruits are obvious. Corn, growing on soils with depths getting shallower each season (see Section 7.1 below), will experience declining yields and fail to produce any grain when there is a dry spell of a few days. Yields cited by farmers range from 450 kg to 6,000 kg per harvest, with two to three harvests a year.

As indicated in Table 3, bananas give 2-6 times the income than corn or cassava generating up to P225/10m², compared with P126/10m² for the top yields of corn (n.b. corn incomes decrease substantially when the costs of fertilizers and labour is taken into account). Tree crops free labour for use elsewhere, and protect the soil.

The Marketing Consultant, Mr Eddy Vernon drew attention to the important fact that there are several banana chip factories in Southern Mindanao who cannot get enough bananas to meet their needs. Farmers are reminded of this.

Table 3. Comparison of incomes from corn with bananas (PPO 4: San Juan & Rio del Pilar)

<table>
<thead>
<tr>
<th>Details</th>
<th>San Juan</th>
<th>Rio del Pilar</th>
<th>San Juan</th>
<th>Rio del Pilar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield</td>
<td>6,000 kg/ha*</td>
<td>450 kg</td>
<td>15 kg/hill</td>
<td>13 kg/hill</td>
</tr>
<tr>
<td>No. of harvests/yr</td>
<td>3</td>
<td>3</td>
<td>3/hill</td>
<td>1/hill</td>
</tr>
<tr>
<td>Yield/10 m²/yr</td>
<td>18 kg</td>
<td>1.35 kg</td>
<td>.45 kg</td>
<td>13 kg</td>
</tr>
<tr>
<td>Sale price/kg</td>
<td>P 7</td>
<td>P 10</td>
<td>P 5</td>
<td>P 7</td>
</tr>
<tr>
<td>Income/10 m²/yr</td>
<td>P 126</td>
<td>P 13.5</td>
<td>P 225</td>
<td>P 91</td>
</tr>
<tr>
<td>Operations/cropping cycle</td>
<td>6</td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>Distance walked/operation</td>
<td>133 x 100 = 13,300 m</td>
<td>2,500 m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total distance/cropping cycle</td>
<td>6 x 13.3 km = 80 km</td>
<td>10 km</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total distance per year</td>
<td>3 x 80 = 240 km</td>
<td></td>
<td></td>
<td>30 km</td>
</tr>
</tbody>
</table>

* using improved seeds and six sacks of fertiliser

6.2 Projected returns from other fruits

Well-mulched pineapples, which are relatively drought-resistant, can grow on soils 30-60 cm deep, and can produce in the region of P400 to P600/10m² if properly spaced. An area of 1,200 m² would generate an annual income of between P48,000-60,000.

Mangoes planted at 10 x 10 m can generate P120/10m². 50 mango trees, covering 0.5 ha, produce about 100 kg per tree at 8 years, worth a total of P60,000 (if sold at P12/kg). However, a contractor would take 50-60% of this in payment for inducing, bagging, harvesting etc the mangoes.

Lanzones give a better return. They produce about 40 kg per tree after 8 years, and currently sell at P30/kg. An area of 0.5 ha has the potential to produce P93,000 a year without paying contractors.

The Consultant provided the Rural Finance TA Consultant, Mr David Baillie, details of the range of areas land units of different slopes have on farms, as well as data regarding yields of various tree crops from these land units (see Annex 6.1) as well as annual crops. With additional information from the PPO offices Mr Baillie produced a series of projections showing the costs and returns for various crops for small areas of land (See RFS data base).
6.3 Recommendations

- Further cooperation between the Divisions should produce the data showing the minimum area and inputs needed for crops to be monthly income generators. This information should be passed to the extension workers in a simple format for discussions with farmers.

- MED should hold discussions with UBAs and UCOs outlining the differences in income potential between corn and fruit tree crops. MED should advise farmers how to organize themselves so they produce sufficient harvests to make it worthwhile for traders to visit their area, and so they can purchase inputs as a group and get discounts.

7. Conduct any other assignment given by the Co-Directors

7.1 Report on the causes and consequences of a reduction in soil depths in the upland areas of Southern Mindanao

7.1.1 Background to the Study

On 5th October 2004, the Consultant, Ken Proud, was asked to accompany Co-Director Mr Dashiel Invisible, Resource Management Coordinator Mr Rogelio Abalus, to a press conference in Davao City where they briefed the press and radio journalists on the work of the Upland Development Programme (UDP). In response to questions they also gave a detailed explanation of how project strategies aimed to ensure replicability and adoption of project interventions – even after the project has ended.

When asked his opinion on the condition in the uplands of Mindanao compared to other countries, Ken Proud responded that the situation was alarming. Having visited numerous upland farms in six provinces he estimated that the soil profile was being reduced by 2-4 cm of soil annually. This was mainly due to inappropriate farming practices, particularly growing corn and cassava on very steep slopes. He compared this loss with the 100 years it takes to form one centimetre of soil. Reductions in soil depth lead to lower crop yields while rapidly lowering the potential for switching to tree crops.

The Consultant pointed out that upland soils in the humid tropics are generally fragile, highly erodible and infertile. Other projects had classified the uplands of the Davao Gulf provinces as unsuitable for upland crops, with only half the area considered suitable for establishing orchards. Nonetheless, despite this blanket assessment by JICA, the Consultant explained that UDP has been able identify several areas within the uplands of Southern Mindanao, where permanent and diversified cropping systems can be undertaken profitably. However, this requires laying out and maintaining soil and water conservation interventions according to specified designs, and adopting and adhering to recommended cropping practices.

A few days later, the project received a letter from a Davao City councillor, Leonardo Avilla, requesting a report on the causes of the reduction in soil depths as he considered the situation serious enough to warrant changing the council’s policy on the uplands. At the Co-Directors request, the Consultant prepared a report on the causes and consequences of the reduction in soil depths in the upland (see Annex 7.1).

---

7.1.2 Evidence for the reduction in soil depths

Evidence for the reduction in soil depths in upland soils included:

- Field observations of rill erosion, headcutting, gullying, and on the build up of eroded soil behind cross-slope barriers such as leguminous hedgerows, natural vegetative strips (NVS), and Napier and lemon grass hedges.
- Comparisons of soil depths in remnant forest patches or old, established plantations, with nearby cultivated, fallowed or abandoned land on similar slopes.
- Soil erosion studies from elsewhere in the Philippines.
- Studies giving measurements of soil loss under corn and cassava on similar slopes and soils elsewhere in the humid tropics.

Comparisons between soil depths on cultivated or abandoned agricultural land with the relatively undisturbed soils in nearby remnant patches of secondary forest, or well-established fruit trees, indicated reductions of 25-166 cm on very steep slopes in the UDP area. In one instance, corn cultivation on a 90% slope has reduced the soil depth by 53 cm in just five-years (i.e. an average of 10 cm/year) exposing a stone substratum.

7.1.3 Recommendations

- The communities, barangays, municipal governments and the DENR/NCIP should formally agree that, based on slopes and soil factors, certain areas in the barangays will be declared off-limits for certain types of agricultural use. The agreed status of these lands will be ensured by a simple co-management MOA and scheme in which responsibilities of parties are detailed.

- Allocate the rest of the area in the barangay for different types of agricultural uses (e.g. short-, medium-, and long-term crops, based on UDP’s slope treatment-oriented practices (STOP) land capability classification), or for settlements etc by the LGU/DENR/NCIP.

- Municipal and barangay ordinances are needed that specify the conditions to be fulfilled before eligible farmers can expand their farmland. Expansion plans should be submitted and approval obtained that the land is suitable for the proposed use, and the proposed soil protection measures are appropriate. The emphasis is to be on growing fruit tree crops.

- Priority should be given to applying soil and water conservation measures to protect those limited areas with the highest potential for diversified agricultural production. These are the land units such as hilltops, crests, ridges upper slopes and minor valleys, where slopes tend to be shorter and are less steep. The cultivation of erosive crops such as maize and cassava should be restricted to these areas, provided slope gradients have been reduced by appropriate soil and water conservation measures.

- When slopes are too steep or soils are too shallow to apply STOP interventions, or when there is no future for any form of cropping system, the decision on land use should be passed to the DENR. The law allows the DENR Secretary to reclassify alienable and disposable lands as forest lands to form part of the forest reserves.

- The DENR should be the agency to decide whether the continued cultivation of very steep slopes is in the public interest, or whether the lands should be kept in a vegetative condition sufficient to prevent erosion and adverse effects on the lowlands and streams. The DENR Secretary is empowered to take the necessary steps to expropriate, cancel effective titles, reject public land application or eject the occupants from the area.
7.2 Problems with Cassava production in the uplands of Southern Mindanao

7.2.1 Background to the Study

A number of cooperatives in San Isidro, Davao Oriental, have signed memoranda of agreement with San Miguel Corporation (SMC) to “initially establish a minimum of four hundred (400) hectares for the production of cassava, which shall be increased to one thousand two hundred (1,200) hectares in the next three years for the production of corn and/or cassava”. Under the contract, SMC agrees to provide technical assistance to the farmers for training, including farm visits for observational purposes. However, the costs of the technicians and their farm visits have to be paid for by the cooperatives.

As the cultivation of cassava in hilly or mountainous terrain is particularly damaging, with massive soil losses the UDP Co-Directors directed the Consultant to visit some of the farms and report on the matter (see Annex 7.2). A trip was made to the area on 8 September, 2004.

7.2.2 Soil losses are excessively high under cassava cultivation

Cassava is being grown on a commercial scale (i.e. mono-cropped on plots often exceeding 1.0 ha) on slopes mostly above 35%. In the extreme case, cassava had been planted on 85% slopes with 50 cm deep clay soils. Based on documented studies of soil erosion under cassava, which erosion increases dramatically with small increases in slope, the Consultant estimated that soil losses could exceed 1,300 t/ha/year - equivalent to a potential reduction in depth of 11 cm/year. With a current soil depth of 50 cm, the economic life of that particular piece of land may only extend to a second harvest of cassava, after which the land will only support cogon grass. A 1996 study in Vietnam stated that, “as a direct consequence of planting upland rice and cassava for food self-sufficiency, more than a one million ha have become eroded skeleton soils with no value for agriculture or forestry”

Given the fragile, highly erodible and infertile upland soils, it must be concluded that continued cultivation of cassava (and corn), even on gently sloping land, is unsound land husbandry. If the uplands are to have a future for supporting agriculture, farmers must be persuaded to move away from growing of highly erosive annual crops (cassava and all other root crops, corn, etc). As indicated in Section 6 (above), pineapples, bananas and other fruit crops offer viable alternatives to cassava and corn.

7.2.3 Recommendations

- Cassava production, even on the gentlest of slopes, causes unacceptable amounts of soil loss and damages the agricultural potential and economic value of the farm. To maintain the health of the land, UDP should only support the cultivation of cassava (and other root crops) when it is to grown in the flat, valley bottoms, or on areas where level (0-3%) terraces have already been formed by well-established cross-slope barriers.

- The cassava production contracts between the SMC and Cooperatives in the UDP area should be cancelled. One way this could be achieved is for DENR to decide if continued cultivation of very steep slopes is in the public interest, or whether the law requires the lands to be kept in a...

---

6 For example, soil losses for different slopes are: 1% slope: 3 tons/ha/yr; 5% slope: 87 tons/ha/yr. 15% slope: 221 tons/ha/yr
vegetative condition sufficient to prevent erosion and adverse effects on the lowlands and streams. The DENR Secretary is empowered to take the necessary steps to expropriate, cancel effective titles, reject public land application or eject the occupants from the area.

- Involve MED in advising farmers, via UBAs and UCOs, on the profitability and marketability of various crops, citing the comparative value of crops such as bananas and pineapples compared to cassava and corn.

- Establish banks of both Vetiver grass and Napier grass on the learning sites (particularly where there are minor valleys) to meet the needs of neighbouring farms for material for cross-slope barriers. Although Napier grass is more effective at intercepting eroding soil than leguminous hedgerows, it is not as effective as Vetiver grass when planted in a single row. The gaps between stems are too wide for it to control the flow of soil and water after a heavy rainstorm. Double rows of Napier are advisable.

- Protect all gentle crests, plateaux and upper slopes against erosion by planting appropriately spaced cross-slope barriers. Short- and medium-term crops should be planted on the terraces that develop. (A farmer will be more willing to fell a banana tree, than a mature mango or durian tree, for example, should there be a need to return to annual crops in the future).

8. CONCLUSIONS OF THE JUNE-DECEMBER 2004 UF/SWC MISSION

With respect to agricultural production, the Project is on the way to achieving the RM component objective of developing farm models aimed at “substituting the corn-based mixed farming to perennial crops and agroforestry. Grassland will be converted to agroforestry and mixed farming.” (Financing Proposal (IB/1037/97-EN)).

Farmers are starting to realise that corn as a crop on sloping land is a loser in all senses: it reduces incomes, it is an inefficient use of labour, it reduces the soil depth so that yields decline further, and it lowers the potential of the land to support other more valuable crops.

Throughout the UDP project area there is a discernible trend of farmers wanting to switch from corn to tree crops. Farmers are finally beginning to appreciate that fruit trees not only give much higher returns than corn, but they give increasing returns as the trees get older. The value of a plantation of fruit trees is being seen as attractive substitute for a pension. The STOP logic of restricting the cultivation of annual crops to gentle or terraced slopes and minor valleys where SWC interventions are effective, is gaining acceptance, but still needs reinforcing and should be extended to a wider audience.

It is crucial that this momentum be maintained by continued extension efforts during the next two years. Stopping now risks wasting the investments of the last four years, leading to the continued cultivation of corn on slopes and the formation of unproductive skeletal soils over extensive areas. Corn crops are already failing due to insufficient rain and shallow soil depths.

It should be noted that the Monitoring Report of the UDP, dated 10/09/04, undertaken by Frans Geilfus expressed concern that “the upland development model to be achieved and replicated by the project has been scaled down to its adoption by a few municipalities, while it was clearly the intention of the FA to promote a model that might be advocated at all levels of development policy” (see Annex 8.1).

The Report points out that although the project is supporting ‘replications’, replicability is properly measured by how the activities may be implemented without the project’s help. While
the monitoring mission praises the excellence of many practices promoted by the project in the field, it cautions that many promising initiatives might quickly peter out “if no further support and coaching are ensured after 2005”.

9. **MAIN RECOMMENDATIONS**

- One effective way of meeting the Monitoring mission’s concerns is to set up show case farms demonstrating the STOP interventions on different upland terrain types, in municipalities adjacent to the Project area. Groups of farmers should choose one of their members to be the contact farmer on the understanding that the only the farm of the selected candidate will be developed with inputs provided by the Project. Neighbouring farmers will be invited to attend training sessions on the show case farm, and their constraints to adopting innovations examined and dealt with appropriately.

  This will enable the Project to leave behind something that farmers outside the project area can replicate. Experience from other projects shows that adoption of interventions may occur many years after a project has ended – but all too often there is no model or trainer around to provide advice.

- Continue to support ICRAF/WAC to develop and manage the learning sites and demonstrate how STOP technologies (cross-slope barriers, multi-storey cropping, and zero-tillage/mulching) can improve incomes within the current project area. Similarly, efforts should be made to tackle the relevant constraints affecting the farmers’ ability to adopt the technologies.

- The Project should turn the effects of the coming El Niño to advantage by encouraging more farmers to change their cropping practices. This can be achieved through discussions with UBAs and UCOs, FTGs etc about the differences in incomes between growing corn and bananas and other fruit trees. Flip charts and posters need preparing to help increase awareness on this issue.

- Material for cross-slope barriers (i.e. splits of Napier and Vetiver grass, *Setaria*, etc) should be acquired and bulked up at municipal and community nurseries, and on farms where supplementary watering is possible. Supplies of splits should be available for planting when sufficient rain has fallen at the start of the cropping season.

- Encourage LGUs to collect fruit tree seeds for sale to upland farmers. These are cheaper than seedlings, easier to transport, and less of a financial risk. The move away from growing corn can be accelerated if LGUs follow the example of the Municipal Agriculturist of Laak, ComVal, by providing 160 banana corms to each farmer on a plant now, pay later basis. The LGUs should be encouraged to promote multi-storey cropping on sloping land by under-planting coconut plantations with the seeds of fruit trees.

- Give refresher courses in grafting to BEWs and ATs so they can train farmers to graft scions onto directly-seeded plants in the field. Farmers trained in grafting should be provided with grafting knives so they can assist their neighbours in future.
ANNEXES

LIST OF ANNEXES

Annex A   Land Suitability Issues

Annex 1.1  Davao del Norte, Tibulao Demo Farm. Land Unit Prescriptions and Inputs

Annex 2.1  Field Trip Reports (Jun-Dec 2004)

Annex 3.1  Form to compare inputs and yields of Corn with Bananas

Annex 4.1  STOP 1. Land Unit Farming

Annex 4.2  STOP 2. Multi-Storey Cropping

Annex 4.3  STOP 3. Zero-tillage and Mulching for Crop Production on Shallow Soils

Annex 4.4  An Improved Design for Cross-slope Barriers

Annex 4.5  A Guide to Rehabilitating and Managing Cross-slope Barriers (Hedgerows, Grass strips, NVS)

Annex 4.6  Bolo Hygiene against Banana Bunchy Top Disease

Annex 4.7  Using Cogon to Control Cogon

Annex 4.8  Take the pressure off your carabao ‘s neck with a Goyod

Annex 5.1  Setaria splendida. Another species for use as a cross-slope barrier

Annex 6.1  Land unit prescription form comparing incomes from bananas and fruits with corn

Annex 7.1  Report on the Causes and Consequences of a Reduction in Soil Depths in the Uplands of Southern Mindanao

Annex 7.2  Report on Problems with Cassava Production in Southern Mindanao

LAND SUITABILITY ISSUES

The 1999 *Planning Atlas* for Region XI\(^1\), considers the general land development suitability of much of the UDP project areas either as forest conservation areas or not suitable for upland crops or for orchard development. The JICA land capability classification maps of the Davao Gulf Provinces classify over 90% of the UDP-covered barangay areas as not suitable for upland crops (Map 1); with about 50% of the UDP area considered unsuitable even for orchard crops (Map 2).

From JICA’s assessment it would appear that sustainable agricultural development is not possible in the uplands of the Compostela Valley, Davao Oriental and Davao del Sur. JICA does not provide information on Sarangani and South Cotabato as these provinces are outside JICA’s study area.

Map 1. Land capability of the Davao Gulf Provinces for Upland Crops according to JICA

---

Map 2. Land capability of the Davao Gulf Provinces for Upland Orchards according to JICA
<table>
<thead>
<tr>
<th>LAND UNIT</th>
<th>Site factors</th>
<th>Prescriptions / Recommendations</th>
<th>Projected Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 *</td>
<td><strong>Shape+</strong></td>
<td><strong>Width m</strong></td>
<td><strong>Length m</strong></td>
</tr>
<tr>
<td>RIDGE</td>
<td>Convex</td>
<td>8</td>
<td>80</td>
</tr>
<tr>
<td>2 *</td>
<td><strong>Shape+</strong></td>
<td><strong>Width m</strong></td>
<td><strong>Length m</strong></td>
</tr>
<tr>
<td>CREST/Plateau</td>
<td>Flat</td>
<td>50</td>
<td>70</td>
</tr>
<tr>
<td>3 *</td>
<td><strong>Shape+</strong></td>
<td><strong>Width m</strong></td>
<td><strong>Length m</strong></td>
</tr>
<tr>
<td>RIDGE</td>
<td>Convex</td>
<td>6</td>
<td>80</td>
</tr>
<tr>
<td>4 *</td>
<td><strong>Shape+</strong></td>
<td><strong>Width m</strong></td>
<td><strong>Length m</strong></td>
</tr>
<tr>
<td>SIDE SLOPE</td>
<td>Convex</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td>5 *</td>
<td><strong>Shape+</strong></td>
<td><strong>Width m</strong></td>
<td><strong>Length m</strong></td>
</tr>
<tr>
<td>SIDE SLOPE</td>
<td>Concave</td>
<td>60</td>
<td>40</td>
</tr>
</tbody>
</table>

# Napier needs double row of splits
## ANNEX 1.1
### Upland Farming/Soil & Water Conservation Report Jun-Dec 2004

<table>
<thead>
<tr>
<th>LAND UNIT</th>
<th>Site Factors</th>
<th>Prescriptions / Recommendations</th>
<th>Projected Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6</strong> * Shape+ Width m Length m Area: m² (W x L)</td>
<td>SPUR Convex</td>
<td>36-45</td>
<td>Vetiver splits 300</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
<td>OR</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>15</td>
<td>Napier splits 600</td>
</tr>
<tr>
<td></td>
<td>250</td>
<td>250</td>
<td>Pineapple suckers 60</td>
</tr>
<tr>
<td></td>
<td>Slope: %</td>
<td>Sandy clay</td>
<td>Vetiver splits 900</td>
</tr>
<tr>
<td></td>
<td>Soil texture</td>
<td>Sandy clay</td>
<td>Napier splits 1800</td>
</tr>
<tr>
<td></td>
<td>Soil depth (cm)</td>
<td>&gt;50</td>
<td>Pineapple suckers 150</td>
</tr>
<tr>
<td></td>
<td>Erosion:</td>
<td>Sheet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stoniness:</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Land use:</td>
<td>Fruit trees</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>5</strong> * Shape+ Width m Length m Area: m² (W x L)</td>
<td>SPUR Convex</td>
<td>36-45</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td></td>
<td>375</td>
<td>375</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slope: %</td>
<td>Sandy clay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil texture</td>
<td>Sandy clay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil depth (cm)</td>
<td>&gt;50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Erosion:</td>
<td>Sheet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stoniness:</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Land use:</td>
<td>Fruit trees</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>8</strong> * Shape+ Width m Length m Area: m² (W x L)</td>
<td>SIDE SLOPES Convex</td>
<td>46-55</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>100</td>
<td>Banana suckers 150</td>
</tr>
<tr>
<td></td>
<td>30</td>
<td>30</td>
<td>Fruit seeds + scions 100</td>
</tr>
<tr>
<td></td>
<td>3000</td>
<td>3000</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Slope: %</td>
<td>Sandy clay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil texture</td>
<td>Sandy clay</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil depth (cm)</td>
<td>&gt;50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Erosion:</td>
<td>Sheet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stoniness:</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Land use:</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>9</strong> * Shape+ Width m Length m Area: (W x L)</td>
<td>VALLEY HEAD Straight</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>70</td>
<td>3 kg Complete fertilizer</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>40</td>
<td>Herbicide 1 litre (?)</td>
</tr>
<tr>
<td></td>
<td>2800</td>
<td>2800</td>
<td>Carabao hire 3 days$</td>
</tr>
<tr>
<td></td>
<td>Slope: %</td>
<td>Clay loam</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil texture</td>
<td>Clay loam</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil depth (cm)</td>
<td>&gt;50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Erosion:</td>
<td>Sheet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stoniness:</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Land use:</td>
<td>Mango, Coconut</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>10</strong> * Shape+ Width m Length m Area: (W x L)</td>
<td>PLATEAU Flat</td>
<td>0-3</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>50</td>
<td>Herbicide 1 litre (?)</td>
</tr>
<tr>
<td></td>
<td>70</td>
<td>70</td>
<td>Carabao hire 3 days$</td>
</tr>
<tr>
<td></td>
<td>3500</td>
<td>3500</td>
<td>Hybrid corn 1000m²</td>
</tr>
<tr>
<td></td>
<td>Slope: %</td>
<td>Clay loam</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil texture</td>
<td>Clay loam</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil depth (cm)</td>
<td>&gt;60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Erosion:</td>
<td>Sheet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stoniness:</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Land use:</td>
<td>Cogon</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>11</strong> * Shape+ Width m Length m Area: (W x L)</td>
<td>UPPER SLOPE Straight</td>
<td>26-35</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>6</td>
<td>Herbicide 1 litre (?)</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>300</td>
<td>Carabao hire 3 days$</td>
</tr>
<tr>
<td></td>
<td>Slope: %</td>
<td>Clay loam</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil texture</td>
<td>Clay loam</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil depth (cm)</td>
<td>&gt;60</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Erosion:</td>
<td>Sheet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stoniness:</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Land use:</td>
<td>Cogon</td>
<td></td>
</tr>
</tbody>
</table>

---

* This is purely for demonstration purposes for farmers who have a plateau or broad crest suitable for vegetable production but do not have minor valley. A pond is not necessary on this particular farm, due to the minor valley and available well water.

$ Days of carabao hire covers all farm not just this land unit
<table>
<thead>
<tr>
<th>LAND UNIT</th>
<th>Site Factors</th>
<th>Prescriptions / Recommendations</th>
<th>Projected Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UPPER SLOPE</strong></td>
<td></td>
<td></td>
<td>Vetiver splits 1000</td>
</tr>
<tr>
<td>12 * Shape+</td>
<td>Straight</td>
<td>• Contour 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 2.8 m). Objective is to develop terraces.</td>
<td>Vetiver splits 700</td>
</tr>
<tr>
<td>Width m</td>
<td>50</td>
<td>• Plant peanuts, mungo, pineapples, beans. Mulch well with cogon from side slopes</td>
<td>Vetiver splits³ 1400</td>
</tr>
<tr>
<td>Length m</td>
<td>6</td>
<td></td>
<td>Pineapple suckers 120</td>
</tr>
<tr>
<td>Area: m²</td>
<td>300</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(W x L)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RIDGE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 * Shape+</td>
<td>Convex</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).</td>
<td></td>
</tr>
<tr>
<td>Width m</td>
<td>8</td>
<td>• Plant peanuts, mungo, beans, pineapples. Mulch well with cogon from side slopes</td>
<td></td>
</tr>
<tr>
<td>Length m</td>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Area: m²</td>
<td>400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(W x L)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>RIDGE END</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 * Shape+</td>
<td>Flat</td>
<td>• Contoured leguminous hedgerows/Napier or Vetiver grass strips at flat area/side slope interface, 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).</td>
<td>Banana suckers 120</td>
</tr>
<tr>
<td>Width m</td>
<td>12</td>
<td>• Plant peanuts. Mulch well with cogon from side slopes</td>
<td>Fruit seeds + scions 60</td>
</tr>
<tr>
<td>Length m</td>
<td>20</td>
<td></td>
<td>12 kg Complete</td>
</tr>
<tr>
<td>Area: m²</td>
<td>240</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(W x L)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SIDE SLOPES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 * Shape+</td>
<td>Convex</td>
<td>• Lay out triangular planting arrangement with spacing according to fruit trees to be planted. Plant bananas in one area at least.</td>
<td>Banana suckers 120</td>
</tr>
<tr>
<td>Width m</td>
<td>80</td>
<td>• 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.</td>
<td>Fruit seeds + scions 60</td>
</tr>
<tr>
<td>Length m</td>
<td>30</td>
<td>• Make 90 cm diameter eyebrow basins and plant seeds of required fruit trees, mulch with cogon, and graft scions later</td>
<td></td>
</tr>
<tr>
<td>Area: m²</td>
<td>2400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(W x L)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SIDE SLOPES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 * Shape+</td>
<td>Convex</td>
<td>• Lay out triangular planting arrangement with spacing according to fruit trees to be planted. Plant bananas in one area at least.</td>
<td>Banana suckers 120</td>
</tr>
<tr>
<td>Width m</td>
<td>90</td>
<td>• 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.</td>
<td>Fruit seeds + scions 60</td>
</tr>
<tr>
<td>Length m</td>
<td>30</td>
<td>• Make 90 cm diameter eyebrow basins and plant seeds of required fruit trees, mulch with cogon, and graft scions later</td>
<td></td>
</tr>
<tr>
<td>Area: m²</td>
<td>2700</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(W x L)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MINOR VALLEY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 * Shape+</td>
<td>Concave-Flat</td>
<td>• Prepare raised beds near well and plant vegetables.</td>
<td>Veg seeds</td>
</tr>
<tr>
<td>Width m</td>
<td>20</td>
<td>• Demonstrate ways of preparing compost</td>
<td></td>
</tr>
<tr>
<td>Length m</td>
<td>60</td>
<td>• Demonstrate basket composting/FAITH gardens.</td>
<td></td>
</tr>
<tr>
<td>Area: m²</td>
<td>1200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(W x L)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

UDP Technician: ___________________________  Signature: ___________________________
Cooperator: ___________________________  Signature: ___________________________
Date: ______________________
ANNEX 1.1
Upland Farming/Soil & Water Conservation Report Jun-Dec 2004

MAP 1. LAND UNIT AND SLOPE MAP
MAP 2. SOIL AND WATER CONSERVATION MEASURES

- Cross-slope barriers
- Planting from seed (no fertilizers)
- Mulching
- Ring ledding + mulching
UPDATE ON UPLAND FARMING/ S&WC SPECIALIST INPUT

Due to delays in getting the Rider to the BCEOM/EU contract approved the Consultant was absent from the project during May 2004 so was unable to backstop the training of ATs and BEWs by the core teams of SAD and RM coordinators and MSOs, trained in applying STOP, to ensure errors were not inadvertently introduced.

Report for the period 9-25th June 2004-06-24

The Consultant visited upland farming sites in Davao Oriental with the SAD and RM Coordinators from 14-17 June; and visited sites in Sarangani with the RM Coordinator from 21-24 June.

Main findings:

STOP

- Some of the ATs/BEWs in PPO2, although trained in applying STOP, were still drawing the farm maps from a generalised side view and not from the top or overhead view showing the whole farm and the relationship of its land units to it (e.g. Brgy Palau Gil).

- The CTO, PPO2, commenting on STOP said the ATs and BEWs were asking why it was only now that STOP was being introduced and not earlier in the Project cycle. This suggests they understand the logic of the methodology.

- At an AT/ BEW STOP training session at Malungon, the CTO, PPO4, expressed her surprise that slope as a factor in soil erosion had not been highlighted by previous consultants involved in land management. (When I first arrived on the Project in July 2003 and read the Community Watershed Plans, I was surprised that little, if any, emphasis was given to slope in zoning the watersheds. Slope steepness and slope length are two of the main factors affecting erosion and land use).

- Although ATs and BEWs in PPO4 have been trained in STOP, they have started selecting second line farms without doing a STOP survey and drawing a land unit map of the farms (e.g. Mun. Maasim, sitio Maknit). As a result, we found ourselves scrambling up >60% slopes to look at farms that did not meet UDP criteria. Farms should not be selected without an accompanying map and description of the land units (slope, soil depth and soil texture).

- Millet, the CTO PPO4, said she would like STOP surveys (mapping the various land units/slopes and measuring slopes, soil depth and assessing soil texture) to be made before the planning sessions with ICRAF. This would facilitate the planning of the Learning sites as the physical factors could be taken into account during the sessions. I was not able to meet with ICRAF to discuss this.

- The existing hedgerows on some of the farms proposed as training sites were not put in at appropriate spacing, nor were they aligned using A-frames so some correction is needed. This can make some areas unsuitable as learning
sites for farmers interested in the STOP technology and dualistic cropping systems – though they could be useful to see how well they can be amended to reduce erosion etc.

CROPS AND CROP MANAGEMENT

- More attention needs to be given to writing prescriptions on managing land units, depending on site factors and crop requirements. In conjunction with the Rural Finance and Marketing TAs and CTOs, the inputs (kg seeds/ha, fertiliser requirements, optimum spacing of crops, expected yields etc) for the six main annual crops and six main perennial crops in each Municipality are being collected, so that income projections can be given to farmers for small units of land (of a few hundred sq m only). This will also be helpful in helping farmers decide whether to apply for loans (small areas have a lower risk) while assisting the lenders to decide whether the application is a good risk. Good progress is being made in this respect.

- Some interesting observations were made regarding the optimum spacing of crops and use of fertilisers. We noted that some farmers had planted corn at 50-75 cms spacing between plants within the row, and 75-100 cms spacing between rows. Yields were only about 800 kg/ha/harvest.

  In PPO4 (Kiamba) a farmer had planted corn at the optimum spacing of 25 cms within the row and 75 cms between rows, and applied three sacks of complete fertiliser (150 kg) as a top dressing, (300 kg is the recommended amount). His yields amounted to 2,800 kg/ha/harvest. This amounted to an additional yield of 13kg corn for every one kg of fertiliser applied. A good investment.

- In Brgy Palma Gil, a group of farmers were asked about the value of their crop of corn from 10 sq m of cultivated field. They were then asked how many kilos of bananas they expected from one hill of banana occupying the same area. They were surprised that bananas gave P135 more than corn. Apparently, they had never considered comparing the relative returns from different crops. However, one of the farmers said that no traders came to their village to buy crops. When Gel asked why not, they admitted it was because they had nothing to sell. Then another farmer pointed out that if 100 of them each planted 0.5 ha of bananas, then traders would come. (Group action by farmers is one of the accelerators need for agricultural development). Further investigation by MED, to determine the volumes of produce that traders require to make visits to various barangays economically viable, might be worthwhile.

MISCELLANEOUS

- When we paid a courtesy call on Mayor Yap (Mun. Glan) we were invited to attend a presentation to the Indonesian Consulate General, intended to promote local trade between the Philippines and Indonesia. (The Mayor told the Consul that he provided special slaughter houses to provide halal beef and pork for the muslims!). On a more serious note, the Mayor told us he was
concerned over the delays in getting funds for projects released by UDP. He claimed he it was costing him far more to meet UDP’s administrative requirements than the Municipality was getting from UDP for projects.

- We also learned that the mayor had issued an ordinance stating that farmers who had not applied soil conservation measures to their farm would be ineligible for free schooling and medical treatment. While this is a good incentive, the ordinance does not require certification that the measures are appropriate and correctly applied. Consequently, it was obvious that virtually all the hedgerows we saw had been laid out without using an A-frame, and were too widely spaced to be effective.

- At Brgy Rio del Pilar we saw a first line farm where the hedgerows had been dug up by the son, when he took over the farm from his farmer. Apparently, the hedgerows interfered with his farming practices (corn planted on >55% slope).

- In Kiamba, a group of farmers were very interested in applying STOP but asked why the project had not set up a demo farm comparing the techniques with their usual practices. I said the Project could not promise them anything, but told them that this required a group of farmers to chose one of their farms as a demo site, and agreeing that the owner of that farm would receive all the inputs and that the neighbours would use the farm as a training site. (See my final report on the Soil and Water Conservation Mission: 3.10 Selecting farms to demonstrate Land Unit Farming).

CONCERNS

Some field staff expressed concerns about the large amounts of cash being paid to NGOs to carry out training in areas that have already been done by the Project, and for which the NGOs don’t necessarily have the expertise or experience. We planned to have a meeting with Dash this morning to discuss these issues but Gel was delayed so I cannot report accurately on this in this report (which I will e-mail before I leave the office for the airport). As most of the discussions weren’t in English, and held in the back of the vehicle while driving between sites, you will need to discuss with Gel Abalus for more details.

UDP
Davao City

25 June 2004
Field visit to Maitum and Maasim. 24-25 August 2004

Co-Director Wiebe van Rij, and TA Upland Farming/SWC Ken Proud visited upland farms in Maitum and Maasim on 24th and 25th August, 2004 to verify the site data of farms proposed for 2nd line DFS cooperators.

Main points noted (see Mr van Rij’s report for detailed notes regarding individual farms):

- Data improperly recorded:
  - Soil depth sometimes given in inches when the form states it is to be recorded in cms.
  - Slopes apparently recorded in degrees (º) when STOP chart is based on percent slope (%).

- Despite being trained in STOP, some ATs and BEWs need reminding that hedgerows are not needed when only tree crops are planted. A good grass ground cover is the requirement.

- Farms with slopes sometimes exceeding 70%, which do not meet the STOP criteria of <45%, are being short-listed for 2nd line DFS cooperators.

- More attention should be given to informing farmers that the project is aiming at reducing and replacing corn cultivation on steep slopes with tree crops; and to convert cogon land to orchards. As it is, some farmers seem to be putting in NVS solely for the purpose of receiving free inputs. When delivery of inputs was delayed, some farmers destroyed the NVS – suggesting they were not made aware that the main function of the NVS is to prevent soil from washing downhill, and to maintain soil fertility.

- Where farmers have more than one farm plot, it can often be observed that they plant corn on the steeper sites, and trees on the less steep slopes. Perhaps their strategy is to “mine” the fertility of the steeper slopes, which may have been fallowed for some years, before planting perennial crops.

- In Massim, the soil depth in a patch of secondary forest with coconut trees on a >60% slope, was 60 cm. On the adjacent cogon-infested land of similar slope, which had been cultivated for many years, the soil depth was 20 cm. The technician has been asked to determine when the area was first cultivated, and why it is lying idle. If similar surveys are undertaken by all the ATs/BEWs of, say, five sites in their areas, then the results may provide the UDP with a rule-of-thumb means of estimating the number years remaining for cropping of annual crops under present practices*.

---

* For example, if farmers abandon an area when only 20 cm depth of soil remain, and soil losses are estimated to be one cm depth of soil per year, then a 40 cm depth of soil indicates a cropping life of just 20 years for annual crops.
REPORT ON VISITS TO LEARNING SITES: 1-3 Sep & 6-9 Sep 2004
By K R S Proud TA Upland Farming/Soil & Water Conservation

Bearing in mind that the five stages leading to farmers adopting an innovation are: *Awareness, Interest, Evaluation, Trials, Adoption*; the purpose of the site visits was to assess the suitability of the first line farms as learning sites.

Aspects that were looked at included:

- **Awareness**: What will visiting farmers learn, that they don’t already know, when they visit the learning sites? (i.e. will the sites create a positive awareness of the range of options available for developing less environmentally damaging cropping systems in the uplands).
- **Interest**: Does the site demonstrate the logic of the innovations, and are they visibly successful so they will interest the visiting farmer?
- **Evaluation**: Is information available on the inputs and outputs, etc. from innovations, which can enable the visiting farmer to evaluate whether he thinks the innovation is worth trying under his particular circumstances (i.e. slopes and soil types; economic circumstances; etc) compared to traditional methods?
- **Trials**: Does the cooperator fully understand the principles of the innovations, and is he able to help visiting farmers set up small trials after UDP ceases operation?
- **Adoption**: When UDP ceases, who will assist the farmers in overcoming any constraints to full-scale adoption of innovations.

<table>
<thead>
<tr>
<th>Date</th>
<th>Location and Cooperator</th>
<th>Observations</th>
<th>Recommendations for demonstrations</th>
</tr>
</thead>
</table>
| 1 Sep 04 | PPO 3 Malita. Kilalag Agafieto LLena | 10-20 m wide crests Side slopes 45-55% Slopes >100 m long A-frame not used. Hedgerows too wildly off the contour to be re-aligned, and too widely spaced (10-12 m). Peanuts and fruit trees being grown. | a) Reduce erosion damage from badly aligned hedgerows by using A-frame to align contour strips of Vetiver or Napier Grass between hedgerows to form small terraces for growing peanuts, mung beans.  
b) Plant hedgerows to develop terraces on crests for planting corn, cassava, peanuts, etc.  
c) On slopes <55% – plant trees from seed (eyebrow terraces).  
d) Laying hedgerows to improve ability to hold back soil. |
| 2 Sep 04 | PPO 3 Upper Bala, Kabuhian. Anna Lisa Rafaela | Long slope, 45-55%, very stony and rocky with shallow soil. Rubber trees and bananas planted with good ground cover. Attempt to plant hedgerows at 3-10 m spacing, but no rain for germination. Cooperator wants to plant trees and mung beans. | Hedgerows not needed.  
Demonstrations to include:  
- Use of stones to make dry stone micro-basin walls and narrow terraces for growing mung beans. (Get expertise from Sitio Labidayan and Sitio Belen, Lanog).  
- Planting seeds of wild lansones from nearby remnant forest. Graft on scions of certified varieties. This shows the value of having patches of forest in the vicinity (also mycorhiza inoculation from forest litter), and show benefit of tap toots in stony soil.  
- Demonstrate difference in cost and area planted between 30 seedlings and equivalent value of seeds and scions. |
<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Observation/Recommendation</th>
</tr>
</thead>
</table>
| 2 Sep 04 | PPO 3 Malalag     | Line 1 farm. Hedgerows not on contour, limited area covered. Pineapples not mulched, trees not in micro-basins or ring-weeded.  
|          | Sitio Banyau      | Has 5-6 m wide slightly eroded ridge (18% slope) on which terracing trials can be done for planting cassava and peanuts.  
|          | Junado Pinol      | Coco nut plantation on 50% slope (sandy soil) could be used for small-scale trials on growing corn under heavy mulch using improved seed/fertiliser technology.  |
| 3 Sep 04 | PPO 3 Santa Cruz  | Learning site is 50 minutes walk from community centre. Most of brgy is gently sloping land well covered with tree crops. Community buys its staples with harvest of tree crops.  
|          |                   | Use brgy to demonstrate ideal “End-of-Project” situation. Farmers with only 1-3 ha get into short-term debt to buy food until able to harvest copra and fruits. They earn off-farm income elsewhere. Explain that when trees are not at planted at optimum spacing or in E-W alignment, production is lost.  |
| 6 Sep 04 | PPO 1 Malamodao   | Good mixed cropping but exposed soil on steep slope 45-50% with widely spaced hedgerows – not on contour.  
|          | Maco. Romeo Manrique | Not much potential for demonstrating STOP. |
| 6 Sep 04 | PPO 1 Mabini,     | Potential learning site. 25-35% sloping ridge and side slope leading to valley bottom. Wants to dig well and grow vegetables. Rest of plot consists of well-established mangoes on ridge crest – but with roots exposed by erosion.  
|          | Pangibiran        | Demonstrate establishment of terraces with grass strips and herbicide, for vegetables and arable crops.  
|          | Alfredo Sabion    | Micro-basins around trees.  
|          |                   | Pruning.  |
| 7 Sep 04 | PPO 1 Pantukan     | 45-60% upper slopes, 25% lower slope. Hedgerows too wide. Shallow soil (30 cm)  
|          | Kingking          | Set up trials to offset effects of widely spaced hedges by leaving back part of terrace to grass and tree crops, and front part to annual crops. Line of pineapples or Kenya grass at rear of cultivable strip will prevent disturbance of grassy “riser” area.  
|          | Wilfredo Mahinac  | Demonstrate micro-basins.  
|          |                   | Grow vegetables on 25% slope area.  
|          |                   | Laying hedgerows to increase density and strength to support weight of soil.  
|          |                   | Compare incomes from corn and bananas  |
| 7 Sep 04 | PPO 1 Laak         | 1st line farmer. Hedgerows not properly contoured. Bananas grown on broad gently sloping crest, with peanuts, corn etc. grown on 45% side slopes, with tree crops. Corn crop failed at cob stage – soil only 20-30 cm deep.  
|          | Kilagdig Victor Dilag | No potential for demonstrating STOP. Fruit trees need ring weeding and mulching.  |
|          | Next door to MSO  |                                                                 |
|          | Betty’s farm      |                                                                 |
8 Sep 04  | PPO 2 San Isidro  
Sito Cabocanan  
Visited SIDOUCO.   
Cassava sites in.  
Noa Pacienio,  
Project Dvlpt Off.  
Felix Agut VII,  
Agriculturalist, and  
Nador Galagar,  
Brgy Captain  |
| Site 1: Approx 1 ha  
37% slope, Clay loam. Soil depth 50-100cm. Contour ploughing with carabao. Cassava planted in maize trash.  |
| Site 2: 2-3 ha. Young hedgerow  
3 m spacing (Indiofiera,  
Rinsones, Flemingia)  
85% slope, Clay loam. Soil depth 50 cm.  |
| Site 3: 45% slope. Mixed cropping with hedgerows 4-5 m spacing, durian, cacao, mango, lansones, banana, coconut. Fairly well shaded.  |
| Promote terracing by planting Kenya grass contour strips at 2m spacing.  |
| No future for cassava or any other crop after harvesting roots. Most of soil depth likely to be lost as lumps of soil roll down hill.  |

8 Sep 04  | PPO 2 San Isidro.  
Cabocanan  
Santos Badiot  |
| Good farm for learning site. STOP can be demonstrated. Cassava grown on gently sloping crest and upper slopes between Kenya grass hedgerows. Trees on steeper slopes.  |
| Improve density of grass strips.  |
| Laying of hedgerows  |
| Pruning of trees  |
| Management of cassava  |

8 Sep 04  | PPO 2 Tawas.  
Brgy Tagibo  |
| Excellent farm on crest – but not typical of surrounding area. Plastic mulching. No potential for demonstrating STOP  |
| Need explanations and evaluation of what is being done  |

9 Sep 04  | PPO 2 Taraguna  
Maítum Brgy  
Tubuan  
Coop: Concordio  
Quijano/  
Nolly Sautirian  
MAO, and Dolores  
Valdesco MPT  |
| Limited area of hedgerows not all on contour (diverting runoff away from fish pond). Limited area. Training given in Abaca mgmt. Livestock mgmt, plant propagation/grafting. Plans to give training in pruning  |
| No potential for STOP  |

Conclusions

- The learning sites were set up before STOP was developed. They do not, therefore, demonstrate the STOP principles and objectives. At present there is little farmers can learn from the sites.

- Upland farmers need to be shown the range of options available for promoting permanent upland cultivation (reportedly one of the most intractable problems in the humid tropics) so they can reduce the area under annual crops and increase the area under tree crops, with least effort and risk from the farmer’s point of view. Such options have to be:
  
  - *ecologically sound* – due to the fragile nature of the upland soils;
  - *technically feasible and appropriate*;
  - *economically viable*;
  - *socially acceptable*; and
  - *legally permissible* – that is, they must comply with current environmental and land use rules and regulations.

- Commercial production of cassava should not be allowed on steep to precipitous slopes (see Annex 1). Digging up the clay soils to harvest the rhizomess will inevitably result in a significant portion of the soil rolling down hill as lumps.
**Recommendations**

Set up at least one learning site per province and ensure as many of the following options are demonstrated. They must be properly set up to impress visitors.

<table>
<thead>
<tr>
<th>TERRACES</th>
<th>TREE CROPS</th>
<th>ANNUAL CROPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Promote terracing on clay soils (grass strips on fallowed land + ploughing)</td>
<td>- Tree crops grown on steeper grass-covered slopes without hedgerows.</td>
<td>- Annual crops to be planted between hedgerows on areas with slopes &lt;20% or where terraces are being formed</td>
</tr>
<tr>
<td>- Use A-frame to align contours. Point out damage caused by not following contour</td>
<td>- Controlling cogon with herbicide. (3 m diameter ring around planting site)</td>
<td>- Zero-tillage using herbicides to control cogon. (Discuss labour savings: cite Andap, New Bataan experience)</td>
</tr>
<tr>
<td>- Planting double row hedgerows on slopes &lt;20%</td>
<td>- Ring weeding round trees</td>
<td>- Improved seed/fertilizer technology. (Corn yields up to 3 times higher with hybrids than with OPV)</td>
</tr>
<tr>
<td>- Napier grass hedgerows</td>
<td>- Mulching of trees</td>
<td>- Optimise crop spacing (e.g. plant corn at 25 cm within row)</td>
</tr>
<tr>
<td>- Re-contouring inter-terrace areas with napier grass</td>
<td>- Eyebrow terraces and seedlings + mulch</td>
<td>- Pineapples + mulch</td>
</tr>
<tr>
<td>- Laying hedges</td>
<td>- Eyebrow terraces and seeds + mulch + grafting on scions</td>
<td>- Gabi cultivation on ridges</td>
</tr>
<tr>
<td>- Subdividing terrace by planting napier grass</td>
<td>- Direct seeding + mulch + grafting on scions</td>
<td>- Organic farming demo and comparison of inputs</td>
</tr>
<tr>
<td>- Reduce cultivable area of terrace by planting perennial crops on upper portion of terrace, and encouraging grass.</td>
<td>- Optimise tree spacing (e.g. triangular spacing on hillsides enables 15% more trees to be planted per hectare).</td>
<td>- 14-day composting method.</td>
</tr>
<tr>
<td>- Tree pruning, and management of banana hills (1 main stem and two suckers 5 months apart)</td>
<td>- Vegetable growing – basket composting</td>
<td>- Orient multi-canopy trees East-West</td>
</tr>
</tbody>
</table>

KR S Proud
UDP
Davao City

11 September 2004
Some notes on Cassava production

- Cassava is very demanding in its nutrient requirements. Continuous cropping on the same land rapidly depletes the soil of its plant food reserves, while cultivating cassava on hilly terrain can lead to accelerated erosion.

- The average growth period for cassava, for commercial starch production, is 14 months. Two crops of corn a year would give better income, but with soil erosion losses. Bananas would give even higher income with much reduced erosion risk. It is a pity MED wasn’t asked comment on the profitability and marketability of cassava in relation to other crops.

- Heavy applications of commercial fertiliser containing N, P and K, (300-400 kg of complete fertiliser/ha) are required to obtain maximum yields of cassava (average 20 t/ha per crop with moderate inputs in terms of land preparation and weeding).

- Some varieties mature in shorter periods of time but yields are markedly reduced.

- Cassava can survive on impoverished soils but very low yields are obtained.
REPORT ON FIELD TRIPS TO PROPOSED LEARNING SITES IN CARMEN (DAVAO DEL NORTE) AND THE COMPOSTELA VALLEY: 15-17 SEP 2004

K R S Proud
TA Upland Farming Systems/Soil and Water Conservation

1. Carmen, Davao del Norte

I was accompanied by Gel Abalus, RM Coordinator on a day trip to Tibulao, Carmen, Davao del Norte. We were accompanied by Edgar Llana (AT) and Cornielio Dimialig (BEW).

a) Site 1

The farm of Lolita Onofre was identified as suitable for a learning centre. It has an amplitude 30-50 m, and rounded hills which are representative of the area. It is close to the road, readily visible and has a range of land units to display a number of management options (moderately sloping ridge and crest, steep side slopes (45-60%) and a minor valley). The soils are reportedly over 100 cm deep, so terracing is possible.

b) Site 2

The farm of Mario Alburo was a ridge top on which he had planted hedgerows and beans after visiting the ICRAF/WAC centre at Lampitan.

The cost of land preparation by spraying herbicide to kill cogon was P2,720 compared to the P12,000 he normally incurred with several ploughings.
### PPO 5: INITIAL INSPECTION OF FIRST LINE FARMS

**Visit made:** 20-23 Sep 2004

| **OBSERVATIONS** | • Despite the STOP training sessions specifying the importance for farm maps, no maps have been drawn showing the relationship of land units to each other and the range of slopes, soil textures and soil depths.  
• There is no indication as whether farmer needs to grow corn or rice to eat, or the quantities of produce required to support the family. |
| **SIGNIFICANCE** | • Cannot use STOP to plan terrace/NVS/ hedgerow layout as spacing and crop selection depend on site characteristics such as slope, soil texture and depth.  
• No need to grow corn on the site if the farmer plans to sell short- and medium-term cash crops to buy daily staples, or if the farmer has land elsewhere where he grows corn.  
• Yield-increasing techniques will need applying if the area of land suitable for annual crops is smaller than usually cropped. |
| **RECOMMENDATIONS** | Before approving second line farms:  
− Draw a map showing the distribution and characteristics of the land units.  
− Determine the farmer’s subsistence food needs so STOP can be applied to create terraces to meet area requirements for annual food crops. |
| **ACTION** | • Technical Chief to instruct SAD and RM specialists to get the information.  
• SAD specialist to inform LGU/MSO that maps are needed  
• MSO to instruct ATs and BEWs to prepare maps, etc  
• BEW and cooperator to visit farm - prepare map, determine cropping requirements, submit to MSO.  
• SAD, RM, and/or MSO to visit sites, verify map, etc  
• Obtain approval to proceed with developing farm  

**Action by:**  
TC  
SAD specialist  
MSO  
BEW  
Specialists/MSO  
TC/SAD Coordinator

**Miscellaneous comments**

---

ANNEX 2.1.5
PPO 5: LAKE SEBU-LAKE SELOTON. INSPECTION OF SECOND LINE FARMS

Visit made: 20 Sep 2004
Farms visited: Jerome Delmo
AT: Jesse Palmes
BEW: Jerome Delmo

**OBSERVATIONS**

- 1.5 ha of land with 12-25% slopes (no SWC) being ploughed (twice) and harrowed (twice) by carabao – not following the contour. This is bordered by a very steep 40 m long slope (45-60%) with coconut palms – which has also been ploughed. There is a carabao-grass covered ridge, 40 m long by 5-10 m wide ridge by the lake.
- Clay loam soil reportedly >100 cm deep.
- No farm map.
- Farmer grows 3 crops of hybrid corn and applies 6 sacks (300 kg) complete fertiliser and 2 sacks (100 kg) urea.
- Corn provides the farmer with an income of PhP 45-60K each harvest for unshelled corn (i.e. PhP 30-45K/ha or PhP30-45/10m²).
- Bananas reportedly yield PhP 120/10m², or twice the income from corn. (The farmer apparently was discouraged from growing bananas because his neighbour reportedly stole the bunches at night time).

**SIGNIFICANCE**

- Planting contour hedgerows on the extensive rolling area would encourage contour ploughing and harrowing.
- The income from hybrid corn is two to three times higher than farmers who grow OPV or traditional varieties. This can be attributed to applying the correct amount of inorganic fertiliser. Farmers with limited areas of gently sloping land suitable for growing their subsistence needs for corn should be made aware of this data.
- Despite using improved/fertiliser technology, the potential income from bananas is much higher (more so, when the cost of hiring the carabao is deducted). A trial to demonstrate this needs to be set up.
- The steep slopes and ridge, though only a small part of this particular farm, seem typical of farms in the locality. These should be used to demonstrate various STOP interventions.

**RECOMMENDATIONS**

- Interview the farmer and determine the labour costs (including man-days and carabao time) and inputs for growing corn, and the value of the harvested corn.
- Plant the steep parts (45-55% slope) of the coconut tree area with 50 banana suckers (in triangular layout), and monitor inputs and income.
- Plant the steepest parts (>55% slope) with seeds of fruit trees.
- Set up the improved design for cross-slope barriers on the carabao-grass covered ridge, and grow peanuts, cassava, vegetables, etc.

**ACTION**

- SAD specialist to interview the farmer to find out food requirements; and inputs etc for corn cultivation.
- Produce land unit map of farm with slope and soil data.
- Supervise farmer in correct use of A-frame to lay out contour hedgerows on main corn field.
- Show the farmer how to make eyebrow basins (in triangular layout) on steep part of coconut area and plant with banana suckers.
- Use herbicide to clear 3m-diameter areas on >55% slope, followed by direct seeding of mango, etc.
- Develop improved cross-slope barriers on ridge.
- Maintain accurate records of labour and inputs

|Miscellaneous comments|
The farmer’s wife described how up to nine operations are carried out for each corn production cycle. We estimated that this was equivalent to one person walking over 300 km a year.|

Ken Proud, Upland Farming Systems/SWC Specialist
26 Sep 2004
PPO 5: PERDOAN-TANTANGAN. INSPECTION OF SECOND LINE FARMS

Visit made: 21 Sep 2004
AT: Anastasio Laurente
BEW: Fructoso Cabrera

OBSERVATIONS

- The dominant land system is a dissected sandy peneplain - a formerly level plain eroded over the millennia to leave a series of short “fingers” of land with flat to gently sloping crests, and short side slopes with rapidly steepening convexity.
- Minor valleys (10-25 m wide) lie in between.
- The amplitude of the land system is 30-50 m (height from valley bottom to crest).
- Soil are sandy with depths from 50 cm to 100 cm.
- Much of the area is covered with cogon.

SIGNIFICANCE

- Most of the farms are virtually identical consisting of one or two crests 5-15 m wide, a 40-60 m convex ridge gradually increasing in slope steepness from 12%-25%-35%-55%, 30-50 m long convex side slopes, and 10-25 m wide minor valleys.
- DFS can be demonstrated by planting short-term cash crops on the upper slopes and crest; vegetable production in the minor valleys; and fruit trees on the very steep slopes or cogon covered hillsides.
- The sandy soils indicate that soil moisture may be a limiting factor to crop production.

RECOMMENDATIONS

- On the gently sloping ridges up to 25% slope: plant contour hedgerows of leguminous species.
- On the 25-35% upper slopes: promote terracing by planting napier or vetiver grass strips at STOP spacing. Promote terracing by ploughing.
- In the minor valleys: construct raised beds for growing vegetables.
- At the interface between the minor valleys and the slopes: dig a cut-off drain (to protect the raised beds from flooding) and store water to irrigate the vegetables during dry spells.
- On cogon-covered hillsides: kill cogon in 3m diam. circles by spraying herbicides; plant seeds of fruit trees in eyebrow terraces or directly into the ground.
- Heavily mulch the crops, vegetable beds and young trees to conserve soil moisture in the sandy soils.
- Set up compost heaps protected from rainfall. And heavily mulch fruit trees

ACTION

- Arrange STOP refresher course for SAD, RM specialists and MSC.
- STOP refresher course for ATs and BEWs to ensure STOP spacing and A-frames used to lay out contours.
- Draw farm maps and plan layout of SWC measures and crops, taking into account farmer’s subsistence needs.
- Approval of plans.
- Ensure each cooperator has a compactor and beater for forming the eyebrow terraces.
- Set out terraces, hedgerows, eyebrows terraces etc

Action by:
TC
SAD, RM and MSC
ATs, BEWs
TC, SAD
AT, BEW, Farmer

Miscellaneous comments

Concerning herbicides: Some of the UDP staff have expressed concerns about using herbicides, such as RounUP, as they may be harmful to soil micro-organisms. These concerns are unfounded! If the staff take the time to check the World Wide Web/Internet and they will find a number of studies that show that microbial activity is actually stimulated, not suppressed, in the presence of RoundUp and atrazine. Tests have also shown that Glyphosate, the main ingredient in RoundUp, binds tightly to soil particles until it is degraded, so there is an extremely low potential for Glyphosate to move into groundwater. UDP farmers have found that applying herbicides to control cogon saved them between P2,500 to P9,700 per hectare in labour costs. This increases their incomes and helps achieves the UDP’s main objective.
### PPO 5: ALBAGAN-TAMPAKAN. INSPECTION OF SECOND LINE FARMS

Visit made: 22 Sep 2004  
Farms visited: Cesar Capute

#### OBSERVATIONS

- The landscape is dominated by mountains with steep to very steep slopes, with limited areas of gentle slopes at the base, before dropping precipitously into narrow river chasms.  
- The amplitude of the land system is 200-500 m (height from valley bottom to crest).  
- The soils on the gentle slopes are mainly coarse sand to gravels with depths from 50 cm - >100 cm.  
- Main crops are fruit trees and vegetables. Corn and rice are seldom grown.  
- Vegetable gardens grow carrots, gabi etc on ridges. NVS established – but not on the contour;  
- Community tree nurseries have been set up.  
- Composting is practiced but without protection from rainfall.

#### SIGNIFICANCE

- DFS will be restricted to short-term cash crops and vegetables on the limited areas with gentle (<25%) slopes, with fruit trees on the very steep slopes.  
- Coarse sandy soils are “excessively drained” which severely reduces the amount of soil moisture that can be stored for tree and crop growth, and nutrients are readily leached out of the profile.  
- Strategies that maintain fertility and conserve soil moisture will need to be applied.

#### RECOMMENDATIONS

- Protect compost heaps from rainfall by covering them with banana leaves.  
- After the next harvest of roots and vegetables, apply plenty of compost in the furrows and bury it by splitting the ridges when ploughing. This will help retain soil nutrients and moisture in the coarse soil.  
- Heavily mulch the crops, vegetable beds and young trees to conserve soil moisture.  
- Plant fruit trees from seeds and graft on scions in the field. Compare growth with fibrous rooted stock produced in the nurseries.

#### ACTION

- Arrange tree-planting course for ATs and BEWs showing range of options (nursery stock, planting from seed, eyebrow terraces - if soils are suitable – planting from seed if soils are very coarse).  
- Ensure each cooperator has a compactor and beater for forming the eyebrow terraces.  
- Train farmers in composting and mulching methods. Emphasise problems of coarse- textured soils.  
- Vegetable gardens: lay out napier grass contours/NVS using A-frame.  
- Provide improved seeds/fertilisers etc  

**Action by:**  
SAD, MSO  
SAD, ATs, BEWs.  
SAD, RM, AT, BEW.  
MSO.

#### Miscellaneous comments

- Gabi is being grown on *ridges* in the vegetable plots. This differs from the procedure outlined in the Dept of Agriculture pamphlet “How to increase Gabi Corm yield” by Jose B Pardales Jr. which shows planting gabi in the *furrows*.  
- According to the pamphlet, *Kalpao is the only recommended variety for farmers*. When properly cultivated it yields as much as 30 tons/ha in the uplands.  

The Technical Chief and MSO need to check whether this information is still valid and, if so, do upland farmers have access to stocks of the *Kalpao* variety of Gabi? If not, where can they obtain stocks?
TRAVEL REPORT

The Consultant made the following field visits accompanied by Ben-Hur Viloria, the SAD Coordinator:


   Date of visit: 28 September, 2004.

   This a proposed learning site identified by ICRAF. On 6th September the Consultant supervised the establishment of a modified design for developing terraces with grass strips acting as risers (see attached diagram). The farmer wants to diversify from corn and mangoes into vegetables and arable crops, as well as expand his fruit production to durians. A small amount of herbicide was sprayed to kill off cogon in an area to demonstrate planting durian from seed, followed by in-field grafting.

   **Progress to date**
   Three to four terraces have been ploughed following the design specifications for a 25% slope (see attached diagram), leaving 1.7 m wide grass strips between the strips.
   - Eyebrow basins formed on a 45% slope now require durian seeds to be planted in them.
   - On the cogon area: the herbicide killed off most of the cogon on the 3 m-diameter circles. Of interest, however, was the mulching effect of the cogon cut down a month before and laid in strips across the land. It had suppressed all cogon growth underneath it, though the cut areas had all regenerated to knee high grass. This suggests that cogon can be used against itself for reclaming areas for tree crops – provided a sufficient depth of cuttings (i.e. piled 30 cm high) are laid in the 3 m diameter circles where the seeds will be placed. The mulch will suppress any further weed competition and conserve soil moisture. Soil testing is needed to see if the rotting cogon has affected soil acidity and rectification measures taken.

   **Action needed**
   - The BEW, Rommel, is to visit other areas to get Napier or other similar grass for the cross-slope barrier on the terraces.
   - A source of pineapple slips to plant the back of the terrace needs identifying.
   - Durian seeds will be planted in the eyebrow basins

2. **PPO 5. Gensan, Land Bank. Landan Peoples Multipurpose Cooperative.**

   Date of visit: 29 September, 2004.

   Co-Director Wiebe van Rij texted the Consultant that the Land Bank had received a request for a PhP 5 million credit fund for pineapple growing by the Landan Peoples Multipurpose Cooperative. According to Mr van Rij, the loan can only go through if DFS and STOP initiatives are adopted. He asked Ben-Hur and I to visit the area and confirm that this was being done, and to meet with Land Bank, Socsargen, to obtain details of the clients. We met with Mrs Susan Acosta, who directed us to the Landan
Peoples Multipurpose Cooperative. We were unable to visit the area as several days of rain had made the road to Maisong impassable. However, our discussions found that the farmers in Maisong did not want to grow pineapples but were wanting support for vegetable production, but had been told they had to join the Landan Peoples Multipurpose Cooperative before the Land Bank would consider their loan. Besides, the Protected Area Management Board (PAMB) would not allow pineapple production in the area. Ben-Hur’s report provides a full breakdown of the discussions.

3. PPO 5. Tantangan, Poblacion, Tanquerido model farm.

Date of visit: 30 September, 2004

The Consultant went to give a STOP refresher course to senior technical staff, but ended up discussing STOP with a group of farmers, ATs, BEWs, and SAD and RM staff. In addition to STOP, ways to offset negative impacts from too-widely spaced hedgerows were outlined and pointed out in the field.

A comparison between income be derived from bananas compared to corn was discussed. One farmer added that he grows peanuts without any inputs and still gets a higher income than from growing hybrid corn with fertilisers. The BEW was directed to get this information in detail so it could be used to give other farmers the option to move away from corn.

A 1.5 m-diameter eyebrow basin was made on a 35-45% slope and a seedling planted in it. This took 30 minutes - in line with the 13-16 a day estimated for the particular slope range. If seeds were to be planted, then over 80 eyebrow basins could be constructed on the same slope as they would only need to be 0.9 m diameter.


Date of visit: 1 October, 2004

We met up with Alex Tabbada, the ICRAF coordinator, to see how the rehabilitation of first line farms was progressing. As recommended in STOP, emphasis is being given to encouraging the use of gently sloping land for annual crops, with tree crops dominating on the steep slopes.
DFS VERIFICATION REPORT

1. General overview

- Field visits were made by Ken Proud and Ben Hur Viloria, between 22 – 26 November 2004, in PPOs 3, 4 and 5 to verify that selected farms met DFS requirements.

- The farm maps showing the arrangement of land units and proposed SWC layout were used when available.

- At each farm the cooperator was asked to compare his income from growing corn with that from bananas on a comparable area. In all cases the farmers found that bananas will generate 2-6 times their current income from corn with less labour. The lesson was that the cash earned from bananas could be used to buy the household staples of corn, rice etc, and still leave money to spare for purchasing some inputs to boost yields still further.

- The benefits of allocating 2-3 days a month to planting and maintaining fruit trees as a pension plan for the future were explained to the farmers, who seem to find the concept attractive.

- The principles of the improved design for cross-slope barriers on steep slopes were explained to the Technical chiefs, SAD specialists, MSOs, ICRAF staff, ATs and BEWs. Whereas the terrace spacing stays the same for the particular slope, as outlined in the STOP table, the main difference is that a 2.0 m wide NVS is added immediately below the hedgerow (see attached Figure 1).

- A draft copy of *A Guide to Rehabilitating and Managing Cross-slope Barriers*, prepared by Ken Proud, was given to field staff as an aid to correcting misaligned hedgerows, etc.

2. Main findings and recommendations

- As crops are currently in the ground on most of the farms, putting in SWC measures will have to wait until the crops have been harvested. This is likely to be in January or February 2004. The availability of planting material such as seeds for leguminous hedgerows, splits of Napier or Guinea grass, etc is a limiting factor.

- Some areas are experiencing drought conditions (El Niño?) so planting seedlings or seeds is not advisable until soil moisture conditions are suitable to guarantee successful establishment of the plants.

- Applying the improved design for cross-slope barriers will reinforce the SWC aspects for the land. Diversification of cropping is promoted by planting:
  - bananas and other fruit trees in the NVS;
  - a line of pineapples separating the NVS from the terrace;
erosion-inducing annual crops such as corn, root crops, peanuts etc, in the 2-4 m wide terrace behind the hedgerow where eroding soil has been intercepted, and where a level bench should develop over time.

- Intensiﬁcation of cropping can be improved by ensuring the optimum spacings recommended for the crops are followed, and yield-increasing techniques applied.

- Use the cuttings of Napier grass or the leguminous hedges to mulch the trees, pineapples or crops in the cultivated strip, or else to feed goats or carabaos.

- Where the spacing between hedgerows exceeds the STOP specifications, the principles described above for the improved design for cross-slope barriers are applied but the NVS is expanded beyond 2.0 m to limit the width of the cultivated strip to that recommended in the STOP table.

- Most of the farmers visited expressed a wish to switch from corn to tree crops. (One of them said he wanted to use the land for his pension plan). The seeds of fruit trees such as mangoes and durians are currently in short supply in some areas. The following procedure should overcome the problems arising from local dry seasons and or where shortages of materials for putting in the Project’s SWC requirements occur:
  
  - Provide farmers with banana suckers or corms. At P2.00 per banana corm, the P3,000.00 allocated for inputs will provide enough material to convert 1.5 ha of corn to banana plantation, whereas 30 mango seedlings will only cover 0.3 to 0.45 ha, leaving land for growing corn.

  - Before being given the banana suckers or corms, each farmer must lay out the planting sites (at the appropriate spacing for the species) in a triangular layout on the sloping land. This will allow 15% more trees to occupy the site than with standard square planting layouts. On slopes above 45%, a 30 cm depth of mulch in a 3.0 m diameter ring should be applied on each planting site, to suppress weeds, protect the soil and improve soil moisture conditions. On slope below 45%, 90 cm diameter eyebrow basins need to be constructed and mulched. This will also deter ploughing.

  - When seeds of fruit trees become available, the farmers should be reminded of the benefits of planting these by direct seeding in the field and be trained in grafting on the scions of certified trees.

  - With this in mind, the ATs and BEWs should be given a refresher training course in grafting.

3. Specific observations


3.1.1 Upoh Learning Centre.

---

1 For example, a more vigorous rooting system, with a deep tap root, enables the tree to survive droughts and get nutrients from deeper in the soil. Directly seeded trees also live longer.
Some thought was given as to what farmers could learn from visiting the learning site. Bananas and other fruit trees have been planted between hedgerows on the 65% lower slopes – which is outside the limitations given in STOP, and on 45% upper slopes. Fruit trees had also been planted under dense shade, or very close to mature banana trees. Not very good lessons to pass on to farmers.

The history of the site was a good starting point:

Corn used to be grown on the site. Two harvests a year yielded a total of four tons of corn when fertiliser was applied, but only 800-900 kg/ha per harvest without fertiliser. The 4 tons/ha/year of corn translated into 4.0 kg per 10m², or an income of P28/10m².

On the other hand, one hill of banana, which occupies 10m², produces 13 kg of bananas a year, and sells at P11/kg when bagged, or P6/kg unbagged. Compared to corn, bananas give an income of 66-143 kg/10m². The labour for all the operations in producing each harvest of corn is also much higher than for bananas, further reducing the farmer’s profit. (If one person did all the work, s/he would walk 80 km during one cropping cycle for 1.0 ha of corn). The learning site should also emphasise the benefits of investing in bags for the bananas.

The site should also be used to explain the advantages of triangular spacing to increase the number of trees per unit area; to show eyebrow basins and mulching.

### 3.1.2 Malungon, Gamay

All the farmers were keen to replace their annual crops with fruit trees. As outlined in Section 2, above, the farmers should set up mulch mounds in triangular spacing for planting seeds of fruit trees, or for banana corms or suckers.

One farmer expressed a desire to have some hedgerows that would be visible from the road. Fortunately, he has some clumps of Vetiver grass so the BEW was given a handout on how to plant a Vetiver hedgerow, and these will be planted on the 25-45% slopes at the top of the hill where mungo beans are being grown.

### 3.2 PPO 5. (Dates visited: 23-24 Nov 2004)

#### 3.2.1 Paghidait, Maibo

The main reason to visit this area was because of a request for an improved irrigation system. However, most of the farms are on very gently sloping land, with some that have been terraced since the early 1990s. SWC measures are mostly in place.

 Arnulfo Arneta
One of the farms seen had hedgerows to widely spaced. However, it was ideally situated near the top of the hill to adopt the improved design of cross-slope barriers by adding a wide NVS strip below the hedgerow.

First, it was necessary for the farmer to understand that corn as a crop was a loser – both of soil and of income. The farmer explained that yields of corn had declined considerably since the 1980s. One of the reasons given for the decline was the soil had become acidic. Since no soil testing had been done, we asked him what made him
think the soils had turned acidic. The answer: the leaves of the corn were yellow. This is symptomatic of Nitrogen deficiency in the soil, not of acidity.

In the ensuing discussions it transpired that the farmer spent P13,500 in labour to produce corn worth P13,000. On hearing this, the farmer said they had a word to apply to that situation: Short! A simple comparison showed that bananas would give almost ten times the income.

It was decided that he should reduce the area under corn by restricting its cultivation to a 3.0 m strip behind the hedgerows, and leaving 2-3 m wide band below the hedgerow as an NVS, where bananas would be planted. He was also advised to try adding 3 kg of complete fertiliser (NPK) as a basal dressing and 3 kg of urea as a side dressing on a 30-35 m long strip of corn, and compare the yields with unfertilised strips of corn. Basically, an investment in 1 kg of fertiliser (about P13) should give 12-13 kg more corn (a return of P84-91).

Ricky Morales
Contractor to Rodrigo Arnota, owner of the land. Aim of owner is to plant mangoes.

Slope is 20-25%. Needs some Vetiver hedgerows.

Vegetables grown, especially egg-plant, which seems particularly productive, but periodic shortfalls in soil moisture cause crop losses.

Other farmers
The farmers have already diversified into vegetables, fruit trees, fish ponds and livestock. It is difficult to see how they can fulfil their requirements for UDP support for DFS – not that they need it.

Recommendations

While not strictly typical of the upland farming situation in most of the UDP area, the opportunity should not be lost to demonstrate the value of maintaining springs and streams to provide gravity-fed irrigation for high value vegetable crops.

- Provide supplementary irrigation to improve survival of the crop and boost incomes. Several farmers could benefit. Sprinkler irrigation would be most efficient way of providing the (suspected) limited amount of water available.

- Gravity-fed water supply makes sprinkler irrigation of vegetables feasible. Small sprinkler already present. However, irrigation engineer in Infra section needs to assess:
  - The field capacity of soil and efficiency of the available sprinklers;
  - calculate the irrigation period and irrigation interval for the particular mix of crops; and
  - determine the area that can be irrigated during the weeks without rain.

3.2.2 Lampitak

The area is inside what looks like the caldera of an extinct volcano. A soil profile shows a blackish silty A-horizon of up to 30 cm deep, overlying a coarse sandy B-horizon.
The farmer wanted to switch from growing corn on slope >60% to fruit trees - which he wanted to use as his pension plan. As stated above: he will be required to mulch the planting sites before receiving UDP inputs. The sites should be in a triangular layout. He is interested in planting bananas, as well as the seeds of fruit trees to be followed by field-grafting of scions. Training in grafting should be given.

Run-off from the steep slopes is damaging the fertile soils and crops in the gentle slopes (<10% slope) in the “valley” bottom. The farmers with these lands are advised:

- to dig a diversion ditch at the top of the field (at a 1% grade) to divert run-off into the nearby stable drainage channel; and
- to use A-frames to identify the contours and plant Vetiver or Napier grass strips at 10 m intervals along the length of the field. If these species are not available then they should mark out the contour lines and let 1.0 m wide NVS develop until they can get the planting material. The land is too valuable to be allowed to wash away.

3.3 PPO 3. (Date visited: 26 Nov 2004)

3.3.1 Malawit/Magsaysay

The first site shown, beside the road, in the settlement, resembled a football field with fruit trees already planted. Supporting this farm will give no discernable benefits to the environment, such as converting corn on slopes or cogon areas to fruit orchards, so it was rejected.

The second site was a 1.0 ha piece of land reportedly fallowed for eight years. The slope was 45-55%, soil depth >100 cm with a cover crop. Unfortunately, the land had been cleaned in anticipation of getting project benefits. It was explained that when trees are to be planted a good grass cover is required, except on the immediate planting site.

The problem is there has been a drought since July this year and the farmers do not expect any rain until June 2005. The corn on nearby fields has failed so farmers are wanting to switch to tree crops, preferably mangoes. Eyebrow basins should be prepared and mulched, but there is no point providing any planting material until soil moisture conditions are satisfactory. At the right time (July 2005?) seeds should be distributed for field planting, because their seedlings are more resistant to drought than nursery-produced seedlings.

3.3.2 Upper Bala/Magsaysay

Due to the onset of a rainstorm we only visited one farm. This was an area of 2-3 ha surrounded by forest. The farmer had put in hedgerows before the STOP guidelines were produced. At 6m spacing on a 45% slope with clay soils, they are too far apart to be effective. Two options were offered:

- He could add another cross-slope barrier between each pair of hedgerows; or
- Leave the upper 3 m as an NVS and plant bananas and other fruit trees there, and restrict his annual cropping to a 3-m wide strip.
The farmer had also formed raised bed terraces for vegetables. He buys rice to eat (50 kg/month at P22/kg = P1,110). In discussions it transpired that one hill of banana generates P110/yr. Consequently, with one row of 10 banana trees planted in the NVS providing him the income to buy his month’s supply of rice, he would need 12 rows to meet his year’s requirements. He has 26 rows so he would produce a surplus. Combined with income from other fruit trees and vegetables his prospects look good.

Problems

This area is at the end of a poorly maintained old logging road, in a catchment dominated by slopes >70%. The questions that need answers are:

- What are the criteria for forest lands to be declared public land?
- Does the area meet the criteria to be considered as public land?
- Is there a legal document approving the change of status? and;
- Does the DENR agree that it is in the public interest for agriculture to be allowed in this area?

It seems to go against the principles of UDP to be encouraging cultivation in a well-forested area. The dilemma is that, on the one hand, by showing how to make the land more productive UDP risks encouraging more people to move in, resulting in further deforestation. On the other hand, however, by not taking action, the resident farmers may end up expanding their areas to offset declining yields.

The Co-Directors to advise on follow up action, please!
30 November to 2nd December 2004 DFS VERIFICATION REPORT PPO 4

1. General overview

- Field visits were made by Ken Proud, Warlito “Bubut” Bornea (PPO 4 SAD Specialist) and Bong between 30 November to 2nd December 2004, in PPO 4 to check whether selected farms could meet DFS requirements.

- The farm maps produced by the ATs or BEWs, showing the arrangement of land units and proposed SWC layout, were referred to, and slope measurements taken with plastic Slope Indicators checked with a hand held Suunto clinometer.

- Farmers were asked to compare the income from growing corn with that from bananas on a comparable area. In all cases bananas had the potential to generate 2-6 times the income from corn with less labour. Using the cash earned from bananas to buy the household needs for corn or rice etc, leaves money to spare for purchasing some inputs to boost yields still further.

- The benefits of allocating 2-3 days a month to planting and maintaining fruit trees as a pension plan for the future were explained to the farmers, who are finding the concept attractive. The availability of cheap grafting knives may be a limiting factor. They currently sell at about P150 each.

- To promote DFS, farmers were encouraged to calculate the potential month’s income from small plots of land. For example, 13 to 20 pineapples grown on the area occupied by 1 hill of banana (10 m²) earns P195-300. while 4 mango trees (900 m²) would give a month’s income of P 4,800 after 8 years (50 trees would give a year’s income). Diversification of the crops would help iron out fluctuations in prices or crop failures.

2. Main findings and recommendations

- As mentioned in the 22-26 Nov report, crops are currently in the ground on most of the farms, so putting in SWC measures will have to wait until the crops have been harvested. This is likely to be in January or February 2004, or as late as May or June depending on how long the forecasted El Niño lasts. Planting seedlings or seeds is not advisable until soil moisture conditions are suitable to guarantee successful establishment of the plants.

- Similarly, the availability of planting material such as seeds for leguminous hedgerows, splits of Napier or Guinea grass (Setaria), etc is a limiting factor. Discussions with the TOUs and MSOs concluded that bulking up could be done at municipal nurseries, community nurseries, and even around the community water supply outlets where watering of the stocks can be done. Basic supplies of Napier and Vetiver can be sourced from Bukidnon, while Setaria is available in Rio del Pilar.

The following recommendations are the same for the 22-26 Nov report:

- Applying the improved design for cross-slope barriers will reinforce the SWC aspects for the land. Diversification of cropping is promoted by planting:
  - bananas and other fruit trees in the NVS;
− a line of pineapples separating the NVS from the terrace;
− erosion-inducing annual crops such as corn, root crops, peanuts etc, in the 2-4 m wide terrace behind the hedgerow where eroding soil has been intercepted, and where a level bench should develop over time.

- Intensification of cropping can be improved by ensuring the optimum spacings recommended for the crops are followed, and yield-increasing techniques applied.

- Use the cuttings of Napier grass, Setaria etc. or the leguminous hedges to mulch the trees, pineapples or crops in the cultivated strip, or else to feed goats or carabaos.

- Where the spacing between hedgerows exceeds the STOP specifications, the principles described above for the improved design for cross-slope barriers are applied but the NVS is expanded beyond 2.0 m to limit the width of the cultivated strip to that recommended in the STOP table.

- Most of the farmers visited expressed a wish to switch from corn to tree crops. (In Brgy Rio del Pilar, the Brgy Captain has introduced an ordinance requiring every farmer to plant one banana tree a day). The seeds of fruit trees such as mangoes and durians are currently in short supply in some areas. The following procedure should overcome the problems arising from local dry seasons and or where shortages of materials for putting in the Project’s SWC requirements occur:

  - Provide farmers with banana suckers or corms. At P2.00 per banana corm, the P3,000.00 allocated for inputs will provide enough material to convert 1.5 ha of corn to banana plantation, whereas 30 mango seedlings at 15 x 15m spacing will only cover 0.6 to 0.7 ha and there will be at least a 5 year wait to get the first harvest (compared with 18 months for bananas).

  - Before being given the banana suckers or corms, each farmer must lay out the planting sites (at the appropriate spacing for the species) in a triangular layout on the sloping land. This will allow 15% more trees to occupy the site than with standard square planting layouts. On slopes above 45%, a 30 cm depth of mulch in a 3.0 m diameter ring should be applied on each planting site, to suppress weeds, protect the soil and improve soil moisture conditions. On slope below 45%, 90 cm diameter eyebrow basins need to be constructed and mulched. This will also deter ploughing and planting corn.

  - When seeds of fruit trees become available, the farmers should be reminded of the benefits of planting these by direct seeding in the field1 and be trained in grafting on the scions of certified trees.

---

1 For example, a more vigorous rooting system, with a deep tap root, enables the tree to survive droughts and get nutrients from deeper in the soil. Directly seeded trees also live longer.
3. **Specific observations**

3.1 **PPO 4.** (Dates visited: 30 Nov to 2 Dec 2004).

3.1.1 **Abgang Bato, Sepatubo. 30 Nov 2004**  

*Cooperator: Rodito Francisco*

The farm has three land units: one is 10% slope covering 0.25 ha. Advised to plant contour hedgerows at 10 m spacing, and grow improved variety of corn with fertiliser to meet family needs. Hedgerows will ensure he ploughs across the slope and not up and down as he does at present.

The other land units are on sloping land, and he wants to plant mangos. A mixture of bananas and mangos is recommended to provide income in the medium term (18 months from now). He should improve and increase the size of his pineapple patch (better spacing, weeding, mulching etc) to diversify his sources of income.

Impending drought means distribution of planting material will be delayed but he can prepare planting sites by mulching them.

*Miscellaneous*  

Nearby UDP-installed water supply point not working as intake is broken. We reported this to the PPO engineer.

3.1.2 **Abgang Bato, Sepatubo. 30 Nov 2004**  

*Cooperator: Joly Nadela*

Has hedgerows of *Flemingia* but needs to add two more rows on upslope side to crest of hill. Must stop growing corn on very steep convex slope (>55%) with gullying.

Same problem: needs to harvest corn before he can prepare planting sites.

3.1.3 **Brgy Rio del Pilar. Sitio Centro. 1 Dec 2004**

Discussion held with Brgy Captain who has issued an ordinance requiring every farmer in the area to plant one banana sucker each day. Discussed the merits of bananas and other fruit trees versus corn. They seemed surprised (and amused) to realise the distance person walked by a person during the operations for a single crop of corn (80 km).

Discussed importance of mulching, and that corn stalks should be left to cover the field. He was sorry, but they used to burn all the trash afterwards.

*Cooperator: Pablito Tak-an*

Guinea grass strips but at 6 m spacing. 50 cm high build up of soil. Growing corn and bananas but wants to convert to tree crops. Sandy loam soil is only 30 cm deep and corn failed – probably because soil only able to store moisture for 3 days ET. Last rain was 5-6 days earlier.
Recommend that he leaves a 3-m wide NVS below the grass strips and plants bananas there – if only to verify there is enough soil depth to support growth. The cultivable strip behind the Guinea grass strip should be heavily mulched and zero tillage practiced to prevent further soil movement.

*Cooperator: Carlos Gallinato*

This is another farmer willing to switch from corn to fruit trees. Farm has crest with steep side slopes planted with peanut.

Recommend that crest (15% slope) be protected with leguminous hedgerow at 3 m spacing (no NVS needed as back up) so land is protected for growing annual crops in future.

The side slopes need another hedgerow with NVS between the 8-m wide spaced hedgerows. This will give two terraces comprising a 2 m wide terrace, 2-m wide NVS and 0.5 m wide hedgerow.

The mid-slope to be converted to tree crops in mulched planting sites.

*Cooperator: Rodrigo Zurita (BEW)*

Also wants to replace corn with trees. Has good grass strips of *Setaria*/Guinea grass formed four months after planting (see Photo 1), but needs to double the lines to form effective barriers. He is also cutting it correctly – leaving about 20 cm of stem with enough chlorophyll to photosynthesise and produce more material quickly.

Same recommendation as for other farmers. Maintain good cross-slope barriers to protect land at top of hill for future annual crops, and plant trees on steeper lower slopes.

He has a grafting knife so can show his neighbours how to graft scions onto directly seeded seedlings.

Rodrigo claims he gets 50 coconuts per tree on each of the four harvests. With 3 nuts = 1.0 kg copra (P17.5 / kg), coconuts provide a good income. But need under-planting to form multi-storey effect to protect soil.

### 3.1.4 Brgy Rio del Pilar. Sitio Wa’ay. 1 Dec 2004

*Cooperator: Pepito Sardido*

Planted hedgerows of cassava and sugar cane without using A-frame – so they were badly aligned. However, these attracted rats so he ripped out the hedgerows leaving the lines of accumulated soil – now adding to the erosion hazard on his farm.

He considers bananas a good crop – even though he only gets 9 kg/hill. Also grows ginger in untilled soil, claiming to get 50 kg/10m² which is exceptional as 20-30 kg/10m² is considered high. Sells ginger at P15/kg

Farmer wants to move from corn to bananas and fruit trees. Already has some coconuts established.
Advised to plant bananas in triangular layout with ginger in between. Ginger plants should be mulched with coconut fronds to maintain soil moisture.

3.1.5 Malungon. Brgy San Juan. Sitio Proper. 2 Dec 2004

Cooperator: Milani Labnawan

House and land in a 100 m wide valley, but cleared and grows corn on 60-70% slopes – planting up and down slope. Hedgerows were put in without an A-frame and were widely spaced. Mass movement of soil is visible.

We estimate the hill is climbed 400 times each cropping cycle. His family admit their life seems to be involved in growing corn non-stop – which is exhausting and soul-destroying. Our comments on the potential of banana and fruit trees to generate higher incomes, giving them time for other activities, were viewed optimistically. Owns a maize sheller.

Claims to get 6,000 kg shelled corn per harvest, three times a year (using improved seeds and six sacks of fertiliser). His income after deducting cost of fertiliser is equivalent to P114/10m². By his own account he claims to harvest 25 kg bananas per hill three times a year (i.e. 75 kg/hill) which he sells at P5 per kg giving P225/10m².

He was advised to:
- Restrict his cultivation on the hills to the narrow 35% ridge and crest, where contour hedgerows or grass strips should be planted at 3m spacing and peanuts or ginger grown.
- Plant a mix of bananas and fruit trees with coconuts (triangular layout, mulched etc).
- Use the valley bottom land to grow his family’s household needs for corn (50 kg/month), which should only occupy less than 0.1 ha per season given the yields stated above. They said that the corn didn’t store well after three months so producing 600 kg of corn in one crop and storing it for a year is not practical
- Construct some raised beds in the valley and grow vegetables. Supplementary water is available from the nearby stream.
UPDATE ON UPLAND FARMING/ S&WC SPECIALIST INPUT

Due to delays in getting the Rider to the BCEOM/EU contract approved the Consultant was absent from the project during May 2004 so was unable to backstop the training of ATs and BEWs by the core teams of SAD and RM coordinators and MSOs, trained in applying STOP, to ensure errors were not inadvertently introduced.

Report for the period 9-25th June 2004-06-24

The Consultant visited upland farming sites in Davao Oriental with the SAD and RM Coordinators from 14-17 June; and visited sites in Sarangani with the RM Coordinator from 21-24 June.

Main findings:

STOP
- Some of the ATs/BEWs in PPO2, although trained in applying STOP, were still drawing the farm maps from a generalised side view and not from the top or overhead view showing the whole farm and the relationship of its land units to it (e.g. Brgy Palau Gil).

- The CTO, PPO2, commenting on STOP said the ATs and BEWs were asking why it was only now that STOP was being introduced and not earlier in the Project cycle. This suggests they understand the logic of the methodology.

- At an AT/BEW STOP training session at Malungon, the CTO, PPO4, expressed her surprise that slope as a factor in soil erosion had not been highlighted by previous consultants involved in land management. (When I first arrived on the Project in July 2003 and read the Community Watershed Plans, I was surprised that little, if any, emphasis was given to slope in zoning the watersheds. Slope steepness and slope length are two of the main factors affecting erosion and land use).

- Although ATs and BEWs in PPO4 have been trained in STOP, they have started selecting second line farms without doing a STOP survey and drawing a land unit map of the farms (e.g. Mun. Maasim, sitio Maknit). As a result, we found ourselves scrambling up >60% slopes to look at farms that did not meet UDP criteria. Farms should not be selected without an accompanying map and description of the land units (slope, soil depth and soil texture).

- Millet, the CTO PPO4, said she would like STOP surveys (mapping the various land units/slopes and measuring slopes, soil depth and assessing soil texture) to be made before the planning sessions with ICRAF. This would facilitate the planning of the Learning sites as the physical factors could be taken into account during the sessions. I was not able to meet with ICRAF to discuss this.

- The existing hedgerows on some of the farms proposed as training sites were not put in at appropriate spacing, nor were they aligned using A-frames so some correction is needed. This can make some areas unsuitable as learning
sites for farmers interested in the STOP technology and dualistic cropping systems – though they could be useful to so how well they can be amended to reduce erosion etc.

CROPS AND CROP MANAGEMENT

- More attention needs to be given to writing prescriptions on managing land units, depending on site factors and crop requirements. In conjunction with the Rural Finance and Marketing TAs and CTOs, the inputs (kg seeds/ha, fertiliser requirements, optimum spacing of crops, expected yields etc) for the six main annual crops and six main perennial crops in each Municipality are being collected, so that income projections can be given to farmers for small units of land (of a few hundred sq m only). This will also be helpful in helping farmers decide whether to apply for loans (small areas have a lower risk) while assisting the lenders to decide whether the application is a good risk. Good progress is being made in this respect.

- Some interesting observations were made regarding the optimum spacing of crops and use of fertilisers. We noted that some farmers had planted corn at 50-75 cms spacing between plants within the row, and 75-100 cms spacing between rows. Yields were only about 800 kg/ha/harvest.

In PPO4 (Kiamba) a farmer had planted corn at the optimum spacing of 25 cms within the row and 75 cms between rows, and applied three sacks of complete fertiliser (150 kg) as a top dressing, (300 kg is the recommended amount). His yields amounted to 2,800 kg/ha/harvest. This amounted to an additional yield of 13kg corn for every one kg of fertiliser applied. A good investment.

- In Brgy Palma Gil, a group of farmers were asked about the value of their crop of corn from 10 sq m of cultivated field. They were then asked how many kilos of bananas they expected from one hill of banana occupying the same area. They were surprised that bananas gave P135 more than corn. Apparently, they had never considered comparing the relative returns from different crops. However, one of the farmers said that no traders came to their village to buy crops. When Gel asked why not, they admitted it was because they had nothing to sell. Then another farmer pointed out that if 100 of them each planted 0.5 ha of bananas, then traders would come. (Group action by farmers is one of the accelerators need for agricultural development). Further investigation by MED, to determine the volumes of produce that traders require to make visits to various barangays economically viable, might be worthwhile.

MISCELLANEOUS

- When we paid a courtesy call on Mayor Yap (Mun. Glan) we were invited to attend a presentation to the Indonesian Consulate General, intended to promote local trade between the Philippines and Indonesia. (The Mayor told the Consul that he provided special slaughter houses to provide halal beef and pork for the muslims!). On a more serious note, the Mayor told us he was
concerned over the delays in getting funds for projects released by UDP. He claimed he it was costing him far more to meet UDP’s administrative requirements than the Municipality was getting from UDP for projects.

- We also learned that the mayor had issued an ordinance stating that farmers who had not applied soil conservation measures to their farm would be ineligible for free schooling and medical treatment. While this is a good incentive, the ordinance does not require certification that the measures are appropriate and correctly applied. Consequently, it was obvious that virtually all the hedgerows we saw had been laid out without using an A-frame, and were too widely spaced to be effective.

- At Brgy Rio del Pilar we saw a first line farm where the hedgerows had been dug up by the son, when he took over the farm from his farmer. Apparently, the hedgerows interfered with his farming practices (corn planted on >55% slope).

- In Kiamba, a group of farmers were very interested in applying STOP but asked why the project had not set up a demo farm comparing the techniques with their usual practices. I said the Project could not promise them anything, but told them that this required a group of farmers to chose one of their farms as a demo site, and agreeing that the owner of that farm would receive all the inputs and that the neighbours would use the farm as a training site. (See my final report on the Soil and Water Conservation Mission: 3.10 Selecting farms to demonstrate Land Unit Farming).

CONCERNS

Some field staff expressed concerns about the large amounts of cash being paid to NGOs to carry out training in areas that have already been done by the Project, and for which the NGOs don’t necessarily have the expertise or experience. We planned to have a meeting with Dash this morning to discuss these issues but Gel was delayed so I cannot report accurately on this in this report (which I will e-mail before I leave the office for the airport). As most of the discussions weren’t in English, and held in the back of the vehicle while driving between sites, you will need to discuss with Gel Abalus for more details.

UDP
Davao City

25 June 2004
Field visit to Maitum and Maasim. 24-25 August 2004

Co-Director Wiebe van Rij, and TA Upland Farming/SWC Ken Proud visited upland farms in Maitum and Maasim on 24th and 25th August, 2004 to verify the site data of farms proposed for 2nd line DFS cooperators.

Main points noted (see Mr van Rij’s report for detailed notes regarding individual farms):

- Data improperly recorded:
  - Soil depth sometimes given in inches when the form states it is to be recorded in cms.
  - Slopes apparently recorded in degrees (º) when STOP chart is based on percent slope (%).

- Despite being trained in STOP, some ATs and BEWs need reminding that hedgerows are not needed when only tree crops are planted. A good grass ground cover is the requirement.

- Farms with slopes sometimes exceeding 70%, which do not meet the STOP criteria of <45%, are being short-listed for 2nd line DFS cooperators.

- More attention should be given to informing farmers that the project is aiming at reducing and replacing corn cultivation on steep slopes with tree crops; and to convert cogon land to orchards. As it is, some farmers seem to be putting in NVS solely for the purpose of receiving free inputs. When delivery of inputs was delayed, some farmers destroyed the NVS – suggesting they were not made aware that the main function of the NVS is to prevent soil from washing downhill, and to maintain soil fertility.

- Where farmers have more than one farm plot, it can often be observed that they plant corn on the steeper sites, and trees on the less steep slopes. Perhaps their strategy is to “mine” the fertility of the steeper slopes, which may have been fallowed for some years, before planting perennial crops.

- In Massim, the soil depth in a patch of secondary forest with coconut trees on a >60% slope, was 60 cm. On the adjacent cogon-infested land of similar slope, which had been cultivated for many years, the soil depth was 20 cm. The technician has been asked to determine when the area was first cultivated, and why it is lying idle. If similar surveys are undertaken by all the ATs/BEWs of, say, five sites in their areas, then the results may provide the UDP with a rule-of-thumb means of estimating the number years remaining for cropping of annual crops under present practices*.

---

* For example, if farmers abandon an area when only 20 cm depth of soil remain, and soil losses are estimated to be one cm depth of soil per year, then a 40 cm depth of soil indicates a cropping life of just 20 years for annual crops.
REPORT ON VISITS TO LEARNING SITES: 1-3 Sep & 6-9 Sep 2004
By K R S Proud TA Upland Farming/Soil & Water Conservation

Bearing in mind that the five stages leading to farmers adopting an innovation are: Awareness, Interest, Evaluation, Trials, Adoption; the purpose of the site visits was to assess the suitability of the first line farms as learning sites.

Aspects that were looked at included:

- **Awareness**: What will visiting farmers learn, that they don’t already know, when they visit the learning sites? (i.e. will the sites create a positive awareness of the range of options available for developing less environmentally damaging cropping systems in the uplands).
- **Interest**: Does the site demonstrate the logic of the innovations, and are they visibly successful so they will interest the visiting farmer?
- **Evaluation**: Is information available on the inputs and outputs, etc. from innovations, which can enable the visiting farmer to evaluate whether he thinks the innovation is worth trying under his particular circumstances (i.e. slopes and soil types; economic circumstances; etc) compared to traditional methods?
- **Trials**: Does the cooperator fully understand the principles of the innovations, and is he able to help visiting farmers set up small trials after UDP ceases operation?
- **Adoption**: When UDP ceases, who will assist the farmers in overcoming any constraints to full-scale adoption of innovations.

<table>
<thead>
<tr>
<th>Date</th>
<th>Location and Cooperator</th>
<th>Observations</th>
<th>Recommendations for demonstrations</th>
</tr>
</thead>
</table>
| 1 Sep 04 | PPO 3 Malita. Kilalag Agafieto LLena | 10-20 m wide crests Side slopes 45-55% Slopes >100 m long A-frame not used. Hedgerows too wildly off the contour to be re-aligned, and too widely spaced (10-12 m). Peanuts and fruit trees being grown. | a) Reduce erosion damage from badly aligned hedgerows by using A-frame to align contour strips of Vetiver or Napier Grass between hedgerows to form small terraces for growing peanuts, mung beans.  
b) Plant hedgerows to develop terraces on crests for planting corn, cassava, peanuts, etc.  
c) On slopes <55% – plant trees from seed (eyebrow terraces).  
d) Laying hedgerows to improve ability to hold back soil. |
| 2 Sep 04 | PPO 3 Upper Bala, Kabuhian. Anna Lisa Rafaela | Long slope, 45-55%, very stony and rocky with shallow soil. Rubber trees and bananas planted with good ground cover. Attempt to plant hedgerows at 3-10 m spacing, but no rain for germination. Cooperator wants to plant trees and mung beans. | Hedgerows not needed. Demonstrations to include:  
- Use of stones to make dry stone micro-basin walls and narrow terraces for growing mung beans. (Get expertise from Sitio Labidayan and Sitio Belen, Lanog).  
- Planting seeds of wild lansones from nearby remnant forest.  
- Graft on scions of certified varieties. This shows the value of having patches of forest in the vicinity (also mycorhiza inoculation from forest litter), and show benefit of tap toots in stony soil.  
- Demonstrate difference in cost and area planted between 30 seedlings and equivalent value of seeds and scions. |
<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Observations</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Sep 04</td>
<td>PPO 3 Malalag</td>
<td>Line 1 farm. Hedgerows not on contour, limited area covered. Pineapples not</td>
<td>• Has 5-6 m wide slightly eroded ridge (18% slope) on which terracing trials can</td>
</tr>
<tr>
<td></td>
<td>Sitio Banyau</td>
<td>mulched, trees not in micro-basins or ring-weeded.</td>
<td>be done for planting cassava and peanuts.</td>
</tr>
<tr>
<td></td>
<td>Junado Pinol</td>
<td></td>
<td>• Coco nut plantation on 50% slope (sandy soil) could be used for small-scale</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>trials on growing corn under heavy mulch using improved seed/fertiliser technology.</td>
</tr>
<tr>
<td>3 Sep 04</td>
<td>PPO 3 Santa Cruz</td>
<td>Learning site is 50 minutes walk from community centre. Most of brgy is</td>
<td>Use brgy to demonstrate ideal “End-of-Project” situation. Farmers with only 1-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>gently sloping land well covered with tree crops. Community buys its staples</td>
<td>ha get into short-term debt to buy food until able to harvest copra and fruits.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>with harvest of tree crops.</td>
<td>They earn off-farm income elsewhere. Explain that when trees are not planted at</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>optimum spacing or in E-W alignment, production is lost.</td>
</tr>
<tr>
<td>6 Sep 04</td>
<td>PPO 1 Malamodao</td>
<td>Good mixed cropping but exposed soil on steep slope 45-50% with widely</td>
<td>Not much potential for demonstrating SOL.</td>
</tr>
<tr>
<td></td>
<td>Maco. Romeo Manrique</td>
<td>spaced hedgerows – not on contour.</td>
<td></td>
</tr>
<tr>
<td>6 Sep 04</td>
<td>PPO 1 Mabini,</td>
<td>Potential learning site. 25-35% sloping ridge and side slope leading to</td>
<td>• Demonstrate establishment of terraces with grass strips and herbicide, for</td>
</tr>
<tr>
<td></td>
<td>Pangibiran</td>
<td>valley bottom. Wants to dig well and grow vegetables. Rest of plot consists</td>
<td>vegetables and arable crops.</td>
</tr>
<tr>
<td></td>
<td>Alfredo Sabion</td>
<td>of well-established mangoes on ridge crest – but with roots exposed by erosion.</td>
<td>• Micro-basins around trees.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Pruning.</td>
</tr>
<tr>
<td>7 Sep 04</td>
<td>PPO 1 Pantukan</td>
<td>45-60% upper slopes, 25% lower slope. Hedgerows too wide. Shallow soil (30 cm)</td>
<td>• Set up trials to offset effects of widely spaced hedges by leaving back part</td>
</tr>
<tr>
<td></td>
<td>Kingking</td>
<td></td>
<td>of terrace to grass and tree crops, and front part to annual crops. Line of</td>
</tr>
<tr>
<td></td>
<td>Wilfredo Mahinac</td>
<td></td>
<td>pineapples or Kenya grass at rear of cultivable strip will prevent disturbance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>of grassy “riser” area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Demonstrate micro-basins.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Grow vegetables on 25% slope area.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Laying hedgerows to increase density and strength to support weight of soil.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Compare incomes from corn and bananas</td>
</tr>
<tr>
<td>7 Sep 04</td>
<td>PPO 1 Laak</td>
<td>1st line farmer. Hedgerows not properly contoured. Bananas grown on broad</td>
<td>No potential for demonstrating SOL. Fruit trees need ring weeding and mulching.</td>
</tr>
<tr>
<td></td>
<td>Kiladig</td>
<td>gently sloping crest, with peanuts, corn etc. grown on 45% side slopes, with</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Victor Dilag</td>
<td>tree crops. Corn crop failed at cob stage – soil only 20-30 cm deep.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Next door to MSO</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Betty’s farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Sep 04</td>
<td>PPO 2 San Isidro</td>
<td>Site 1: Approx 1 ha</td>
<td>Promote terracing by planting Kenya grass contour strips at 2m spacing.</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------------------------------------</td>
<td>------------------------------------------------------</td>
<td>---------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Sitio Cabocanan</td>
<td>37% slope, Clay loam. Soil depth 50-100cm. Contour ploughing with carabao. Cassava planted in maize trash.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Visited SIDOUCO.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cassava sites in.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Noa Paciencio, Project Devt Off.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Felix Agut VII, Agriculturalist, and Nador Galagar, Brgy Captain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Sep 04</td>
<td>PPO 2 San Isidro. Cabocanat Santos Badiot</td>
<td>Good farm for learning site.</td>
<td>Improve density of grass strips.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STOP can be demonstrated.</td>
<td>Laying of hedgerows</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cassava grown on gently sloping crest and upper slopes between Kenya grass hedgerows. Trees on steeper slopes.</td>
<td>Pruning of trees</td>
</tr>
<tr>
<td>8 Sep 04</td>
<td>PPO 2 Tawas. Brgy Tagibo</td>
<td>Excellent farm on crest – but not typical of surrounding area. Plastic mulching. No potential for demonstrating STOP</td>
<td>Need explanations and evaluation of what is being done</td>
</tr>
<tr>
<td>9 Sep 04</td>
<td>PPO 2 Taraguna Maitum Brgy Tubuan Coop: Concordio Quijano/ Nolly Sautirian MAO, and Dolores Valdesco MPT</td>
<td>Limited area of hedgerows not all on contour (diverting runoff away from fish pond). Limited area. Training given in Abaca mgt. Livestock mgt, plant propagation/grafting. Plans to give training in pruning</td>
<td>No potential for STOP</td>
</tr>
</tbody>
</table>

**Conclusions**

- The learning sites were set up before STOP was developed. They do not, therefore, demonstrate the STOP principles and objectives. At present there is little farmers can learn from the sites.

- Upland farmers need to be shown the range of options available for promoting permanent upland cultivation (reportedly one of the most intractable problems in the humid tropics) so they can reduce the area under annual crops and increase the area under tree crops, with least effort and risk from the farmer’s point of view. Such options have to be:
  - **ecologically sound** – due to the fragile nature of the upland soils;
  - **technically feasible and appropriate**;
  - **economically viable**;
  - **socially acceptable**; and
  - **legally permissible** – that is, they must comply with current environmental and land use rules and regulations.

- Commercial production of cassava should not be allowed on steep to precipitous slopes (see Annex 1). Digging up the clay soils to harvest the rhizomes will inevitably result in a significant portion of the soil rolling down hill as lumps.
**Recommendations**

Set up at least one learning site per province and ensure as many of the following options are demonstrated. They must be properly set up to impress visitors.

<table>
<thead>
<tr>
<th>TERRACES</th>
<th>TREE CROPS</th>
<th>ANNUAL CROPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Promote terracing on clay soils (grass strips on fallowed land+ ploughing)</td>
<td>• Tree crops grown on steeper grass-covered slopes without hedgerows.</td>
<td>• Annual crops to be planted between hedgerows on areas with slopes &lt;20% or where terraces are being formed</td>
</tr>
<tr>
<td>• Use A-frame to align contours. Point out damage caused by not following contour</td>
<td>• Controlling cogon with herbicide. (3 m diameter ring around planting site)</td>
<td>• Zero-tillage using herbicides to control cogon. (Discuss labour savings: cite Andap, New Bataan experience)</td>
</tr>
<tr>
<td>• Planting double row hedgerows on slopes &lt;20%</td>
<td>• Ring weeding round trees</td>
<td>• Improved seed/fertilizer technology. (Corn yields up to 3 times higher with hybrids than with OPV)</td>
</tr>
<tr>
<td>• Napier grass hedgerows</td>
<td>• Mulching of trees</td>
<td>• Optimise crop spacing (e.g. plant corn at 25 cm within row)</td>
</tr>
<tr>
<td>• Re-contouring inter-terrace areas with napier grass</td>
<td>• Eyebrow terraces and seedlings + mulch</td>
<td>• Pineapples + mulch</td>
</tr>
<tr>
<td>• Laying hedges</td>
<td>• Eyebrow terraces and seeds + mulch + grafting on scions</td>
<td>• Gabi cultivation on ridges</td>
</tr>
<tr>
<td>• Subdividing terrace by planting napier grass</td>
<td>• Direct seeding + mulch + grafting on scions</td>
<td>• Organic farming demo and comparison of inputs</td>
</tr>
<tr>
<td>• Reduce cultivable area of terrace by planting perennial crops on upper portion of terrace, and encouraging grass.</td>
<td>• Optimise tree spacing (e.g. triangular spacing on hillside enables 15% more trees to be planted per hectare).</td>
<td>• 14-day composting method.</td>
</tr>
<tr>
<td>•</td>
<td>• Tree pruning, and management of banana hills (1 main stem and two suckers 5 months apart)</td>
<td>• Vegetable growing –basket composting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Orient multi-canopy trees East-West</td>
</tr>
</tbody>
</table>

KR S Proud

UDP
Davao City

11 September 2004
Some notes on Cassava production

- Cassava is very demanding in its nutrient requirements. Continuous cropping on the same land rapidly depletes the soil of its plant food reserves, while cultivating cassava on hilly terrain can lead to accelerated erosion.

- The average growth period for cassava, for commercial starch production, is 14 months. Two crops of corn a year would give better income, but with soil erosion losses. Bananas would give even higher income with much reduced erosion risk. It is a pity MED wasn’t asked comment on the profitability and marketability of cassava in relation to other crops.

- Heavy applications of commercial fertiliser containing N, P and K, (300-400 kg of complete fertiliser/ha) are required to obtain maximum yields of cassava (average 20 t/ha per crop with moderate inputs in terms of land preparation and weeding).

- Some varieties mature in shorter periods of time but yields are markedly reduced.

- Cassava can survive on impoverished soils but very low yields are obtained.
REPORT ON FIELD TRIPS TO PROPOSED LEARNING SITES IN CARMEN (DAVAO DEL NORTE) AND THE COMPOSTELA VALLEY: 15-17 SEP 2004

K R S Proud
TA Upland Farming Systems/Soil and Water Conservation

1. Carmen, Davao del Norte

I was accompanied by Gel Abalus, RM Coordinator on a day trip to Tibulao, Carmen, Davao del Norte. We were accompanied by Edgar Llana (AT) and Cornelio Dimialig (BEW).

a) Site 1

The farm of Lolita Onofre was identified as suitable for a learning centre. It has an amplitude 30-50 m, and rounded hills which are representative of the area. It is close to the road, readily visible and has a range of land units to display a number of management options (moderately sloping ridge and crest, steep side slopes (45-60%) and a minor valley). The soils are reportedly over 100 cm deep, so terracing is possible.

b) Site 2

The farm of Mario Alburo was a ridge top on which he had planted hedgerows and beans after visiting the ICRAF/WAC centre at Lampitan.

The cost of land preparation by spraying herbicide to kill cogon was P2,720 compared to the P12,000 he normally incurred with several ploughings.
### PPO 5: INITIAL INSPECTION OF FIRST LINE FARMS

**Visit made:** 20-23 Sep 2004

| OBSERVATIONS | • Despite the STOP training sessions specifying the importance for farm maps, no maps have been drawn showing the relationship of land units to each other and the range of slopes, soil textures and soil depths.  
|             | • There is no indication as whether farmer needs to grow corn or rice to eat, or the quantities of produce required to support the family. |
| SIGNIFICANCE | • Cannot use STOP to plan terrace/NVS/hedgerow layout as spacing and crop selection depend on site characteristics such as slope, soil texture and depth.  
|             | • No need to grow corn on the site if the farmer plans to sell short- and medium-term cash crops to buy daily staples, or if the farmer has land elsewhere where he grows corn.  
|             | • Yield-increasing techniques will need applying if the area of land suitable for annual crops is smaller than usually cropped. |

#### RECOMMENDATIONS

Before approving second line farms:

− Draw a map showing the distribution and characteristics of the land units.  
− Determine the farmer’s subsistence food needs so STOP can be applied to create terraces to meet area requirements for annual food crops.

#### ACTION

| Technical Chief to instruct SAD and RM specialists to get the information.  
| SAD specialist to inform LGU/MSO that maps are needed.  
| MSO to instruct ATs and BEWs to prepare maps, etc.  
| BEW and cooperator to visit farm - prepare map, determine cropping requirements, submit to MSO.  
| SAD, RM, and/or MSO to visit sites, verify map, etc.  
| Obtain approval to proceed with developing farm |

**Action by:**

| TC  
| SAD specialist  
| MSO  
| BEW  
| Specialists/MSO  
| TC/SAD Coordinator |

### Miscellaneous comments


PPO 5: LAKE SEBU-LAKE SELOTON. INSPECTION OF SECOND LINE FARMS

Visit made: 20 Sep 2004
Farms visited: Jerome Delmo
AT: Jesse Palmes
BEW: Jerome Delmo

| OBSERVATIONS | • 1.5 ha of land with 12-25% slopes (no SWC) being ploughed (twice) and harrowed (twice) by carabao – not following the contour. This is bordered by a very steep 40 m long slope (45-60%) with coconut palms – which has also been ploughed. There is a carabao-grass covered ridge, 40 m long by 5-10 m wide ridge by the lake.
• Clay loam soil reportedly >100 cm deep.
• No farm map.
• Farmer grows 3 crops of hybrid corn and applies 6 sacks (300 kg) complete fertiliser and 2 sacks (100 kg) urea.
• Corn provides the farmer with an income of PhP 45-60K each harvest for unshelled corn (i.e. PhP 30-45K/ha or PhP30-45/10m²).
• Bananas reportedly yield PhP 120/10m², or twice the income from corn. (The farmer apparently was discouraged from growing bananas because his neighbour reportedly stole the bunches at night time). |
| SIGNIFICANCE | • Planting contour hedgerows on the extensive rolling area would encourage contour ploughing and harrowing.
• The income from hybrid corn is two to three times higher than farmers who grow OPV or traditional varieties. This can be attributed to applying the correct amount of inorganic fertiliser. Farmers with limited areas of gently sloping land suitable for growing their subsistence needs for corn should be made aware of this data.
• Despite using improved/fertiliser technology, the potential income from bananas is much higher (more so, when the cost of hiring the carabao is deducted). A trial to demonstrate this needs to be set up.
• The steep slopes and ridge, though only a small part of this particular farm, seem typical of farms in the locality. These should be used to demonstrate various STOP interventions. |
| RECOMMENDATIONS | • Interview the farmer and determine the labour costs (including man-days and carabao time) and inputs for growing corn, and the value of the harvested corn.
• Plant the steep parts (45-55% slope) of the coconut tree area with 50 banana suckers (in triangular layout), and monitor inputs and income.
• Plant the steepest parts (>55% slope) with seeds of fruit trees.
• Set up the improved design for cross-slope barriers on the carabao-grass covered ridge, and grow peanuts, cassava, vegetables, etc. |
| ACTION | • SAD specialist to interview the farmer to find out food requirements; and inputs etc for corn cultivation.
• Produce land unit map of farm with slope and soil data.
• Supervise farmer in correct use of A-frame to lay out contour hedgerows on main corn field.
• Show the farmer how to make eyebrow basins (in triangular layout) on steep part of coconut area and plant with banana suckers.
• Use herbicide to clear 3m-diameter areas on >55% slope, followed by direct seeding of mango, etc.
• Develop improved cross-slope barriers on ridge.
• Maintain accurate records of labour and inputs |

Miscellaneous comments
The farmer’s wife described how up to nine operations are carried out for each corn production cycle. We estimated that this was equivalent to one person walking over 300 km a year.
**PPO 5: PERDOAN-TANTANGAN. INSPECTION OF SECOND LINE FARMS**

Visit made: 21 Sep 2004  
AT: Anastasio Laurente  
BEW: Fructoso Cabrera

<table>
<thead>
<tr>
<th>OBSERVATIONS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• The dominant land system is a dissected sandy peneplain - a formerly level plain eroded over the millennia to leave a series of short “fingers” of land with flat to gently sloping crests, and short side slopes with rapidly steepening convexity.</td>
<td></td>
</tr>
<tr>
<td>• Minor valleys (10-25 m wide) lie in between.</td>
<td></td>
</tr>
<tr>
<td>• The amplitude of the land system is 30-50 m (height from valley bottom to crest).</td>
<td></td>
</tr>
<tr>
<td>• Soil are sandy with depths from 50 cm- &gt;100 cm.</td>
<td></td>
</tr>
<tr>
<td>• Much of the area is covered with cogon.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SIGNIFICANCE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Most of the farms are virtually identical consisting of one or two crests 5-15 m wide, a 40-60 m convex ridge gradually increasing in slope steepness from 12%-25%-35%-55%, 30-50 m long convex side slopes, and 10-25 m wide minor valleys.</td>
<td></td>
</tr>
<tr>
<td>• DFS can be demonstrated by planting short-term cash crops on the upper slopes and crest; vegetable production in the minor valleys; and fruit trees on the very steep slopes or cogon covered hillsides.</td>
<td></td>
</tr>
<tr>
<td>• The sandy soils indicate that soil moisture may by a limiting factor to crop production.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RECOMMENDATIONS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• On the gently sloping ridges up to 25% slope: plant contour hedgerows of leguminous species.</td>
<td></td>
</tr>
<tr>
<td>• On the 25-35% upper slopes: promote terracing by planting napier or vetiver grass strips at STOP spacing. Promote terracing by ploughing.</td>
<td></td>
</tr>
<tr>
<td>• In the minor valleys: construct raised beds for growing vegetables.</td>
<td></td>
</tr>
<tr>
<td>• At the interface between the minor valleys and the slopes: dig a cut-off drain (to protect the raised beds from flooding) and store water to irrigate the vegetables during dry spells.</td>
<td></td>
</tr>
<tr>
<td>• On cogon-covered hillsides: kill cogon in 3m diam. circles by spraying herbicides; plant seeds of fruit trees in eyebrow terraces or directly into the ground.</td>
<td></td>
</tr>
<tr>
<td>• Heavily mulch the crops, vegetable beds and young trees to conserve soil moisture in the sandy soils.</td>
<td></td>
</tr>
<tr>
<td>• Set up compost heaps protected from rainfall. And heavily mulch fruit trees</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACTION</th>
<th></th>
</tr>
</thead>
</table>
| • Arrange STOP refresher course for SAD, RM specialists and MSO. | Action by:  
TC  
SAD, RM and MSC  
ATs, BEWs  
TC, SAD  
AT, BEW, Farmer |
| • STOP refresher course for ATs and BEWs to ensure STOP spacing and A-frames used to lay out contours. |  |
| • Draw farm maps and plan layout of SWC measures and crops, taking into account farmer’s subsistence needs. |  |
| • Approval of plans. |  |
| • Ensure each cooperator has a compactor and beater for forming the eyebrow terraces. |  |
| • Set out terraces, hedgerows, eyebrows terraces etc |  |

Miscellaneous comments

Concerning herbicides: Some of the UDP staff have expressed concerns about using herbicides, such as RounUP, as they may be harmful to soil micro-organisms. These concerns are unfounded! If the staff take the time to check the World Wide Web/Internet and they will find a number of studies that show that microbial activity is actually *stimulated*, not suppressed, in the presence of RoundUp and atrazine. Tests have also shown that Glyphosate, the main ingredient in RoundUp, binds tightly to soil particles until it is degraded, so there is an extremely low potential for Glyphosate to move into groundwater. UDP farmers have found that applying herbicides to control cogon saved them between P2,500 to P9,700 per hectare in labour costs. This increases their incomes and helps achieves the UDP’s main objective.
PPO 5: ALBAGAN-TAMPANAN. INSPECTION OF SECOND LINE FARMS

Visit made: 22 Sep 2004
Farms visited: Cesar Capute

<table>
<thead>
<tr>
<th>OBSERVATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The landscape is dominated by mountains with steep to very steep slopes, with limited areas of gentle slopes at the base, before dropping precipitously into narrow river chasms.</td>
</tr>
<tr>
<td>• The amplitude of the land system is 200-500 m (height from valley bottom to crest).</td>
</tr>
<tr>
<td>• The soils on the gentle slopes are mainly coarse sand to gravels with depths from 50 cm- &gt;100 cm.</td>
</tr>
<tr>
<td>• Main crops are fruit trees and vegetables. Corn and rice are seldom grown.</td>
</tr>
<tr>
<td>• Vegetable gardens grow carrots, gabi etc on ridges. NVS established – but not on the contour;</td>
</tr>
<tr>
<td>• Community tree nurseries have been set up.</td>
</tr>
<tr>
<td>• Composting is practiced but without protection from rainfall.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SIGNIFICANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>• DFS will be restricted to short-term cash crops and vegetables on the limited areas with gentle (&lt;25%) slopes, with fruit trees on the very steep slopes.</td>
</tr>
<tr>
<td>• Coarse sandy soils are “excessively drained” which severely reduces the amount of soil moisture that can be stored for tree and crop growth, and nutrients are readily leached out of the profile.</td>
</tr>
<tr>
<td>• Strategies that maintain fertility and conserve soil moisture will need to be applied.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Protect compost heaps from rainfall by covering them with banana leaves.</td>
</tr>
<tr>
<td>• After the next harvest of roots and vegetables, apply plenty of compost in the furrows and bury it by splitting the ridges when ploughing. This will help retain soil nutrients and moisture in the coarse soil.</td>
</tr>
<tr>
<td>• Heavily mulch the crops, vegetable beds and young trees to conserve soil moisture.</td>
</tr>
<tr>
<td>• Plant fruit trees from seeds and graft on scions in the field. Compare growth with fibrous rooted stock produced in the nurseries.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Arrange tree-planting course for ATs and BEWs showing range of options (nursery stock, planting from seed, eyebrow terraces - if soils are suitable – planting from seed if soils are very coarse).</td>
</tr>
<tr>
<td>• Ensure each cooperator has a compactor and beater for forming the eyebrow terraces.</td>
</tr>
<tr>
<td>• Train farmers in composting and mulching methods. Emphasise problems of coarse- textured soils.</td>
</tr>
<tr>
<td>• Vegetable gardens: lay out napier grass contours/NVS using A-frame.</td>
</tr>
<tr>
<td>• Provide improved seeds/fertilisers etc</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Action by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAD, MSO</td>
</tr>
<tr>
<td>SAD, ATs, BEWs.</td>
</tr>
<tr>
<td>SAD, RM, AT, BEW. MSO.</td>
</tr>
</tbody>
</table>

Miscellaneous comments
• Gabi is being grown on ridges in the vegetable plots. This differs from the procedure outlined in the Dept of Agriculture pamphlet “How to increase Gabi Corm yield” by Jose B Pardales Jr, which shows planting gabi in the furrows.
• According to the pamphlet, “Kalpao is the only recommended variety for farmers”. When properly cultivated it yields as much as 30 tons/ha in the uplands.

The Technical Chief and MSO need to check whether this information is still valid and, if so, do upland farmers have access to stocks of the Kalpao variety of Gabi? If not, where can they obtain stocks?

Ken Proud, Upland Farming Systems/SWC Specialist
25 Sep 2004
TRAVEL REPORT

The Consultant made the following field visits accompanied by Ben-Hur Viloria, the SAD Coordinator:


Date of visit: 28 September, 2004.

This a proposed learning site identified by ICRAF. On 6th September the Consultant supervised the establishment of a modified design for developing terraces with grass strips acting as risers (see attached diagram). The farmer wants to diversify from corn and mangoes into vegetables and arable crops, as well as expand his fruit production to durians. A small amount of herbicide was sprayed to kill off cogon in an area to demonstrate planting durian from seed, followed by in-field grafting.

**Progress to date**

Three to four terraces have been ploughed following the design specifications for a 25% slope (see attached diagram), leaving 1.7 m wide grass strips between the strips.

- Eyebrow basins formed on a 45% slope now require durian seeds to be planted in them.
- On the cogon area: the herbicide killed off most of the cogon on the 3 m-diameter circles. Of interest, however, was the mulching effect of the cogon cut down a month before and laid in strips across the land. It had suppressed all cogon growth underneath it, though the cut areas had all regenerated to knee high grass. This suggests that cogon can be used against itself for reclaiming areas for tree crops – provided a sufficient depth of cuttings (i.e. piled 30 cm high) are laid in the 3 m diameter circles where the seeds will be placed. The mulch will suppress any further weed competition and conserve soil moisture. Soil testing is needed to see if the rotting cogon has affected soil acidity and rectification measures taken.

**Action needed**

- The BEW, Rommel, is to visit other areas to get Napier or other similar grass for the cross-slope barrier on the terraces.
- A source of pineapple slips to plant the back of the terrace needs identifying.
- Durian seeds will be planted in the eyebrow basins

2. **PPO 5. Gensan, Land Bank. Landan Peoples Multipurpose Cooperative.**

Date of visit: 29 September, 2004.

Co-Director Wiebe van Rij texted the Consultant that the Land Bank had received a request for a PhP 5 million credit fund for pineapple growing by the Landan Peoples Multipurpose Cooperative. According to Mr van Rij, the loan can only go through if DFS and STOP initiatives are adopted. He asked Ben-Hur and I to visit the area and confirm that this was being done, and to meet with Land Bank, Socsargen, to obtain details of the clients. We met with Mrs Susan Acosta, who directed us to the Landan
Peoples Multipurpose Cooperative. We were unable to visit the area as several days of rain had made the road to Maisong impassable. However, our discussions found that the farmers in Maisong did not want to grow pineapples but were wanting support for vegetable production, but had been told they had to join the Landan Peoples Multipurpose Cooperative before the Land Bank would consider their loan. Besides, the Protected Area Management Board (PAMB) would not allow pineapple production in the area. Ben-Hur’s report provides a full breakdown of the discussions.

3. **PPO 5. Tantangan, Poblacion, Tanquerido model farm.**

   Date of visit: 30 September, 2004

   The Consultant went to give a STOP refresher course to senior technical staff, but ended up discussing STOP with a group of farmers, ATs, BEWs, and SAD and RM staff. In addition to STOP, ways to offset negative impacts from too-widely spaced hedgerows were outlined and pointed out in the field.

   A comparison between income be derived from bananas compared to corn was discussed. One farmer added that he grows peanuts without any inputs and still gets a higher income than from growing hybrid corn with fertilisers. The BEW was directed to get this information in detail so it could be used to give other farmers the option to move away from corn.

   A 1.5 m-diameter eyebrow basin was made on a 35-45% slope and a seedling planted in it. This took 30 minutes - in line with the 13-16 a day estimated for the particular slope range. If seeds were to be planted, then over 80 eyebrow basins could be constructed on the same slope as they would only need to be 0.9 m diameter,

4. **PPO 3. Malungon, Banate, Kinabalan.**

   Date of visit: 1 October, 2004

   We met up with Alex Tabbada, the ICRAF coordinator, to see how the rehabilitation of first line farms was progressing. As recommended in STOP, emphasis is being given to encouraging the use of gently sloping land for annual crops, with tree crops dominating on the steep slopes.
DFS VERIFICATION REPORT

1. General overview

- Field visits were made by Ken Proud and Ben Hur Viloria, between 22 – 26 November 2004, in PPOs 3, 4 and 5 to verify that selected farms met DFS requirements.

- The farm maps showing the arrangement of land units and proposed SWC layout were used when available.

- At each farm the cooperator was asked to compare his income from growing corn with that from bananas on a comparable area. In all cases the farmers found that bananas will generate 2-6 times their current income from corn with less labour. The lesson was that the cash earned from bananas could be used to buy the household staples of corn, rice etc, and still leave money to spare for purchasing some inputs to boost yields still further.

- The benefits of allocating 2-3 days a month to planting and maintaining fruit trees as a pension plan for the future were explained to the farmers, who seem to find the concept attractive.

- The principles of the improved design for cross-slope barriers on steep slopes were explained to the Technical chiefs, SAD specialists, MSOs, ICRAF staff, ATs and BEWs. Whereas the terrace spacing stays the same for the particular slope, as outlined in the STOP table, the main difference is that a 2.0 m wide NVS is added immediately below the hedgerow (see attached Figure 1).

- A draft copy of A Guide to Rehabilitating and Managing Cross-slope Barriers, prepared by Ken proud, was given to field staff as an aid to correcting misaligned hedgerows, etc.

2. Main findings and recommendations

- As crops are currently in the ground on most of the farms, putting in SWC measures will have to wait until the crops have been harvested. This is likely to be in January or February 2004. The availability of planting material such as seeds for leguminous hedgerows, splits of Napier or Guinea grass, etc is a limiting factor.

- Some areas are experiencing drought conditions (El Niño?) so planting seedlings or seeds is not advisable until soil moisture conditions are suitable to guarantee successful establishment of the plants.

- Applying the improved design for cross-slope barriers will reinforce the SWC aspects for the land. Diversification of cropping is promoted by planting:
  - bananas and other fruit trees in the NVS;
  - a line of pineapples separating the NVS from the terrace;
erosion-inducing annual crops such as corn, root crops, peanuts etc, in the 2-4 m wide terrace behind the hedgerow where eroding soil has been intercepted, and where a level bench should develop over time.

- Intensification of cropping can be improved by ensuring the optimum spacings recommended for the crops are followed, and yield-increasing techniques applied.

- Use the cuttings of Napier grass or the leguminous hedges to mulch the trees, pineapples or crops in the cultivated strip, or else to feed goats or carabaos.

- Where the spacing between hedgerows exceeds the STOP specifications, the principles described above for the improved design for cross-slope barriers are applied but the NVS is expanded beyond 2.0 m to limit the width of the cultivated strip to that recommended in the STOP table.

- Most of the farmers visited expressed a wish to switch from corn to tree crops. (One of them said he wanted to use the land for his pension plan). The seeds of fruit trees such as mangoes and durians are currently in short supply in some areas. The following procedure should overcome the problems arising from local dry seasons and or where shortages of materials for putting in the Project’s SWC requirements occur:

  - Provide farmers with banana suckers or corms. At P2.00 per banana corm, the P3,000.00 allocated for inputs will provide enough material to convert 1.5 ha of corn to banana plantation, whereas 30 mango seedlings will only cover 0.3 to 0.45 ha, leaving land for growing corn.

  - Before being given the banana suckers or corms, each farmer must lay out the planting sites (at the appropriate spacing for the species) in a triangular layout on the sloping land. This will allow 15% more trees to occupy the site than with standard square planting layouts. On slopes above 45%, a 30 cm depth of mulch in a 3.0 m diameter ring should be applied on each planting site, to suppress weeds, protect the soil and improve soil moisture conditions. On slope below 45%, 90 cm diameter eyebrow basins need to be constructed and mulched. This will also deter ploughing.

  - When seeds of fruit trees become available, the farmers should be reminded of the benefits of planting these by direct seeding in the field\(^1\) and be trained in grafting on the scions of certified trees.

  - With this in mind, the ATs and BEWs should be given a refresher training course in grafting.

3. Specific observations


3.1.1 Upoh Learning Centre.

---

\(^1\) For example, a more vigorous rooting system, with a deep tap root, enables the tree to survive droughts and get nutrients from deeper in the soil. Directly seeded trees also live longer.
Some thought was given as to what farmers could learn from visiting the learning site. Bananas and other fruit trees have been planted between hedgerows on the 65% lower slopes – which is outside the limitations given in STOP, and on 45% upper slopes. Fruit trees had also been planted under dense shade, or very close to mature banana trees. Not very good lessons to pass on to farmers.

The history of the site was a good starting point:

Corn used to be grown on the site. Two harvests a year yielded a total of four tons of corn when fertiliser was applied, but only 800-900 kg/ha per harvest without fertiliser. The 4 tons/ha/year of corn translated into 4.0 kg per 10m², or an income of P28/10m².

On the other hand, one hill of banana, which occupies 10m², produces 13 kg of bananas a year, and sells at P11/kg when bagged, or P6/kg unbagged. Compared to corn, bananas give an income of 66-143 kg/10m². The labour for all the operations in producing each harvest of corn is also much higher than for bananas, further reducing the farmer’s profit. (If one person did all the work, s/he would walk 80 km during one cropping cycle for 1.0 ha of corn). The learning site should also emphasise the benefits of investing in bags for the bananas.

The site should also be used to explain the advantages of triangular spacing to increase the number of trees per unit area; to show eyebrow basins and mulching.

3.1.2 Malungon, Gamay

All the farmers were keen to replace their annual crops with fruit trees. As outlined in Section 2, above, the farmers should set up mulch mounds in triangular spacing for planting seeds of fruit trees, or for banana corms or suckers.

One farmer expressed a desire to have some hedgerows that would be visible from the road. Fortunately, he has some clumps of Vetiver grass so the BEW was given a handout on how to plant a Vetiver hedgerow, and these will be planted on the 25-45% slopes at the top of the hill where mungo beans are being grown.


3.2.1 Paghidait, Maibo

The main reason to visit this area was because of a request for an improved irrigation system. However, most of the farms are on very gently sloping land, with some that have been terraced since the early 1990s. SWC measures are mostly in place.

Arnulfo Arneta
One of the farms seen had hedgerows to widely spaced. However, it was ideally situated near the top of the hill to adopt the improved design of cross-slope barriers by adding a wide NVS strip below the hedgerow.

First, it was necessary for the farmer to understand that corn as a crop was a loser – both of soil and of income. The farmer explained that yields of corn had declined considerably since the 1980s. One of the reasons given for the decline was the soil had become acidic. Since no soil testing had been done, we asked him what made him
think the soils had turned acidic. The answer: the leaves of the corn were yellow. This is symptomatic of Nitrogen deficiency in the soil, not of acidity.

In the ensuing discussions it transpired that the farmer spent P13,500 in labour to produce corn worth P13,000. On hearing this, the farmer said they had a word to apply to that situation: Short! A simple comparison showed that bananas would give almost ten times the income.

It was decided that he should reduce the area under corn by restricting its cultivation to a 3.0 m strip behind the hedgerows, and leaving 2-3 m wide band below the hedgerow as an NVS, where bananas would be planted. He was also advised to try adding 3 kg of complete fertiliser (NPK) as a basal dressing and 3 kg of urea as a side dressing on a 30-35 m long strip of corn, and compare the yields with unfertilised strips of corn. Basically, an investment in 1 kg of fertiliser (about P13) should give 12-13 kg more corn (a return of P84-91).

*Ricky Morales*
Contractor to Rodrigo Arnota, owner of the land. Aim of owner is to plant mangoes.

Slope is 20-25%. Needs some Vetiver hedgerows.

Vegetables grown, especially egg-plant, which seems particularly productive, but periodic shortfalls in soil moisture cause crop losses.

*Other farmers*
The farmers have already diversified into vegetables, fruit trees, fish ponds and livestock. It is difficult to see how they can fulfil their requirements for UDP support for DFS – not that they need it.

**Recommendations**

While not strictly typical of the upland farming situation in most of the UDP area, the opportunity should not be lost to demonstrate the value of maintaining springs and streams to provide gravity-fed irrigation for high value vegetable crops.

- Provide supplementary irrigation to improve survival of the crop and boost incomes. Several farmers could benefit. Sprinkler irrigation would be most efficient way of providing the (suspected) limited amount of water available.

- Gravity-fed water supply makes sprinkler irrigation of vegetables feasible. Small sprinkler already present. However, irrigation engineer in Infra section needs to assess:
  - The field capacity of soil and efficiency of the available sprinklers;
  - calculate the irrigation period and irrigation interval for the particular mix of crops; and
  - determine the area that can be irrigated during the weeks without rain.

**3.2.2 Lampitak**

The area is inside what looks like the caldera of an extinct volcano. A soil profile shows a blackish silty A-horizon of up to 30 cm deep, overlying a coarse sandy B-horizon.
The farmer wanted to switch from growing corn on slope >60% to fruit trees - which he wanted to use as his pension plan. As stated above: he will be required to mulch the planting sites before receiving UDP inputs. The sites should be in a triangular layout. He is interested in planting bananas, as well as the seeds of fruit trees to be followed by field-grafting of scions. Training in grafting should be given.

Run-off from the steep slopes is damaging the fertile soils and crops in the gentle slopes (<10% slope) in the “valley” bottom. The farmers with these lands are advised:

- to dig a diversion ditch at the top of the field (at a 1% grade) to divert run-off into the nearby stable drainage channel; and

- to use A-frames to identify the contours and plant Vetiver or Napier grass strips at 10 m intervals along the length of the field. If these species are not available then they should mark out the contour lines and let 1.0 m wide NVS develop until they can get the planting material. The land is too valuable to be allowed to wash away.

3.3 PPO 3. (Date visited: 26 Nov 2004)

3.3.1 Malawit/Magsaysay

The first site shown, beside the road, in the settlement, resembled a football field with fruit trees already planted. Supporting this farm will give no discernable benefits to the environment, such as converting corn on slopes or cogon areas to fruit orchards, so it was rejected.

The second site was a 1.0 ha piece of land reportedly fallowed for eight years. The slope was 45-55%, soil depth >100 cm with a cover crop. Unfortunately, the land had been cleaned in anticipation of getting project benefits. It was explained that when trees are to be planted a good grass cover is required, except on the immediate planting site.

The problem is there has been a drought since July this year and the farmers do not expect any rain until June 2005. The corn on nearby fields has failed so farmers are wanting to switch to tree crops, preferably mangoes. Eyebrow basins should be prepared and mulched, but there is no point providing any planting material until soil moisture conditions are satisfactory. At the right time (July 2005?) seeds should be distributed for field planting, because their seedlings are more resistant to drought than nursery-produced seedlings.

3.3.2 Upper Bala/Magsaysay

Due to the onset of a rainstorm we only visited one farm. This was an area of 2-3 ha surrounded by forest. The farmer had put in hedgerows before the STOP guidelines were produced. At 6m spacing on a 45% slope with clay soils, they are too far apart to be effective. Two options were offered:

- He could add another cross-slope barrier between each pair of hedgerows; or

- Leave the upper 3 m as an NVS and plant bananas and other fruit trees there, and restrict his annual cropping to a 3-m wide strip.
The farmer had also formed raised bed terraces for vegetables. He buys rice to eat (50 kg/month at P22/kg = P1,110). In discussions it transpired that one hill of banana generates P110/yr. Consequently, with one row of 10 banana trees planted in the NVS providing him the income to buy his month’s supply of rice, he would need 12 rows to meet his year’s requirements. He has 26 rows so he would produce a surplus. Combined with income from other fruit trees and vegetables his prospects look good.

*Problems*

This area is at the end of a poorly maintained old logging road, in a catchment dominated by slopes >70%. The questions that need answers are:

- What are the criteria for forest lands to be declared public land?
- Does the area meet the criteria to be considered as public land?
- Is there a legal document approving the change of status? and;
- Does the DENR agree that it is in the public interest for agriculture to be allowed in this area?

It seems to go against the principles of UDP to be encouraging cultivation in a well-forested area. The dilemma is that, on the one hand, by showing how to make the land more productive UDP risks encouraging more people to move in, resulting in further deforestation. On the other hand, however, by not taking action, the resident farmers may end up expanding their areas to offset declining yields.

The Co-Directors to advise on follow up action, please!
30 November to 2nd December 2004 DFS VERIFICATION REPORT PPO 4

1. General overview

- Field visits were made by Ken Proud, Warlito “Bubut” Bornea (PPO 4 SAD Specialist) and Bong between 30 November to 2nd December 2004, in PPO 4 to check whether selected farms could meet DFS requirements.

- The farm maps produced by the ATs or BEWs, showing the arrangement of land units and proposed SWC layout, were referred to, and slope measurements taken with plastic Slope Indicators checked with a hand held Suunto clinometer.

- Farmers were asked to compare the income from growing corn with that from bananas on a comparable area. In all cases bananas had the potential to generate 2-6 times the income from corn with less labour. Using the cash earned from bananas to buy the household needs for corn or rice etc, leaves money to spare for purchasing some inputs to boost yields still further.

- The benefits of allocating 2-3 days a month to planting and maintaining fruit trees as a pension plan for the future were explained to the farmers, who are finding the concept attractive. The availability of cheap grafting knives may be a limiting factor. They currently sell at about P150 each.

- To promote DFS, farmers were encouraged to calculate the potential month’s income from small plots of land. For example, 13 to 20 pineapples grown on the area occupied by 1 hill of banana (10 m²) earns P195-300. while 4 mango trees (900 m²) would give a months’s income of P 4,800 after 8 years (50 trees would give a year’s income). Diversification of the crops would help iron out fluctuations in prices or crop failures.

2. Main findings and recommendations

- As mentioned in the 22-26 Nov report, crops are currently in the ground on most of the farms, so putting in SWC measures will have to wait until the crops have been harvested. This is likely to be in January or February 2004, or as late as May or June depending on how long the forecasted El Niño lasts. Planting seedlings or seeds is not advisable until soil moisture conditions are suitable to guarantee successful establishment of the plants.

- Similarly, the availability of planting material such as seeds for leguminous hedgerows, splits of Napier or Guinea grass (Setaria), etc is a limiting factor. Discussions with the TOUs and MSOs concluded that bulking up could be done at municipal nurseries, community nurseries, and even around the community water supply outlets where watering of the stocks can be done. Basic supplies of Napier and Vetiver can be sourced from Bukidnon, while Setaria is available in Rio del Pilar.

The following recommendations are the same for the 22-26 Nov report:

- Applying the improved design for cross-slope barriers will reinforce the SWC aspects for the land. Diversification of cropping is promoted by planting:
  - bananas and other fruit trees in the NVS;
− a line of pineapples separating the NVS from the terrace;
− erosion-inducing annual crops such as corn, root crops, peanuts etc, in the 2–4 m wide terrace behind the hedgerow where eroding soil has been intercepted, and where a level bench should develop over time.

- Intensification of cropping can be improved by ensuring the optimum spacings recommended for the crops are followed, and yield-increasing techniques applied.

- Use the cuttings of Napier grass, *Setaria* etc. or the leguminous hedges to mulch the trees, pineapples or crops in the cultivated strip, or else to feed goats or carabaos.

- Where the spacing between hedgerows exceeds the STOP specifications, the principles described above for the improved design for cross-slope barriers are applied but the NVS is expanded beyond 2.0 m to limit the width of the cultivated strip to that recommended in the STOP table.

- Most of the farmers visited expressed a wish to switch from corn to tree crops. (In Brgy Rio del Pilar, the Brgy Captain has introduced an ordinance requiring every farmer to plant one banana tree a day). The seeds of fruit trees such as mangoes and durians are currently in short supply in some areas. The following procedure should overcome the problems arising from local dry seasons and or where shortages of materials for putting in the Project’s SWC requirements occur:

  - Provide farmers with banana suckers or corms. At P2.00 per banana corm, the P3,000.00 allocated for inputs will provide enough material to convert 1.5 ha of corn to banana plantation, whereas 30 mango seedlings at 15 x 15 m spacing will only cover 0.6 to 0.7 ha and there will be at least a 5 year wait to get the first harvest (compared with 18 months for bananas).

  - Before being given the banana suckers or corms, each farmer must lay out the planting sites (at the appropriate spacing for the species) in a triangular layout on the sloping land. This will allow 15% more trees to occupy the site than with standard square planting layouts. On slopes above 45%, a 30 cm depth of mulch in a 3.0 m diameter ring should be applied on each planting site, to suppress weeds, protect the soil and improve soil moisture conditions. On slope below 45%, 90 cm diameter eyebrow basins need to be constructed and mulched. This will also deter ploughing and planting corn.

  - When seeds of fruit trees become available, the farmers should be reminded of the benefits of planting these by direct seeding in the field and be trained in grafting on the scions of certified trees.

1 For example, a more vigorous rooting system, with a deep tap root, enables the tree to survive droughts and get nutrients from deeper in the soil. Directly seeded trees also live longer.
3. Specific observations

3.1 PPO 4. (Dates visited: 30 Nov to 2 Dec 2004).

3.1.1 Abgang Bato, Sepatubo. 30 Nov 2004

**Cooperator: Rodito Francisco**

The farm has three land units: one is 10% slope covering 0.25 ha. Advised to plant contour hedgerows at 10 m spacing, and grow improved variety of corn with fertiliser to meet family needs. Hedgerows will ensure he ploughs across the slope and not up and down as he does at present.

The other land units are on sloping land, and he wants to plant mangos. A mixture of bananas and mangos is recommended to provide income in the medium term (18 months from now). He should improve and increase the size of his pineapple patch (better spacing, weeding, mulching etc) to diversify his sources of income.

Impending drought means distribution of planting material will be delayed but he can prepare planting sites by mulching them.

**Miscellaneous**

Nearby UDP-installed water supply point not working as intake is broken. We reported this to the PPO engineer.

3.1.2 Abgang Bato, Sepatubo. 30 Nov 2004

**Cooperator: Joly Nadela**

Has hedgerows of *Flemingia* but needs to add two more rows on upslope side to crest of hill. Must stop growing corn on very steep convex slope (>55%) with gullying.

Same problem: needs to harvest corn before he can prepare planting sites.

3.1.3 Brgy Rio del Pilar. Sitio Centro. 1 Dec 2004

Discussion held with Brgy Captain who has issued an ordinance requiring every farmer in the area to plant one banana sucker each day. Discussed the merits of bananas and other fruit trees versus corn. They seemed surprised (and amused) to realise the distance person walked by a person during the operations for a single crop of corn (80 km).

Discussed importance of mulching, and that corn stalks should be left to cover the field. He was sorry, but they used to burn all the trash afterwards.

**Cooperator: Pablito Tak-an**

Guinea grass strips but at 6 m spacing. 50 cm high build up of soil. Growing corn and bananas but wants to convert to tree crops. Sandy loam soil is only 30 cm deep and corn failed – probably because soil only able to store moisture for 3 days $E_T$. Last rain was 5-6 days earlier.
Recommend that he leaves a 3-m wide NVS below the grass strips and plants bananas there – if only to verify there is enough soil depth to support growth. The cultivable strip behind the Guinea grass strip should be heavily mulched and zero tillage practiced to prevent further soil movement.

**Cooperator: Carlos Gallinato**

This is another farmer willing to switch from corn to fruit trees. Farm has crest with steep side slopes planted with peanut.

Recommend that crest (15% slope) be protected with leguminous hedgerow at 3 m spacing (no NVS needed as back up) so land is protected for growing annual crops in future.

The side slopes need another hedgerow with NVS between the 8-m wide spaced hedgerows. This will give two terraces comprising a 2 m wide terrace, 2-m wide NVS and 0.5 m wide hedgerow.

The mid-slope to be converted to tree crops in mulched planting sites.

**Cooperator: Rodrigo Zurita (BEW)**

Also wants to replace corn with trees. Has good grass strips of *Setaria*/Guinea grass formed four months after planting (see Photo 1), but needs to double the lines to form effective barriers. He is also cutting it correctly – leaving about 20 cm of stem with enough chlorophyll to photosynthesise and produce more material quickly.

Same recommendation as for other farmers. Maintain good cross-slope barriers to protect land at top of hill for future annual crops, and plant trees on steeper lower slopes.

He has a grafting knife so can show his neighbours how to graft scions onto directly seeded seedlings.

Rodrigo claims he gets 50 coconuts per tree on each of the four harvests. With 3 nuts = 1.0 kg copra (P17.5 / kg), coconuts provide a good income. But need under-planting to form multi-storey effect to protect soil.

**3.1.4 Brgy Rio del Pilar. Sitio Wa’ay. 1 Dec 2004**

**Cooperator: Pepito Sardido**

Planted hedgerows of cassava and sugar cane without using A-frame – so they were badly aligned. However, these attracted rats so he ripped out the hedgerows leaving the lines of accumulated soil – now adding to the erosion hazard on his farm.

He considers bananas a good crop – even though he only gets 9 kg/hill. Also grows ginger in untilled soil, claiming to get 50 kg/10m² which is exceptional as 20-30 kg/10m² is considered high. Sells ginger at P15/kg

Farmer wants to move from corn to bananas and fruit trees. Already has some coconuts established.
Advised to plant bananas in triangular layout with ginger in between. Ginger plants should be mulched with coconut fronds to maintain soil moisture.

3.1.5 Malungon. Brgy San Juan. Sitio Proper. 2 Dec 2004

Cooperator: Milani Labnawan

House and land in a 100 m wide valley, but cleared and grows corn on 60-70% slopes – planting up and down slope. Hedgerows were put in without an A-frame and were widely spaced. Mass movement of soil is visible.

We estimate the hill is climbed 400 times each cropping cycle. His family admit their life seems to be involved in growing corn non-stop – which is exhausting and soul-destroying. Our comments on the potential of banana and fruit trees to generate higher incomes, giving them time for other activities, were viewed optimistically. Owns a maize sheller.

Claims to get 6,000 kg shelled corn per harvest, three times a year (using improved seeds and six sacks of fertiliser). His income after deducting cost of fertiliser is equivalent to P114/10m². By his own account he claims to harvest 25 kg bananas per hill three times a year (i.e. 75 kg/hill) which he sells at P5 per kg giving P225/10m².

He was advised to:
- Restrict his cultivation on the hills to the narrow 35% ridge and crest, where contour hedgerows or grass strips should be planted at 3m spacing and peanuts or ginger grown.
- Plant a mix of bananas and fruit trees with coconuts (triangular layout, mulched etc).
- Use the valley bottom land to grow his family’s household needs for corn (50 kg/month), which should only occupy less than 0.1 ha per season given the yields stated above. They said that the corn didn’t store well after three months so producing 600 kg of corn in one crop and storing it for a year is not practical.
- Construct some raised beds in the valley and grow vegetables. Supplementary water is available from the nearby stream.
## ANNEX 3.1

### COMPARING INPUTS AND OUTPUTS OF CORN AND BANANAS

<table>
<thead>
<tr>
<th>DETAILS</th>
<th>CORN</th>
<th>Calculation</th>
<th>BANANAS</th>
<th>DIFFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield (kg/ha or hill)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harvests/yr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total yield (kg/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yield/10 m²/yr (kg/ha)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sale price/kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incomes/10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operations/cropping cycle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spacing between rows (m)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metres walked/operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total distance/ cycle (km)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total distance per year</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Man-days work per cycle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per man-day (Pesos)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total labour costs/10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sacks of fertilizer/ha</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per sack</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cost of fertilizer/ yr</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost of fertilizer/ 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL RETURNS/ 10 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Calculation formulas:**

- Yield (kg/ha or hill)
- Harvests/yr
- Total yield (kg/ha)
- Yield/10 m²/yr (kg/ha)
- Sale price/kg
- Incomes/10 m²
- Operations/cropping cycle
- Spacing between rows (m)
- Metres walked/operation
- Total distance/ cycle (km)
- Total distance per year
- Man-days work per cycle
- Cost per man-day (Pesos)
- Total labour costs/10 m²
- Sacks of fertilizer/ha
- Cost per sack
- Total cost of fertilizer/ yr
- Cost of fertilizer/ 10 m²
- TOTAL RETURNS/ 10 m²

**Formulas:**

- \(a \times b\)
- \(c/1000\)
- \(d \times e\)
- \((100/i) \times 100\)
- \(h \times i/1000\)
- \(b \times k\)
- \(b \times m \times n/1000\)
- \(b \times p \times q\)
- \(b \times p \times q/1000\)
- \(f – (o + s)\)
ANNEX 4 (a)

STOP

(SLOPE TREATMENT-ORIENTED PRACTICES)

Annex 4.1 STOP 1. Land Unit Farming

Annex 4.2 STOP 2. Multi-Storey Cropping

Annex 4.3 STOP 3. Zero-tillage and Mulching for Crop Production on Shallow Soils

Annex 4.4 An Improved Design for Cross-slope Barriers
ANNEX 4.1

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 CROSS-SLOPE BARRIERS REDUCE SLOPE GRADIENTS BY PROMOTING TERRACE FORMATION. RESERVE STEEPER AREAS FOR PLANTING TREE CROPS FROM SEED.

1. Objectives
The purpose of STOP 1 is to provide site-specific recommendations on the maximum intensity of land-use permitted and the type and spacing of soil and water conservation measures for a given piece of land, based on its slope, soil texture and soil depth (Table 1).

2. Land Units
A strip of land with the same slope range is termed a land unit. It can be expected to have the same soils, and hence problems and potentials for agriculture, as a similar area of land elsewhere in the landscape.

Land units are areas of land that are recognizable from their position in the landscape (e.g. a plateau, a hill crest, ridge, upper slope, mid-slope, spur, minor valley, etc). However, when the underlying geology changes, the width and length, slopes, soils and dissection of land units will also change. The boundaries of a land unit occur when there is a distinct break in slope (e.g. as between an upper slope and the crest of a hill, or a minor valley).

3. Land unit mapping
Land unit mapping involves:

- Sketching a map (plan or overhead view) showing the whole farm boundary.
- Drawing on the map the different land units crests, ridges, upper slope, side slope, minor valleys, basing boundaries on easily visible, major breaks in slope; and a second map showing the type and position of proposed soil conservation measures.
- Recording the slope*, soil depth and soil texture*, the approximate area and the current land use of each land unit.
- Filling in a land unit prescription form for every land unit specifying the proposed land use and the soil conservation measures for the particular land unit.

4. Land unit farming
Land unit farming is the development of crops on a series of land units usually, but not necessarily, from the top of a hill to the valley depending on their land qualities for agricultural crops (Table 2) and their susceptibility to erosion.

STOP 1 restricts the cultivation of short-term crops to hilltops, crests, ridges, upper slopes and minor valleys, where terracing can reduce slope gradients. Cross-slope barriers consist of a hedgerow or strips of Vetiver or Napier grass, planted accurately on the contour using an A-frame, with a NVS immediately below, planted with banana trees (see Section 6).

* Using a laminated acetate slope indicator (Report of the Third Tree Crop Mission by KRS Proud Annexes 4.1.1, 4.1.2 & 4.1.3 16 July to 16 Oct 2003. UDP)
* Using a guide to determining soil texture in the field (ibid. Annex 4.1.4)
Provided there is a minimum soil depth of 100 cm, the spacing between the SWC measures (see Table 1) ensures that a minimum soil depth of 50 cm will remain for growing crops at the back of the terrace when level bench terraces have developed. Crops that can be productive with less water and therefore suitable for planting in the shallower 30-60 cm deep soil at the back of the terrace include the leguminous mungo, and the relatively drought-tolerant pineapple.

Because the prescriptions for a given land unit can be extrapolated to similar land units occurring in the same landscape, which may cover several square kilometres, land unit farming can be considered to be a replicable model for upland development.

5. Strategy for slopes too steep or too long for cross-slope barriers to be effective

A mixture of fruit trees should replace annual crops on slopes too steep or too long for cross-slope barriers. This is best done by direct seeding, followed by the field-grafting of scions when the young trees have pencil-thin stems (see STOP 2: Multi-storey Cropping). Fruit trees grown from seeds planted in the field develop stronger root systems and live longer.

Figure 1 illustrates how the landscape might look after land unit farming has been adopted.

---

Fig. 1  An impression of a landscape formed after land unit farming

Terraces, for growing annual crops, have formed on the less steep hillcrest and upper slopes because of soil interception by cross-slope barriers. Trees, in a triangular spacing, are growing on the steeper mid- and lower slopes from seeds directly planted into well-mulched planting site. Vegetables are grown on raised beds in the more fertile alluvial soils in the minor valleys.
6. Improved design of cross-slope barriers

Figure 2 shows an improved design for cross-slope barriers on steep slopes when applying STOP on undeveloped land. It incorporates a 2 m wide NVS immediately below the hedgerow, which will dissipate the energy of run-off dropping from the terrace above so it doesn’t undermine the terrace. The spacings given in STOP apply only to the width of the cultivable strip. The cross-slope barrier now includes both the leguminous hedgerow or Napier/Vetiver grass strip and the NVS. Bananas or pigeon peas planted in the NVS and pineapples at the back of the terrace, to prevent ploughing into the NVS, diversify the farming system if there is only a small area of land available to the farmer.

**Fig. 2 An improved design for cross-slope barriers on steep slopes**

<table>
<thead>
<tr>
<th>Slope</th>
<th>Terrace width</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-25%</td>
<td>4.0 m</td>
</tr>
<tr>
<td>26-35%</td>
<td>3.0 m</td>
</tr>
<tr>
<td>36-45%</td>
<td>2.0 m</td>
</tr>
</tbody>
</table>

**Objectives of the new design for cross-slope barriers:**

The new design aims to produce terraces on steep slopes by using soil movement from erosion and contour ploughing over 3-4 years. The function of the NVS is:

- to reduce the riser height of the terrace and minimise the risk of terraces collapsing by absorbing the impact of run-off passing through the barrier.
- to act as an alternative to planting additional contour hedgerows when the original hedgerows are too widely spaced. Mark out the width of the cultivable strip appropriate to the slope steepness and extend the width of the NVS beyond 2-m.
Table 1. SLOPE TREATMENT-ORIENTED PRACTICES FOR STEEP LANDS (STOP) MODIFIED 16 Dec 2004

OBJECTIVE: To produce a series of outward sloping bench terraces with a minimum soil depth of 50 cm at the back of the terrace.

<table>
<thead>
<tr>
<th>Max. slope (%)</th>
<th>Min. soil depth (cm)</th>
<th>Sandy – Loam soils</th>
<th>Maximum intensity of land-use between NVS/ hedgerows</th>
<th>Clay loam– Clay soils</th>
<th>Maximum intensity of land-use between NVS/ hedgerows</th>
</tr>
</thead>
<tbody>
<tr>
<td>12%</td>
<td>50 cm</td>
<td>Contour cultivation</td>
<td>Any. Fallow with forage peanut.</td>
<td>Contour cultivation.</td>
<td>Any. Fallow with forage peanut.</td>
</tr>
<tr>
<td>25%</td>
<td>100 cm*</td>
<td>Contour hedgerows or strips of Vetiver or Napier grass with 2-m wide NVS and 3-m wide cultivable strip² Contour cultivation³.</td>
<td>Relay planting with rice/maize-root crops-beans-peanuts to suppress weeds.</td>
<td>Contour hedgerows or strips of Vetiver or Napier grass with 2-m wide NVS and 3-4.5 m wide cultivable strip² Contour ploughing to form terraces³.</td>
<td>Rotations of corn, root crops and legumes. Relay planting of rice or corn-root crops-beans-peanuts to suppress weeds.</td>
</tr>
<tr>
<td>35%</td>
<td>100 cm</td>
<td>No hedgerows. Vetiver or Napier grass strips with 2-m wide NVS, and 2.5 m wide cultivable strip². Zero tillage. Heavy mulching.</td>
<td>Gradually replace maize and root crops with fruit trees planted among close cover crops and semi-perennials.</td>
<td>Vetiver or Napier grass strips with 2-m wide NVS and 3-3.5 m wide cultivable strip² Contour ploughing to form terraces³ Contour ploughing to form terraces³. Heavy mulching</td>
<td>Rotations of corn and legumes. Relay planting of rice or corn-beans-peanuts to suppress weeds.</td>
</tr>
<tr>
<td>45%</td>
<td>100 cm</td>
<td>No hedgerows. Vetiver or Napier grass strips with 2-m wide NVS. And 2-m wide cultivable strip². Zero tillage. Heavy mulching.</td>
<td>Replace maize and root crops with agroforestry model of semi-perennials and fruit trees. No cultivation of beans and peanuts after 3 years.</td>
<td>Vetiver or Napier grass strips with 2-m wide NVS and 3 m wide cultivable strip² Contour ploughing to form terraces³.</td>
<td>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.</td>
</tr>
<tr>
<td>55%</td>
<td>100 cm</td>
<td>No hedgerows. Grass cover. Direct seeding and mulching around young trees</td>
<td>No cultivation Tree crops and grass cover</td>
<td>Vetiver or Napier grass strips with 2-m wide NVS and 2 m wide cultivable strip² Contour ploughing to form terraces³ Heavy mulching</td>
<td>Agroforestry model of semi-perennials and fruit trees.</td>
</tr>
<tr>
<td>65%</td>
<td>50 cm</td>
<td>Grass cover. Direct seeding and mulching of trees</td>
<td>No cultivation. Tree crops and grass only</td>
<td>Grass cover. Direct seeding and heavy mulching of trees</td>
<td>No cultivation Tree crops and grass cover only.</td>
</tr>
<tr>
<td>&gt;65%</td>
<td>-</td>
<td>None suitable.</td>
<td>No cultivation. Forest trees and grass only</td>
<td>None suitable</td>
<td>No cultivation. Forest trees and grass only</td>
</tr>
</tbody>
</table>

* A slope with 100 cm depth of soil will give a terrace with 50 cm depth of soil below the NVS at the spacing indicated.

² The indicated cultivated strip width is the maximum permissible for 100 cm depth of soil, if 50 cm soil is to remain at the back of the terrace

³Advisable to follow contour ploughing on slopes above 12% with a harrowing to obliterate furrows which, if not exactly on the contour, channel run-off to low points causing gullies.
Table 2. Land qualities necessary for farm production systems

**ROOT CROPS**

<table>
<thead>
<tr>
<th>Soils:</th>
<th>Loose, deep free-draining soils, well-structured and free from compaction. Preferably loamy soils, with little stoniness. Shallow soils to be avoided.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slopes:</td>
<td>Flat to gentle slopes (12%) or on terraces on steeper slopes.</td>
</tr>
<tr>
<td>Drainage:</td>
<td>Well-drained soils important.</td>
</tr>
<tr>
<td>Others:</td>
<td>Animal manure or mineral fertilisers are necessary to maintain fertility.</td>
</tr>
</tbody>
</table>

**VEGETABLES**

<table>
<thead>
<tr>
<th>Soils:</th>
<th>Light workable soils, preferably alluvial or volcanic, which retain fertility and structure.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slopes:</td>
<td>Flat to gentle slopes (0-12%); low risk of erosion.</td>
</tr>
<tr>
<td>Drainage:</td>
<td>Good drainage. Proximity to water supplies would be an advantage.</td>
</tr>
<tr>
<td>Others:</td>
<td>Good shelter. Access to markets.</td>
</tr>
</tbody>
</table>

**SEMI-PERENNIALS e.g. pineapples, bananas**

<table>
<thead>
<tr>
<th>Soils:</th>
<th>Pineapples can be grown on a wide range of soils. Prefer sandy loams with pH 5-6.5. Bananas grow on a wide range of soils. The best soils are fertile of volcanic or alluvial origin. Low pH favours spread of Panama disease in Gros Michel bananas.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slopes:</td>
<td>High erosion results if pineapples are grown without mulching on steep slopes. Bananas should be hilled up on steep slopes, and planted on the contour with adequate soil conservation measures.</td>
</tr>
<tr>
<td>Others:</td>
<td>High calcium and manganese content in soil results in chlorosis in pineapples. High sodium chloride content is deleterious for bananas, but they respond well to added N and have a high K requirement.</td>
</tr>
</tbody>
</table>

**FRUIT TREES**

<table>
<thead>
<tr>
<th>Soils:</th>
<th>Wide range of soils acceptable but less suitable on shallow sandy soils due to risk of drought. Avoid waterlogged soils.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slopes:</td>
<td>Flat to steep slopes (up to 58%) depending on size of mature tree.</td>
</tr>
<tr>
<td>Drainage:</td>
<td>Good to moderate, or moderate to imperfect.</td>
</tr>
<tr>
<td>Others:</td>
<td>Good grass cover with little encroachment of cogon (Imperata cylindrica). Supplementary water advisable if high value fruits are to be grown.</td>
</tr>
</tbody>
</table>
STOP 2
MULTI-STOREY 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

1. Importance of a vegetative cover in dissipating the erosive energy of rainfall

Vegetation intercepts and dissipates the kinetic energy of raindrops before they reach the soil, and prevents the detachment of soil particles. The main function of cover crops such as *Pueraria*, *Calopogonium* and *Centrosema* is to protect the soil from the impact of raindrops falling from the canopy - particularly tall trees when drops may approach their terminal velocity. A disadvantage is that the shade produced by the established tree crop may cause the cover crop to die out, preventing a satisfactory ground cover from developing.

The height of the canopy is important. Water drops falling from seven metres attain 90% of their terminal velocity, while small raindrops intercepted by the canopy may coalesce to form larger drops that are more erosive. Soil loss rates of 360 tons/ha/yr (a reduction in soil depth of 2.5-3.0 cm/yr) have been recorded under industrial tree plantations such as coconuts, compared with 6 tons/ha/yr from undisturbed tropical rain forest.

The much lower rate of soil erosion under tropical rain forest, even on steep slopes, is due to its multi-storey canopy (see Figure 1) and heavy mass of feeder roots immediately under a thick layer of litter on the forest floor. These combine to protect the soil from the direct impact of falling rain and increase its porosity. By enhancing infiltration of rainfall into the soil, the amount of run-off is reduced, and stream flows are maintained through the year.

2. Lesson learned

A UDP study found that slopes of 75-80%, protected by a mixed tree cover of coconuts, bananas, fruit trees and ipil-ipil, had soil depths of over 80 cm. Less than 50 m away years of cultivating corn on slopes of 50% had reduced soil depths to 20-50 cm.

The closer the soil cover resembles the upper canopy and protective undergrowth or leaf mulch of the natural forest, the lower the rates of soil erosion.

3. Multi-storey cropping

For a highly productive, sustainable, permanent upland cultivation to succeed in the humid tropics soil erosion must be kept to a minimum. This is best achieved by imitating the
tropical rainforest that originally covered the soils. Multi-storey cropping, in which a mixture of trees and shrubs are planted together, is a good solution (see Figure 2).

While the canopy of natural forests is most effective at reducing erosion, a dense growth of grass under tree crops may be almost as efficient. However, for adequate erosion protection at least 70% of the ground surface must be covered. Unless the trees are widely spaced, the shade of an established plantation tends to kill off most of the grass under the trees.

Figure 2. Profile of a slope planted with trees to produce a multi-storey effect

4. Planting sequences

Slopes unsuitable for arable crops should be given over to tree crops, preferably planted in rows running east-west to avoid shading and to maximize the utilization of solar radiation. Different types of tree are planted in sequence. For example:

<table>
<thead>
<tr>
<th>Stage</th>
<th>Plants to be planted</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Banana, citrus, ginger</td>
<td>Rows oriented E-W.</td>
</tr>
<tr>
<td>2</td>
<td>Coconut, mango or durian, lansones</td>
<td>Rows oriented E-W between the 1st stage trees</td>
</tr>
<tr>
<td>3</td>
<td>Coffee, cacao, jackfruit, medicinal plants</td>
<td>Plant in the shade produced by the 2nd stage trees</td>
</tr>
</tbody>
</table>

With established coconut plantations start the sequence by planting with bananas, citrus, coffee and ginger to get short-term and medium-term income.

5. Mulching

Because cleared land doesn’t have the layer of dead leaves found on the floor of the original forest, the planting sites of the seeds or seedlings should consist of a 3-meter diameter circle heavily mulched to a depth of 30 cm (e.g. using cogon). A layer of 2-3 coconut fronds should be used to mulch ginger.

The mulch will help retain soil moisture during dry spells, improve soil porosity, and help support soil micro-organisms. Eventually, the leaf litter from bananas and coffee will provide the mulch to protect the soil.

6. Maintaining soil fertility

Under natural conditions the tropical rain forest is a closed system, with the small amounts of nutrients leaving the forest balanced by the few inputs from outside. Between 12-30 tons of organic matter per hectare are recycled per year. On the other hand, harvesting fruits, removes substantial amounts of nutrients. Farmers should expect to supply fruit trees that have been planted in soils depleted of nutrients by crops of corn and cassava, with N, P and K, and some micronutrients. This can be in the form of composts or manures and/or inorganic fertilizers.
STOP 3

MULCHING AND ZERO-TILLAGE

PRINCIPLE

Emulating the original forest floor by covering the soil with a thick layer of mulch 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.

1. How it works

The following layers of compost in various stages of development can be found covering the natural forest floor: freshly fallen leaf litter, barely decomposed leaf litter, partially mature compost, mature compost, then the soil. A root mat can be seen drawing nutrients from the compost layers. With minimal removal of forest products such an essentially closed nutrient recycling system has successfully supported the high biomass and biodiversity of the tropical rainforest for hundreds of thousands of years.

However, when leaves, fruits, shoots, and roots are continuously harvested, the nutrients removed from the soil must be continuously replaced from outside sources. This is especially important to maintain a sustainable agriculture system.

2. The Problems

The expansion of impoverished smallholder farming producing unfertilised arable crops on depleted soils in the tropical uplands destroys forests and wildlife and causes serious erosion. For example, in Vietnam the continuous cultivation of hill rice and cassava has resulted in one million hectares of eroded skeleton soils with no value for agriculture or forestry. If this happens in the Philippines there will be a mass exodus from extensive areas of the uplands. The treeless landscapes and shallow soils will exacerbate the risk of flooding in the lowlands.

The continuous cultivation of corn and cassava on sloping lands in the UDP areas is resulting in soil depth reductions of 2-4 cm per year. In some areas soil depths have been reduced from depths of over 85 cm to less than 25 cm. Because shallow soils are unable to store sufficient soil moisture to support plant growth during the dry season, crop failures will become more frequent and the land may be unable to support tree crops. Efforts must be intensified to increase the awareness of the problems facing the uplands and effect a change to tree crops as soon as practical.

3. A solution. STOP 3 – Mulching and Zero-tillage (ZT)

STOP 3 is an attempt to address the problem of how to grow short-term crops when there is less than 100 cm depth of soil needed for terracing under STOP 1. The objective is to maintain the present soil depth by preventing any further movement of soil down slope. As with STOP 1, growing short-term crops will have to be restricted to gently sloping hilltops and ridges and minor valleys. Drought-tolerant Vetiver grass should be planted as cross-slope barriers to keep soil in place, as other hedgerow species are likely to die off.

Most tree crops will not survive on shallow soils. Short-season crops such as monggo (mung beans), or drought-tolerant crops such as pineapples and sorghum, will make more efficient use of the limited amount of moisture stored in shallow soils. ZT (see 2.2 below) must be adopted

---

1 Depending on soil type and vegetation between 8-25 t/ha need recycling annually to sustain the undisturbed forest

Prepared for the Upland Development Programme by: K R S Proud, Upland Farming / Soil & Water Conservation Specialist. Feb 2005
to minimise exposure of the soil to the erosive impact of raindrops. Heavy mulching will be needed to prevent any further reduction in soil depths and to conserve soil moisture. Tree crops with tap roots will have to be planted from seed, as their tap roots can penetrate cracks in the ‘hardpan’ and access deeply stored moisture.

3.1 Mulching

*Mulching* is the covering of the soil to simulate the effect of the leaf litter-covered forest floor. Suitable materials include crop residues (e.g. corn stalks, rice straw or rice hulls, coconut fronds, sawdust or wood shavings). If cogon or other grasses are used, they should be cut before they set seeds to avoid creating a weed problem. To be effective a mulch should cover at least 70-75% of the soil surface.

Mulching improves the soil’s ability to absorb rainfall and slows down the drying out of the soil during the dry season. This can be particularly important when planting the durian. Durians do not have root hairs. The roots that absorb water and nutrients are fungus roots which grow out from the secondary or tertiary roots, and which grow only within about 50 cm of the soil surface. Without a deep layer of mulch to keep the soil moist, the fungus roots die off affecting the growth and productivity of the tree.

Mulching also protects the soil against erosion; prevents soil temperatures from getting too high; and suppresses weed growth. Crop residues used as mulch increase or retain the level of organic matter in the soil, stimulate soil organisms, and make the use of chemical fertilizers, such as phosphates, more effective if they are applied on top of a layer of mulch, than if they are applied on bare soil. However, as organic mulches decompose they compete with the main crop for nitrogen. Pests such as termites and snails, which harm the crops, may be attracted.

3.2 Zero-tillage (ZT)

As its name implies, ZT (also termed minimum tillage, no-till, etc.) is a system of crop production where the soil is not ploughed or loosened with hand tools. Instead of tillage, the seed is planted directly into the soil. The main features of ZT are:

- Spraying with herbicide 3-5 days before planting to replace hand-weeding, or ploughing and harrowing as the way to control weeds (this saves time and money).
- Planting seeds in holes made by hand using sticks to make the opening (dibbling).
- Using fertilisers and crops that produce a large amount of residues, otherwise mulching materials have to be obtained from outside the farm.
- Establishing a continuous cover of crops by intercropping techniques.
- Retaining the crop residues as a mulch to reduce evaporation and limit weed growth.
- Applying pesticides to control insect pests that spend part of their life cycle in the soil.

4. Principles of STOP 3: Mulching and Zero Tillage

In summary, the principles of STOP 3 are:

a) *Boost organic matter production*

In the first year it may be necessary to plant crops such as HYV corn, which produce large amounts of residues, to generate sufficient mulching material. Plenty of inorganic fertilizer, particularly N, will be needed to boost the production of corn stalks, especially on shallow soils to offset the nutrients lost through harvesting.

---

4 Special planting equipment is usually required. Most commonly the seeders need wheel tractors Prepared for the Upland Development Programme by: K R S Proud, Upland Farming / Soil & Water Conservation Specialist. Feb 2005
b) **Keep the soil covered with a layer of mulch**

In the second year: establish a continuous cover of crops by intercropping techniques. These maintain soil fertility by N-fixation and biomass recycling as a substitute for fallowing. Mulches of crop residues and fast-growing cover crops such as *Arachis pintoi* suppress the growth of weeds, protect the soil from raindrop impact and promote infiltration. Shading the soil from the sun minimizes oxidation of organic matter.

c) **Practice zero tillage (ZT)**

Instead of tilling the soil, use a stick to plant (or dibble) the seeds through the mulch (i.e. the large amounts of plant residues accumulated in the previous year). ZT enhances biological activity under the mulch. Higher infiltration rates result by reducing soil compaction.

d) **Diversify crop production**

Diversify production by growing a wide range of crops to minimize the impact of price fluctuations, and damage to any particular crop by diseases and insect pests. Include legumes such as monggo (mung beans) in the rotation to maintain soil fertility. Plant vegetables in the minor valleys where soil eroded from the slopes has accumulated, and water is available.

e) **Apply fertilizer on top of the mulch**

Many short-term crops develop a dense mat of feeder roots which penetrate the mulch, just like forest trees. As there are not enough nutrients in the available organic matter to sustain a vigorous crop of vegetation, inorganic fertilisers can seldom be replaced by manures and composts. Fertiliser should be applied on top of the mulch to avoid ‘burning’ the crop roots. Phosphate fertilizers, in particular, are more effective if they are applied this way, as contact with bare soil makes P unavailable to plant roots. P inputs are needed to sustain crop yields on the highly weathered soils of the uplands. Deficiency of P prevents nodulation by legumes, resulting in low levels of N-fixation and increased competition between crops for available P.
ANNEX 4.4

AN IMPROVED DESIGN FOR CROSS-SLOPE BARRIERS ON STEEP SLOPES

Figure 1 shows an improved design for cross-slope barriers on steep slopes when applying STOP on undeveloped land. It incorporates a 2 m wide NVS immediately below the hedgerow, which will dissipate the energy of run-off dropping from the terrace above so it doesn’t undermine the terrace. The spacings given in STOP apply only to the width of the cultivable strip. The cross-slope barrier now includes both the leguminous hedgerow or Napier/Vetiver grass strip and the NVS.

Fig. 1  An improved design for cross-slope barriers on steep slopes

Objectives:
To produce terraces on steep slopes by using soil movement from erosion and contour ploughing over 3-4 years.

- To reduce the riser height of the terrace and minimise the risk of terraces collapsing by absorbing the impact of run-off passing through the barrier.
- To act as an alternative to planting additional contour hedgerows when the original hedgerows are too widely spaced.

Principles and Practices

- Use the A-frame to align the 0.5 m wide cross-slope barrier such as Napier grass or leguminous trees.
- Use the STOP table to select the width of the cultivated strip recommended for the particular slope and soil type (see table above).
- Speed up terrace formation by ploughing along the contour of the cultivated strip. Over a 3-4 year period a terrace should form with a much-reduced slope, encouraging infiltration of run-off. Fertiliser applications will penetrate the soil profile rather than being washed downhill.
- Leave a 2-m wide grass strip immediately below the cross-slope barrier. This grass strip acts as a natural riser and absorbs the impact of surplus run-off flowing from one terrace to the next. By retaining its original slope, the strip minimizes the risk of falling run-off under-cutting and collapsing the terrace.
- If pre-STOP hedgerows are too far apart the width of the strip will vary, being the inter-hedgerow distance less the barrier spacing recommended in STOP for the particular slope. It should be allowed to revert to a cover of grass.
- Plant bananas or fruit trees in eyebrow basins in the grass strips to provide medium- to long-term income.
- Plant a row of pineapples at the interface between the cultivated area and the grass strip to reduce the temptation to plough into the grass strip.

---

ANNEX 4 (b)

MISCELLANEOUS HANDOUTS

Annex 4.5  *A Guide to Rehabilitating and Managing Cross-slope Barriers (Hedgerows, Grass strips, NVS)*

Annex 4.6  *Bolo Hygiene against Banana Bunchy Top Disease*

Annex 4.7  *Using Cogon to Control Cogon*

Annex 4.8  *Take the pressure off your carabao’s neck with a Goyod*
A GUIDE TO REHABILITATING AND MANAGING CROSS-SLOPE BARRIERS
(Hedgerows, Grass strips, NVS)

Prepared for the Upland Development Programme In Southern Mindanao (UDP)
by Kenneth R S Proud Upland Farming Systems/ Soil & Water Conservation Specialist

December 2004

A partnership programme sponsored by the European Commission (EC) and the Government of the Philippines (GoP) and executed by the Department of Agriculture (DA)
# INDEX

**A GUIDE TO REHABILITATING AND MANAGING CROSS-SLOPE BARRIERS (HEDGEROWS, GRASS STRIPS, NVS)**

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Review of principles of slope management</td>
<td>2</td>
</tr>
<tr>
<td>1.1 Soil and slope factors</td>
<td>2</td>
</tr>
<tr>
<td>1.2 Strategies for soil conservation in sloping lands</td>
<td>2</td>
</tr>
<tr>
<td>1.2.1 Protecting slopes from erosion</td>
<td>2</td>
</tr>
<tr>
<td>1.2.2 Slope management strategies</td>
<td>2</td>
</tr>
<tr>
<td>a) Reduce Slope Length</td>
<td>2</td>
</tr>
<tr>
<td>b) Slope steepness</td>
<td>3</td>
</tr>
<tr>
<td>2. Cross-slope barriers</td>
<td>3</td>
</tr>
<tr>
<td>2.1 Problems with hedgerow layouts</td>
<td>3</td>
</tr>
<tr>
<td>2.2 Rehabilitation actions needed</td>
<td>4</td>
</tr>
<tr>
<td>a) Hedgerows too widely spaced</td>
<td>4</td>
</tr>
<tr>
<td>b) Hedgerows not aligned on the contour</td>
<td>6</td>
</tr>
<tr>
<td>i) Correcting a low point caused by planting a hedgerow off the contour</td>
<td>6</td>
</tr>
<tr>
<td>ii) Correcting hedgerows planted across the contours</td>
<td>6</td>
</tr>
<tr>
<td>3. An improved design for cross-slope barriers on steep slopes</td>
<td>8</td>
</tr>
<tr>
<td>Objectives:</td>
<td>8</td>
</tr>
<tr>
<td>Principles and Practices</td>
<td>8</td>
</tr>
<tr>
<td>4. PLANTING CROSS-SLOPE BARRIERS OF GRASS STRIPS</td>
<td>9</td>
</tr>
<tr>
<td>4.1 VETIVER GRASS (<em>Vetiveria zizanioides</em>)</td>
<td>9</td>
</tr>
<tr>
<td>a) Reasons to use Vetiver for establishing contour Grass Strips</td>
<td>9</td>
</tr>
<tr>
<td>b) Marking out the contours</td>
<td>9</td>
</tr>
<tr>
<td>c) Preparing the Vetiver slips for planting</td>
<td>10</td>
</tr>
<tr>
<td>d) Planting the Vetiver on the contour</td>
<td>10</td>
</tr>
<tr>
<td>e) Maintenance</td>
<td>12</td>
</tr>
<tr>
<td>4.2 NAPIER GRASS (<em>Pennisetum purpureum</em>)</td>
<td>12</td>
</tr>
<tr>
<td>4.3 LEMON GRASS</td>
<td>12</td>
</tr>
<tr>
<td>4.4 SETARIA SPLENDIDA</td>
<td>13</td>
</tr>
<tr>
<td>4.4.1 Proposed use as a Cross-slope barrier/ Grass strip</td>
<td>13</td>
</tr>
<tr>
<td>4.4.2 Problems using Setaria as fodder for horses</td>
<td>13</td>
</tr>
<tr>
<td><em>Oxalate and ‘big head’ disease in horses</em></td>
<td>13</td>
</tr>
<tr>
<td>5. Hedge laying</td>
<td>14</td>
</tr>
<tr>
<td>How to lay the hedge</td>
<td>14</td>
</tr>
<tr>
<td>6. Hedgerows, NVS and Grass Strip establishment and management</td>
<td>15</td>
</tr>
<tr>
<td>NVS management</td>
<td>15</td>
</tr>
</tbody>
</table>
A GUIDE TO REHABILITATING AND MANAGING CROSS-SLOPE BARRIERS¹
(HEDGEROWS, GRASS STRIPS, NVS)

1. Review of principles of slope management

1.1 Soil and slope factors

Sandy and loam soils tend to be more susceptible to erosion than clay soils. Topsoil with a stable structure is better able to resist the detachment of soil particles, and remains porous, keeping a good infiltration rate. Deep soil has a greater capacity to store water, reducing the risk of over-saturation of the topsoil.

Land with a slope sufficient to allow water to run down may be subject to erosion. As slope steepness increases excess water from rainfall will run down at a higher velocity than on a gentle slope and will therefore cause more serious erosion.

Slope length is important. The longer the slope, the greater the volumes of excess water that accumulate on it, which run downward at ever-increasing volumes and velocities.

1.2 Strategies for soil conservation in sloping lands

Strategies for soil conservation in sloping lands must therefore be based on:

− covering the soil to protect it from raindrop impact;
− increasing the infiltration capacity of the soil to reduce run-off;
− improving the aggregate stability of the soil; and
− reducing slope lengths and slope gradients to prevent the run-off from building up too much volume or reaching erosive velocities

1.2.1 Protecting slopes from erosion

The best protectors of the soil are natural forest with a multi-storey canopy and thick layer of leaf litter, or a dense grass cover (not cogon, Imperata cylindrica). Multi-storey tree cropping on grass is recommended for sloping land.

For annual crops, imitate the litter of the forest floor by covering the soil surface with mulch so it is not exposed to detachment by the direct impact of raindrops. Mulching also enhances the resistance of soil to erosion by raising the humus content to improve infiltration rate and water storage capacity. In addition, the use of natural and artificial fertilisers, and zero or minimum tillage may contribute to more favourable soil properties.

It should be noted that cover crops, e.g. Pueraria phaseoloides, Calopogonium mucunoides, and Centrosema pubescens, protect the soil from the impact of raindrops falling from tree crops, but do not provide a dense ground cover to reduce the speed of overland flow.

1.2.2 Slope management strategies

a) Reduce Slope Length

Slope length can be reduced with all types of physical structures (cross-slope barriers). However, to be effective, conservation systems designed to shorten slope length require some means of drainage to intercept and divert run-off safely to an adjoining river or artificial

---

¹ A cross-slope barrier impedes the movement of run-off water and eroding soil downslope
waterway. The local ecological and socio-cultural situations found in the uplands of Southern Mindanao are not suitable for such engineering works.

Consequently, agroforestry techniques such as the contour planting of leguminous hedgerows, grass strips or natural vegetative strips (NVS), although helping to reduce slope length, are unable to prevent a build up in the volume of run-off. On very long slopes cross-slope barriers are unable to reduce run-off velocity sufficiently to reduce erosion.

However, they can be effective at retaining soil and slowing down run-off velocities by planting them on short slopes where run-off volumes are lower, and run-off velocities slower. These sites are generally found at the tops of hills (plateaux and crests), on the upper slopes just below the crests, and on ridges leading to the top of the hills.

b) **Slope steepness**

Terrace construction or formation is the oldest and most frequently used method of attaining reduced slope gradients in traditional subsistence agricultural systems. The main constraint is the high labour input required\(^2\). Many of the techniques applied in direct construction are not suitable for the UDP areas.

A combination of natural erosion, land management, and contour ploughing can result in nearly level terraces over longer periods of time. Terracing expands the area suitable for cultivating annual crops in areas dominated by steep slopes. They make mechanization of farm operations possible and substantially increase the value of the land.

UDP’s Slope Treatment-Oriented Practices (STOP) model provides site-specific spacings for cross-slope barriers, based on soil depth and texture and slope factors. They are designed to ensure that sufficient soil is left at the back of the terrace to support crop growth once the terrace has formed. To minimize damage from run-off and reduce maintenance costs they must be developed close to the top of the slopes.

2. **Cross-slope barriers**

2.1 **Problems with hedgerow layouts**

The main problems identified with the hedgerow layout on many farms are:

- Whereas the project designs specified that two lines of hedgerows (50 cm apart) be planted on each contour, many farmers only had enough seed for one hedgerow. This made the hedgerow very “porous” reducing its effectiveness in trapping soil. At the same time, insufficient allocations of seed resulted in wider spacing of seedlings within the row. The wide gaps between saplings, combined with a single hedgerow has reduced its effectiveness as a cross-slope barrier.

- Hedgerows are spaced too far apart\(^3\). The danger here is that cultivating the whole inter-hedgerow area can result in soil depths at the back of the terrace being too shallow to support crop growth.

- The hedgerows were laid out without using an A-frame. Because the hedgerows do not follow the contour, resulting low points make the land more susceptible to gully erosion, as opposed to sheet wash and rill erosion.

---

\(^2\) Hand construction of 1.0 ha of bench terraces can take up to 1,800 man-days of labour.

\(^3\) Most of the hedgerows were planted before the Slope Treatment-Oriented Practices (STOP) model had been developed.
2.2 Rehabilitation actions needed

The following rehabilitation actions have been developed to correct the problems of widely spaced hedgerows, and hedgerows planted way off the contour.

a) Hedgerows too widely spaced

Hedgerows that are too far apart create a number of problems. When large amounts of soil build up behind the cross-slope barrier, the soil at the front of the terrace be over 1.5 m deep. As the height that run-off water falls over the terrace increases, the greater the risk that it will undercut the terrace causing it to collapse. The movement of soil to the front of the terrace reduces its the depth at the back of the terrace to less than 50 cm. If the rocky substratum (or hard pan as the farmers describe it) is exposed then nothing can be planted. Figures 2.1a to 2.1d illustrate this point.

Fig. 2.1 Stages in terrace formation on too widely spaced terraces

Fig. 2.1a Corn growing between widely spaced hedgerows. Slight movement of soil forwards

Fig. 2.1 b Terrace formation visible. Shallower soil at back of terrace affecting crop growth
Fig. 2.1 c  Terrace formation is obvious but crops at back of terrace stunted due to subsoil

Fig. 2.1 d  High, unstable terraces formed. Subsoil exposed at back of terrace stunting crops

When hedgerow spacings exceed that recommended by the STOP table:

- Plant extra contour hedgerows or strips of Napier or Vetiver grass between the existing lines. However, difficulties in obtaining planting material means this can take some time to achieve, while the resulting spacing may be too close to be compatible with the farmer’s field operations.

- Alternatively, simply use the terrace spacing for the slope and soil type, as indicated in the STOP table, and let the sloping area between the back of the terrace and the uphill hedgerow revert to grass. The NVS reinforces the hedgerow as a SWC measure and absorbs the impact of run-off passing through the hedgerow. Cultivate the terrace area
for annual crops to eventually produce a level to gently sloping bench, and plant the remaining uphill part of the inter-hedgerow area with bananas and smaller tree crops such as coffee. Plant a line of pineapples at the back of the terrace to reduce the temptation to widen the terrace by ploughing into the NVS (see Figure 2.2).

Fig. 2.2 Adding an NVS when hedgerow spacings exceed STOP specifications.

c) Hedgerows not aligned on the contour

Incorrectly aligned hedgerows, mainly the result of failing to use the A-frame to identify the true contours, are a major problem and lower the value of the land. Depending on slope and soil type some poorly aligned hedgerows have resulted in concentrating run-off at low points, which in some cases has caused gullies. The nature of gullies is to move uphill, cutting through other terraces. Apart from taking land out of cultivation, gullies cannot be crossed by carabaos and ploughs and so disrupt farm operations. In other instances, the accumulation of sediment behind the hedgerows at low points threatens the stability of the terrace.

i) Correcting a low point caused by planting a hedgerow off the contour

When farmers have planted the hedgerow in a straight line, instead of following the curve of the contour, generating a low point: use the A-frame to identify the true contour around the low point, then plant a new section of hedge. Plant the area between the adjusted and old hedgerows with additional hedgerow material, if supplies are sufficient, or bananas or fruit trees (see Fig. 2.3). (Root crops must not be planted in the hedgerow). If hedgerow spacing is too wide for the slope, then the procedure outlined in 2.2.a) above, should also be followed.

ii) Correcting hedgerows planted across the contours

In extreme cases, hedgerows were so badly aligned they were planted across (rather than along) the contours (see Figure 2.4). In these cases it is best to let the area revert to grass and plant tree crops. However, if there are no other areas for planting annual crops then Vetiver grass or Napier grass strips should be planted at the STOP spacing appropriate for the slope. This may well result in a series of small terraces lying diagonally to the original

---

4 Although Napier grass is more effective at intercepting eroding soil than leguminous hedgerows, it is not as effective as Vetiver grass when planted in a single row. The gaps between stems are too wide for it to control the flow of soil and water after a heavy rainstorm. Double rows of Napier are advisable.
hedgerows, limiting farm operations to hand cultivation. This is one of the penalties for not using an A-frame in the first place!

The limited and seasonal availability of planting material, such as seeds and Napier grass etc., as well as having to wait to harvest crops currently in the ground, means action to rectify the hedgerows cannot be taken immediately.

Fig. 2.3 Correcting a low point caused by planting a hedgerow off the contour

Fig. 2.4 Correcting hedgerows planted across the contours
3. An improved design for cross-slope barriers on steep slopes

Figure 3.1 shows an improved design for cross-slope barriers on steep slopes when applying STOP on undeveloped land. It incorporates a 2 m wide NVS immediately below the hedgerow, which will dissipate the energy of run-off dropping from the terrace above so it doesn’t undermine the terrace. The spacings given in STOP apply only to the width of the cultivable strip. The cross-slope barrier now includes both the leguminous hedgerow or Napier/Vetiver grass strip and the NVS.

Fig. 3.1 An improved design for cross-slope barriers on steep slopes

<table>
<thead>
<tr>
<th>Slope width</th>
<th>Terrace width</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-25%</td>
<td>4.0 m</td>
</tr>
<tr>
<td>26-35%</td>
<td>3.0 m</td>
</tr>
<tr>
<td>36-45%</td>
<td>2.0 m</td>
</tr>
</tbody>
</table>

Objectives:

To produce terraces on steep slopes by using soil movement from erosion and contour ploughing over 3-4 years.

- To reduce the riser height of the terrace and minimise the risk of terraces collapsing by absorbing the impact of run-off passing through the barrier.
- To act as an alternative to planting additional contour hedgerows when the original hedgerows are too widely spaced.

Principles and Practices

- Use the A-frame to align the 0.5 m wide cross-slope barrier such as Napier grass or leguminous trees.
- Use the STOP table to select the width of the cultivated strip recommended for the particular slope and soil type (see table above).
- Speed up terrace formation by ploughing along the contour of the cultivated strip. Over a 3-4 year period a terrace should form with a much-reduced slope, encouraging infiltration of run-off. Fertiliser applications will penetrate the soil profile rather than being washed downhill.
- Leave a 2-m wide grass strip immediately below the cross-slope barrier. This grass strip acts as a natural riser and absorbs the impact of surplus run-off flowing from one terrace to the next. By retaining its original slope, the strip minimizes the risk of falling run-off under-cutting and collapsing the terrace.
- If pre-STOP hedgerows are too far apart the width if the strip will vary, being the inter-hedgerow distance less the barrier spacing recommended in STOP for the particular slope. It should be allowed to revert to a cover of grass.
- Plant bananas or fruit trees in eyebrow basins in the grass strips to provide medium- to long-term income.
- Plant a line of pineapples at the back of the cultivated area to prevent cultivation damaging the protection function of the grass strip.
4. PLANTING CROSS-SLOPE BARRIERS OF GRASS STRIPS

4.1. VETIVER GRASS (*Vetiveria zizanioides*)

**a) Reasons to use Vetiver for establishing contour Grass Strips**

- *Vetiver* quickly forms a dense permanent hedge if planted correctly.
- It is cheap and easy to establish and maintain as a hedgerow, as well as to remove when it is no longer wanted.
- The leaves are unpalatable to livestock, except when young, and provide a source of mulch for the soil between the hedgerows.
- *Vetiver* is resistant to fire and overgrazing because its crown is below the surface.
- Its strong fibrous root system can penetrate soil to three metres depth.
- It is perennial and maintenance is minimum.
- Because it mainly reproduces asexually, by tillering, it will not become a weed.
- Its aromatic roots repel rats and other pests.
- *Vetiver* can withstand drought and periods of water-logging.
- It does not compete with the adjacent crop plants.
- It grows in all types of soil, including sands, shales and gravels, regardless of fertility and pH.
- It grows with annual rainfalls of 200-6,000 mm, and elevations up to 2,600 m asl.

**b) Marking out the contours**

Use an A-frame to mark out the contours as shown in the *How to use an A-Frame* pamphlet. Mark the contour line with wooden or bamboo stakes.

Plough through the line of stakes to form a contour furrow in which to plant the *Vetiver* (also see Fig. 4.1).

![Fig. 4.1 Ploughing through the line of stakes to form a contour furrow in which to plant the Vetiver](image)

Table 4.1 gives the terrace widths for slopes from 12% to 55% for two classes of soil textures. The spacings are horizontal measurements. Provided there is a soil depth of 100 cm, a combination of contour ploughing and natural erosion should form level terraces over a period of 4-5 years, leaving 50 cm depth of soil at the back of the terrace – sufficient to support most short-term crops. The recommended spacings refer to the maximum distance between hedgerows, otherwise rilling may be too severe.
Where soil depths are less than 60 cm, the same spacings apply but the cultivated area should be well mulched and zero-tillage (i.e. dibbling in the seeds and fertilizer through the mulch) used to minimize any further movement of soil downslope.

Table 4.1  Spacing for Contour Vetiver Hedgerows based on Slope and Soil Texture

<table>
<thead>
<tr>
<th>Slope</th>
<th>Soil Depth</th>
<th>Sandy - Loam soils</th>
<th>Clay soils</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-25%</td>
<td>100 cm</td>
<td>3.0 m</td>
<td>4.5 m</td>
</tr>
<tr>
<td>26-35%</td>
<td>100 cm</td>
<td>2.5 m</td>
<td>3.5 m</td>
</tr>
<tr>
<td>36-45%</td>
<td>100 cm</td>
<td>2.0 m</td>
<td>3.0 m</td>
</tr>
<tr>
<td>46-55%</td>
<td>100 cm</td>
<td>Tree crops</td>
<td>2.0 m</td>
</tr>
<tr>
<td>&gt;55%</td>
<td>100 cm</td>
<td>Tree crops</td>
<td>Tree crops</td>
</tr>
</tbody>
</table>

To prevent run-off from gaining sufficient velocity to cause erosion, it should be intercepted at frequent intervals. However, in the UDP area it is impractical to install diversion ditches as there are no suitable outlets where run-off can be disposed of safely. Contour hedgerows should therefore be restricted to the upper slopes where run-off volumes are lower, and spaced closely together to reduce run-off velocities, especially on sandy soils.

c) Preparing the Vetiver slips for planting

Nurseries for Vetiver can be established at inlets to dams or lakes, where there is plenty of moisture. Large gullies also make good informal nurseries for Vetiver. In the nursery, the Vetiver root divisions, or slips, should be planted in a double or triple line across the streambed or gully floor, with the rows 30-40 cms apart. Applying di-ammonium phosphate fertiliser (DAP) to the slips encourages fast tillering in the nursery.

Dig up the Vetiver with a spade or pick mattock as its long, massive root system makes it difficult to pull out by hand. Figures 4.2 to 4.4 show how to prepare the planting slips.

d) Planting the Vetiver on the contour

Plant the Vetiver slips into moist soil, preferably at the beginning of the rainy season. If planted correctly, the slips can withstand up to one month of dry weather.

- Make a hole in the furrow ploughed to mark the contour (Fig. 4.5).
- Dibble some di-ammonium phosphate fertiliser (DAP) into the planting furrow before planting the slips to encourage fast tillering.
- Push the slip into the hole taking care not to bend the roots upward.
- Firm the slip into the soil using hands or feet.
- If plenty of planting material is available plant the slips in a continuous line (touching each other). If the supply of material is limited, plant the next slip not more than 10-15 cm along the same furrow, and so on. Only a single row of slips should be planted. The further apart the slips are planted the longer it will take to form a continuous barrier.
- Remember to keep the lines of Vetiver no more than two metres apart on sandy soils on slopes of 36-45%, and on clay-textured soils on slopes up to from 46-55%.
Fig. 4.2 Separating the planting slips

Dig out a clump of Vetiver

Tear a handful of Vetiver, including the roots, from the clump

Fig. 4.3 Cut the tops of the clumps about 20 cm above the base, and the roots 8-10 cm below the base

A slip of Vetiver ready for planting
e) **Maintenance**

With well-distributed rainfall, the Vetiver hedge should establish itself in about a year.

Plant new slips to fill gaps in the hedge created when slips die. If no slips are available bend over the live flower stems or culms of neighbouring plants and bury them in the gap. This can stimulate the production of roots and leaves at the nodes.

Once established, the only care needed is annual trimming to a height of about 30-50 cms. This encourages tillering, helps thicken the hedge, and minimises shading of the crops. The cuttings can be used to mulch crops or trees planted between the hedges. Monthly cutting can also produce young leaves for fodder to feed livestock.

Plough along the edge of the hedgerow to stop the tillers encroaching into the cropped area. This can also be used to prevent the hedge from becoming too thick.

4.2. **NAPIER GRASS (Pennisetum purpureum)**

Although Napier grass is more effective at intercepting eroding soil than leguminous hedgerows, it is not as effective as Vetiver grass when planted in a single row. The gaps between stems are too wide for it to control the flow of soil and water after a heavy rainstorm. Double rows of Napier are therefore advisable.

While Napier grass yields high amounts of forage, it depletes the soil of macro-nutrient elements, and its roots compete with nearby crops.

**Recommended reading**


4.3. **LEMON GRASS**

*Lemon grass* can also be used, but field observations show there is a tendency for farmers to plant it in clumps. Combined with less frequent cutting this leaves gaps between the clumps, reducing its effectiveness as a cross-slope barrier in holding back soil.
4.4 SETARIA SPLENDIDA

4.4.1 Proposed Use as a Cross-slope barrier/ Grass strip

The procedure for planting Var. splendidia vegetatively is:
− top plants to a height of 15 cm;
− split into pieces of 2-3 tillers; and
− plant them in moist soil and don’t allow them to dry out.
− Plant a double row for effective interception of eroding soil.

If the soil remains moist following planting, successful establishment usually exceed 90%.

Photo 1. Development of barrier four months after planting.

4.4.2 Problems using Setaria as fodder for horses

Horses are commonly used as pack animals in the uplands of Mindanao. Care should be taken not to feed horses to much Setaria grass, as it accumulates oxalate if heavily fertilised with nitrogen. Oxalate can lead to a condition in horses called big-head: Osteodystrophia fibrosa. This is not normally a problem provided carabaos and cattle have been allowed to become accustomed to Setaria. Mixing legumes with Setaria helps to correct a calcium imbalance, while feeding calcium is also effective.

Oxalate and ‘big head’ disease in horses

Big head is a calcium imbalance caused when horses graze exclusively grasses containing high levels of oxalate; that locks up calcium making it unabsorbable by the horse’s intestine.

Symptoms of ‘big head’ disease (osteodystrophia fibrosa, hyperparathyroidism) include:
− affected gait, poor performance and swelling of bones of the head;
− weak appetite;
− recumbent (lying down; in a position of comfort or rest);
− get up with difficulty;
− rigid in their movement, tripped and limped;
− painfulness and swelling of tarsal, fetlock and elbow joints;
− deformity of the forelegs and thickened maxi

Reference
5. Hedge laying

Contour hedgerows can become more effective cross-slope barriers to soil movement by “laying” the hedges in the year after planting.

Laying involves cutting the young stem half to three-quarters through at 10cm above ground level, bending it over and anchoring the twiggy growth into the stems neighbour. The shrub regrows from the cut, and from along the bent stem, forming a thick, bushy hedge. If the stem breaks, the plant has merely been pruned.

How to lay the hedge

- Allow the hedge to grow to a height of 2.4-3.6 m tall.
- The main stems are selected for pleachers (see Fig. 2 below), which will be partially cut and laid.
- The cut in the pleacher should be about 3-10cm above ground, and just over three-quarters through so that the stem bends without being forced.
- The first group of pleachers that are cut should be laid to one side, until there is sufficient room to lay a pleacher into the hedge.
- The pleacher should lay upwards at an angle of between 25-45º, and angled across the width of the hedge.
- Stakes of madre de cacao or ipil-ipil 1.4-1.8m long, should be prepared and knocked into the ground and the pleachers woven between them.
- Slender binders of other available materials are then twisted along the top to hold the pleachers in place.
- Leave the brushy ends of the laid pleachers uncut.
6. **Hedgerows, NVS and Grass Strip establishment and management**

Hedgerows of leguminous species such as *Fleminga, Rinsoni, Kakawati*, etc. should be located on the least steep areas of the farm – even if these are on idle land. Such areas may be on small crests or footslope terraces, and may cover only a few hundred square metres. Nonetheless, they offer the best locations to promote sustainable agricultural development, even if they are in several locations. Ensure the area required to grow the farmer’s subsistence needs for erosion-causing crops (maize, root crops) is available.

It is worth encouraging farmers to take the extra time to lay out the NVS and hedgerows along the contour correctly, because the terraces formed are permanent. This will reduce the chance of creating low spots that can concentrate run-off and cause gullies.

- The A-frame is the recommended method for laying out contours.
- The traditional method of using the carabou’s back as a levelling device should *not* be offered as an option. In fact, BEWs and ATs should stress that this method is *not* recommended, and explain the dangers when NVS are not formed along the contour.
- Hedgerows should be located on the least steep areas of the farm – even if these are on idle land. Such areas may be on small crests, spurs, or foot slope terraces, and may cover only a few hundred square metres. They offer the best locations to promote sustainable agricultural development.
- It would be worth testing the effectiveness of closely spaced Vetiver grass hedgerows on sandy and stony soils, particularly where root crops and spring onions are being grown. Vetiver roots can grow to a depth of three metres and should inhibit mass movement. The aerial parts of Vetiver die back when soil moisture is scarce but sprout again after it rains. The roots do not compete with the adjacent crop.

To minimize the risk of land slides:

- On sandy to loam soils, the maximum slope for hedgerows should be 45%.
- If the only sites available on light soils have slopes between 45-65% then encourage an immediate shift to tree crops. Hedgerows and NVS should not be established, as the aim is to minimize terrace formation.
- The opening up of land with slopes above 55% should not be supported, except for direct seeding of forest trees.
- For clay loam to clay soils slopes can be steeper (65%).
- The spacing of hedgerows should be reduced as slopes get steeper and soil texture gets sandier.
- Hedgerows and NVS should not be planted on slopes >45%, especially on shallow and stony soils. These should be left under grass, or planted *from seed* with forest trees that produce rapidly growing taproots, which can rapidly penetrate the subsoil to obtain soil moisture. Multi-purpose species such as *Calliandra calothyrsus* should be used, as they attract bees and are short-rotation firewood crops.

**NVS management**

Some adjustments are needed to the positioning of crops between the hedgerows/NVS. For example, root crops such as gabi should not be used to enrich the NVS as harvesting the corms weakens the terrace. Crops such as pigeon pea can be planted in the NVS. Green grams (*mungo*) could be planted at the back of the terraces, where the soils are usually shallower. They need little water to be productive and are leguminous.
ANNEX 4.6

BOLO HYGIENE AGAINST BANANA BUNCHY TOP DISEASE

Bolos must be kept sharp as dull blades tend to bruise, split or crack the stem, making the wound more susceptible to infection.

Hygiene

- Disinfect Bolos immediately after cutting each tree. This minimizes the risk of passing on any disease to a healthy tree.

- Before moving on to prune another tree always dip the bolo in a solution of 1 part bleach to 9 parts water, or a solution of formalin.

- Immediately burn all dead and diseased stems, leaves, etc that have been removed. Leaving them lying around may lead to re-infection of the remaining trees.
CONTROLLING COGON WITH COGON

Cogon (*Imperata cylindrica*) is an aggressive grass that displaces native vegetation, pasture grasses, and tree seedlings in a wide range of soil types. Due to its poor nutritional value and low palatability cogon is unsuitable as a livestock forage. The seeds of cogon are wind-dispersed and its rhizomes store nutrients enabling the plant to survive extended dry seasons.

Eradicating cogon is difficult as burning and cutting stimulate its growth. Repeated cutting every four or five days can exhaust the rhizome of its stores of carbohydrates, so it dies off. However, this is time-consuming. Delaying the cutting by a few days allows the rhizomes to replenish their store of nutrients. Systemic herbicides need to be applied when cogon is green and actively growing to be most effective.

A cheap way of controlling cogon involves using cogon against itself. After cutting down cogon, heap the cuttings in lines 150 cm wide and 30 cm deep along the contour (Photo 1).

![Photo 1. Cogon heaped up along the contour.](image)

After five weeks, provided there has been some rain, the dead cuttings started to decompose. The underlying ground becomes moist and bare - due to the mulching and composting effect of the cuttings. Tree seedlings or pineapples can now be planted through the mulch. Alternatively, cut down the cogon adjacent to the line, pile it on the contour, and drag some of the decomposing cogon downhill to cover the newly cut area. Leave some of the mulch behind to protect the soil and plant beans or peanuts.

Cutting cogon on hillsides and piling it in 3-metre diameter circles provide weed-free areas for tree-planting. The mulch/compost also helps conserve soil moisture.

![Photo 2. Clean soil under the decomposed cogon.](image)
ANNEX 4.8

TAKE THE PRESSURE OFF YOUR CARABAO’S NECK WITH A GOYOD!

The wood used to make the traditional carabao yoke is reportedly getting harder to find in some areas. The good news, there are plenty of old rubber tyres available. Enter the GOYOD! This is a contraction of Gomang Yogo (Rubber Yoke) but also means to pull. It consists of a discarded rubber tyre cut around the rim, so two yokes can be made from one old tyre.

Unlike the traditional wooden yoke which forces the carabao to pull ploughs, sleds or carts using its neck, the GOYOD puts the strain of pulling implements on to the carabao’s shoulders. This is less tiring for the animal and is more efficient.

As shown in Photo 1, the tyre is cut through at the lower portion so the yoke can be placed around the carabao’s neck. A short piece of rope, passing through holes drilled either side of the cut, holds the sides together. This cut is not needed if the animal has small or short horns. The other holes are to attach the ropes of the plough or sled. Smaller diameter tyres should be used for smaller carabaos, so that their front legs don’t rub against the lower part of the tyre. If necessary, trim the tyre so the legs don’t come into contact with the Goyod.

Photo 1. The GOYOD ready for use.

The GOYOD is placed round the carabao’s neck with the cut surface facing forwards, and the plough is attached by tying the ropes to the holes drilled round the rim. Photo 2 clearly shows the strain of pulling the plough is from the shoulders. It may take several minutes for the carabao to get used to the feel of the yoke and to find that it can pull with its head up.

Trials show it is not necessary to have a rope or strap across the carabao’s back (as shown in the photo above) for ploughing. This was meant to keep the ropes of the plough from tangling the carabao’s legs, but reduced the depth of ploughing. When the farmer removed the strap the plough bit deeper into the soil. However, a back strap is needed to support the weight of a cart.
or sled. The ropes for pulling should lead from the Goyod to the base of the sled and *not* to the handles. This ensures the Goyod is only pulling the sled and not supporting the load.

The two farmers who have tried the GOYOD said they got more power, and that it didn’t hurt the carabao like the wooden yoke. In one case, a carabao that could only pull 150 kg with the traditional was able to pull kg 225 uphill.

Pad the area with sacking if the Goyod is found to be causing sores on the carabao’s skin.

Photo 2. The GOYOD in use. Note how the shoulders take the strain of pulling the plough

Where did the idea of the GOYOD come from? Ken Proud, a consultant for UDP in upland farming systems and soil and water conservation, first heard about the idea when he was working in Kenya in 1985. Photo 3 shows his first attempt on a bullock in Kenya

Photo 3. A GOYOD on a Kenyan bullock (1985). Note: it was not necessary to cut the rim of the tyre as it could pass over the bullock’s horns (Ken Proud is third from the left)
ANNEX 5.1

*Setaria splendidia*1 Another species for use as a cross-slope barrier

1. **Proposed Use as a Cross-slope barrier/ Grass strip**

The procedure for planting Var. *splendida* vegetatively is:

− top plants to a height of 15 cm;
− split into pieces of 2-3 tillers; and
− plant them in moist soil and don’t allow them to dry out.

If the soil remains moist following planting, successful establishment usually exceed 90% (see Photo 1).

**Photo 1. Development of barrier four months after planting.**

2. **Problems as fodder**

Horses are commonly used as pack animals in the uplands of Mindanao. Care should be taken not to feed horses to much *Setaria* grass, as it accumulates oxalate if heavily fertilised with nitrogen. Oxalate can lead to a condition in horses called big-head: *Osteodystrophia fibrosa*. Provided carabaos and cattle have been allowed to become accustomed to *Setaria*, this is not normally a problem.

Mixing legumes with *Setaria* helps to correct a calcium imbalance, while feeding calcium is also effective.

---


**Oxalate and ‘big head’ disease in horses**

Big head is a calcium imbalance caused when horses graze exclusively grasses containing high levels of oxalate; that locks up calcium making it unabsorbable by the horse’s intestine.

Symptoms of ‘big head’ disease (*osteodystrophia fibrosa*, hyperparathyroidism) include:

- affected gait, poor performance and swelling of bones of the head;
- weak appetite;
- recumbent (lying down; in a position of comfort or rest);
- get up with difficulty;
- rigid in their movement, tripped and limped;
- painfulness and swelling of tarsal, fetlock and elbow joints;
- deformity of the forelegs and thickened maxi
ANNEX 6.1

Land unit prescription form comparing incomes from bananas and fruits with corn

<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% Soil texture: Clay loam Soil depth: cm Erosion: Rill Stoniness: None Land use: Corn</td>
<td>TOO STEEP FOR PROJECT INPUTS, BUT ADVISE FARMER TO: • REPLACE CORN WITH BANANAS AT 3 METRE SPACING (Triangular layout) FOR REGULAR MEDIUM TERM INCOME. TREES WILL NEED TO BE PROPPED UP WITH BAMBOO. • PLANT SMALL-CROWNED TREES (to minimise risk of toppling at maturity) E.G. COFFEE, LANSONES, RAMBUTAN ETC FROM SEED (in case bananas affected by bunchy top virus at later stage). ALIGN IN EAST-WEST DIRECTION. • TRAIN FARMER IN GRAFTING ON SUITABLE SCIONS.</td>
<td>1.6 t/ha of corn twice/yr = 3.2 t/ha/yr = 3.2 kg/10 m² @ P14/kg = P45 1 hill banana/10 m² yields 30 kg @ P4/kg = P120/yr Income from Land Unit 1 CORN: 800/10 * P45 = P3,600 BANANAS: 800/10 * P120 = P9,600 LANSONES: 800/10 * P186 = P14,880 (see below)</td>
</tr>
<tr>
<td>2 * RIDGE</td>
<td>Slope: &gt;70% Soil texture: Clay loam Soil depth: cm Erosion: None Stoniness: Corn Land use: A few fruit trees</td>
<td>AS ABOVE.</td>
<td>156 Lansones/ha yielding 40 kg/tree after 8 years @ P30/kg = P186/10 m²/yr Income from Land Unit 2 CORN: 525/10 * P45 = P2,362.50 BANANAS: 525/10 * P120 = P6,300 LANSONES: 525/10 * P186 = P9,765</td>
</tr>
<tr>
<td>3 * MID-SLOPE (a)</td>
<td>Slope: 35-45% Soil texture: Clay loam Soil depth: cm Erosion: None Stoniness: Corn Land use: Corn with a few mango trees</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. • HEAVILY MULCH MICRO-BASINS. • APPLY COMPLETE FERTILISER AT RECOMMENDED RATES WITH ANNUAL INCREMENTS. • INTERPLANT WITH BANANAS TO GET EARLY INCOME.</td>
<td>8 year-old Mango yields 100 kg/tree or 10 kg/10 m² @ P12/kg = P120/10 m² Income from Land Unit 3 CORN: 1,200/10 * P45 = P5,400 BANANAS: 1,200/10 * P120 = P14,400 LANSONES: 1,200/10 * P186 = P22,320 MANGOES: 1,200/10 * P120 = P14,400</td>
</tr>
<tr>
<td>4 * MID-SLOPE (b)</td>
<td>Slope: 35-45% Soil texture: Clay loam Soil depth: cm Erosion: Land slippage at lower end Stoniness: None Land use: Corn</td>
<td>AS ABOVE.</td>
<td>Income from Land Unit 4 CORN: P1,350/yr BANANAS: P3,600 @ 1.5 years LANSONES: P5,580 @ 8 years MANGOES: P3,600 @ 8 years</td>
</tr>
</tbody>
</table>
ANNEX 7.1

THE REDUCTION IN SOIL DEPTHS OF UPLAND SOILS
IN SOUTHERN MINDANAO.
THEIR CAUSES AND CONSEQUENCES
THE REDUCTION IN SOIL DEPTHS OF UPLAND SOILS IN SOUTHERN MINDANAO, THEIR CAUSES AND CONSEQUENCES

A report by
Kenneth R S Proud
Upland Farming Systems/Soil and Water Conservation Consultant

16 October 2004

A partnership programme sponsored by the European Commission (EC) and the Government of the Philippines (GoP) and executed by the Department of Agriculture (DA)
THE REDUCTION IN SOIL DEPTHS
OF UPLAND SOILS IN SOUTHERN
MINDANAO, THEIR CAUSES AND
CONSEQUENCES

A report by
Kenneth R S Proud
Upland Farming Systems/Soil and Water Conservation Consultant
16 October 2004

Cover photo: Heavily rilled plot on a 55% slope
THE REDUCTION IN SOIL DEPTHS OF UPLAND SOILS IN SOUTHERN MINDANAO, THEIR CAUSES AND CONSEQUENCES

TABLE OF CONTENTS

| Executive summary                  | 1 |
| 1. Introduction                    | 4 |
| 2. Evidence for the 2-4 cm loss of soil depth each year | 4 |
| 2.1 Field observations on soil erosion in the uplands of Southern Mindanao | 4 |
| 2.2 Comparisons of soil depths in relatively undisturbed areas with cultivated land | 5 |
| 2.3 Importance of soil depth       | 8 |
| 2.4 Reports of soil loss in the Philippines | 8 |
| 3. Soil losses from growing maize and cassava in the humid tropics | 10 |
| 3.1 Soil losses under Corn/Maize   | 10 |
| 3.2 Soil losses under Cassava      | 11 |
| 4. Consequences of soil loss through accelerated erosion | 11 |
| 5. Options for the Upland Farmer  | 12 |
| Policies needed to promote sustainable upland farming | 12 |

List of Tables

Table 1. Comparison of soil depths between cultivated and undisturbed sites | 7
Table 2. Rates of soil loss under different land uses | 9
Table 3. Soil losses (t/ha/yr) from growing maize on steep slopes in Haiti | 10
Table 4: Soil losses under continuous corn production in the USA | 10
Table 5. Soil losses under Cassava | 11

List of Photographs

Cover: A monument to mismanagement. Precipitous slopes cleared for unsustainable arable agriculture
Photo 1: Sheet wash and rilling are the main forms of erosion in the uplands
Photo 2: Mass movement on slopes with rapidly steepening convexity | 4
Photo 3: Mass movement of soil - typical of slopes with rapidly steepening convexity | 5
Photo 4: Hedgerows cannot prevent a build up in volume and velocity of run-off on long slopes | 6
Photo 5: Build up of 60 cm coarse sandy soil after one year
Photo 6: One-metre build up of sandy soil after 18 months | 6
Photo 7: Very steep slopes in the fragile uplands with no future for crop Production | 7
Photo 8: Eco-terrorism! Precipitous slopes cleared for unsustainable Farming | 16

List of Annexes

Annex 1. Calculating depths of soil lost per hectare
Annex 2. Land suitability issues
THE REDUCTION IN SOIL DEPTHS OF UPLAND SOILS IN SOUTHERN MINDANAO, THEIR CAUSES AND CONSEQUENCES

Summary

Responses on the condition of the uplands in Southern Mindanao and rates of soil loss given by Mr Ken Proud at the press conference in Davao City on October 5th 2004, were based on:

- Field observations of rill erosion, mass movement and gullying, and on the build up of eroded soil behind cross-slope barriers such as leguminous hedgerows, natural vegetative strips (NVS), and Napier and lemon grass hedges.
- Comparisons of soil depths in remnant forest patches or old, established plantations, with nearby cultivated, fallowed or abandoned land on similar slopes.
- Estimates of soil erosion rates from other places in the Philippines.
- Reports giving measurements of soil loss under corn and cassava on similar slopes and soils elsewhere in the humid tropics.

Sheet wash and rill erosion account for the bulk of the sediment removed from a hillside each year. In some instances hedgerows and other cross-slope barriers have intercepted up to 100 cm depth of eroded soil over an 18-month period.

Comparisons between soil depths on cultivated or abandoned agricultural land and the relatively undisturbed soils with similar slopes in nearby remnant patches of secondary forest, or well-established fruit trees, indicate reductions of 25-166 cm on very steep slopes in the UDP area. In one instance, corn cultivation on very steep slopes (>50%) has reduced the soil depth by 53 cm over a five-year period (i.e. 10 cm per year). By comparison, continuous cultivation of corn on flat to gentle slopes (less than 3%) took 100 years to reduce soil depth by 37 cm in the USA. The massive soil losses over short periods of time in the uplands of Southern Mindanao show just how urgent it is to impose constraints and regulate use of land in the watersheds, if they are to have any realistic hope of perpetuating water supplies to maintain the higher productivity potential of the lowlands.

Studies in the Philippines show that soil erosion rates increase dramatically with increase in slope. Erosion studies in Mindanao found soil losses to be 4-6 times greater on 44% slopes than on 20% slopes. Under similar conditions, corn grown on 35-55% slopes in Haiti caused soil losses of 402-483 t/ha/yr (equivalent to an annual reduction in soil depth of 3.7-4.4 cm).

At the MBRLC, at Bansalan, Davao del Sur, soil erosion losses averaged 194 t/ha/yr over six years on control plots of 18% slope (with 340 t/ha lost over an 11 month period).

On cultivated mountain slopes, the average erosion rate was 218.2 tonnes/ha/yr with kaingin lands having the highest soil loss of 508 tonnes/ha/yr (equivalent to an annual reduction in soil depth of between 3.20 to 4.82 cm, depending on soil type). One result of topsoil loss is lower crop yields. This can be as much as 100 kg/ha for every centimeter lost. Subsistence farmers compensate for this by expanding the area under cultivation, (e.g. by moving into remaining tracts of undisturbed forest), or by applying large amounts of inorganic fertilizer. With limited resources many upland farmers will simply expand the area under cultivation, and increase the problems.

Compared to corn, soil losses under cassava rise dramatically, with relatively gradual increases in slope: 1% slopes (3 t/ha/yr); 5% slope (87 t/ha/yr); 15% slope (221 t/ha/yr). In Southern Mindanao, where cassava is commonly grown on slopes in excess of 60%, soil losses will be massive, reducing the economic life of the land to a few years.

Upland soils in the humid tropics are generally fragile, highly erodible and infertile. Previous projects have classified the general land development suitability of much of the UDP project
areas either as suitable for forest conservation areas or not suitable for upland crops or for orchard development.

Despite this blanket assessment, the UDP has been able to identify several areas within the uplands of Southern Mindanao, where permanent and diversified cropping systems can be undertaken profitably. However, this requires certain soil and water conservation interventions to be carefully laid out and maintained according to specified designs, and recommended cropping practices be strictly adhered to.

The Project is introducing a number of low-cost, low risk, soil and water conservation measures, yield-increasing cropping strategies, and tree planting interventions in areas where slopes and soil depths are favourable. If followed correctly, these should promote a more sustainable agriculture, and improve farmers’ incomes. Where slopes are too long and too steep the best protection of the soil is to revert back to a multi-storey tree cover using direct seeding which is within the capabilities and budget of upland farmers.

When asked for yield data, farmers find they can earn 2-10 times more by growing bananas compared with corn. This trend can be encouraged by the LGU maintaining the rural roads so dealers’ trucks and jeepneys can get to the settlements without difficulty.

The objective is to persuade upland farmers to replace corn with fruit trees, which give better protection to the soil and reduce erosion. Eventually, the upland communities will be able to purchase staples such as corn and rice from the sale of fruits, copra, coffee, cacao, etc. as is already happening in parts of Davao del Sur (e.g. Santa Cruz), and in much of Davao del Norte. However, local staff and farmers must be trained to an acceptable level of competency essential for developing sound agricultural practices on these fragile landscapes.

A UDP policy note on upland farming commented that inappropriate agricultural technologies in the upland areas of Southern Mindanao, while rapidly decreasing the productivity and soil fertility of upland farms, impacts lowland communities by causing floods which damage crops, infrastructure and fishing grounds.

Poverty, subsistence needs, family expansion, and continuing migration to the uplands, means pressure to open up more forestland for farming is unavoidable, and cannot be ignored. Existing laws and regulations need to be amended to minimise further deterioration of the uplands watersheds.

Two policy issues have been identified that need addressing:

a) Certain areas in the barangays will be declared off-limits for certain types of agricultural use based on slopes and soil depth limitations in line with current laws. The status of these lands will be agreed by the communities, barangays, municipal governments and the DENR/NCIP, and ensured and enforced by a simple co-management MOA and scheme in which responsibilities of parties are detailed.

b) The remaining area in the barangay will be allocated for different types of agricultural uses (e.g. short-, medium-, and long-term crops, based on UDP’s slope treatment-oriented practices (STOP) land capability classification), or for settlements etc by the LGU/DENR/NCIP. Barangay and municipal ordinances will be needed that specify the conditions to be fulfilled before eligible farmers can expand their farmland.

Due to the dominance of steep slopes, and the infertile and fragile nature of upland soils, the best option is to give priority to applying soil and water conservation measures to protect those limited areas with the highest potential for diversified agricultural production. These
are land units such as hilltops, crests, ridges upper slopes and minor valleys, where slopes tend to be shorter and are less steep. The cultivation of erosive crops such as maize and cassava should be restricted to these areas, provided slope gradients have been reduced by appropriate soil and water conservation interventions, as specified in UDP’s Slope Treatment-Oriented Practices (STOP) land capability classification.

When slopes being cultivated for annual crops are too steep, or the soils are too shallow to apply STOP interventions, the policy should be to pass the decision on land use to the DENR Secretary, who has the power to reclassify them as forest lands to form part of the forest reserves, even if such lands have already been declared as alienable and disposable.

It is up to the DENR to decide if continued cultivation of very steep slopes is in the public interest, or whether the lands should be kept in a vegetative condition sufficient to prevent erosion and adverse effects on the lowlands and streams. If the activities of a few persons are endangering the livelihoods of many, he is empowered to take the necessary steps to expropriate, cancel effective titles, reject public land application or eject the occupants from the area. Unless adequate steps are taken to protect the few remaining perennial streams and springs, it may well be that a combination of loss of soil and water supplies that depopulates the uplands.
1. Introduction

At a press conference in Davao City on 5th October 2004, Co-Director Mr Dashiel Invisible, Resource Management Coordinator Mr Rogelio Abalus, and Upland Farming Systems/Soil and Water Conservation Consultant Mr Kenneth Proud, provided a briefing on the work of the Upland Development Programme (UDP). When asked his opinion on the condition in the uplands of Mindanao, Ken Proud responded that it was alarming, stating that from his field trips to numerous upland farms in six provinces he estimated that the soil profile was being reduced by 2-4 cm of soil annually, due to inappropriate farming practices (mainly growing corn and cassava) on very steep slopes. He compared this loss with the estimated one hundred years it takes to form one centimetre of soil.

2. Evidence for the 2-4 cm loss of soil depth each year

Evidence for the reduction in soil depths in upland soils in Southern Mindanao, cited by Ken Proud, includes:

- Field observations of rill erosion, headcutting, gullying, and on the build up of eroded soil behind cross-slope barriers such as leguminous hedgerows, natural vegetative strips (NVS), and Napier and lemon grass hedges.
- Comparisons of soil depths in remnant forest patches or old, established plantations, with nearby cultivated, fallowed or abandoned land on similar slopes.
- Soil erosion studies elsewhere in the Philippines.
- Studies giving measurements of soil loss under corn and cassava on similar slopes and soils elsewhere in the humid tropics.

2.1 Field observations on soil erosion in the uplands of Southern Mindanao

Photo 1 shows severe rill erosion in crop of spring onions grown on a 55% slope. Some of the rills are several centimetres deep. Although weeding breaks up the rills, this scale of erosion will be repeated several times during each growing season, depending on the rainfall intensity. Heavy mulching, to imitate the leaf litter of the original forest, would protect the soil from raindrop impact and prevent detachment of soil particles from the main mass of soil.

Rill erosion, by concentrating run-off in small channels, accounts for the bulk of sediment removed from a hillside. Rills even occur in areas where there is some kind of ground cover – particularly on sandy and sandy-loam soils – so they are not associated solely with bare soil.
Photo 2 shows the effect of mass movement of soil. This happens at the point down the slope where sheet flow of run-off reaches sufficient velocity to become turbulent, and cuts into the topsoil. Aided by gravity, large volumes of soil move down hill. Slopes with rapidly steepening convexity are most sensitive to this type of erosion (see Photo 3), and are best left under natural forest or multistory tree crops. Gully formation is the next step should run-off be concentrated at one location.

**Photo 2.  Mass movement on slopes with rapidly steepening convexity**

![Photo 2](image)

**Photo 3.  Mass movement of soil - typical of slopes with rapidly steepening convexity**

![Photo 3](image)

Photo 4 illustrates that hedgerows are inappropriate soil and conservation measures on slopes >25% and with lengths greater than 30 metres. Hedgerows cannot prevent a build up in the volume and velocity of run-off. Gullying occurs when flows of run-off converge.

![Photo 4](image)
Photos 1, 5 and 6 show the build up of eroded soil intercepted by cross-slope barriers.

Photo 1 shows the step effect below the grass barrier, as soil is loosened by cultivation and moves down slope, and the build up of soil behind the barrier as the eroded soil is intercepted and retained by the soil conservation measures.

Photo 5 shows 60 cm depth of coarse sandy soil accumulated in just 12 months from hedgerows spaced at 4m intervals on a 45% slope.

**Photo 5. Build up of 60 cm coarse sandy soil after one year**
(Cross bar of A-frame is 105 cms)
Photo 6 is from a hedgerow on a slope of 70%, about 30 metres uphill from the location of Photo 4. Despite having several hedgerows above it, about 100 cm depth of material was retained in the 18 months since the hedgerow was planted.

![Photo 6. One-metre build up of sandy soil after 18 months](image)

2.2 Comparisons of soil depths in relatively undisturbed areas with cultivated land

Whereas gullying and mass soil movement have a dramatic visual impact, erosion processes such as sheet wash and rilling result in a gradual, almost invisible, reduction in the soil profile.

Comparisons between soil depths on cultivated or abandoned agricultural land and the relatively undisturbed soils with similar slopes in nearby remnant patches of secondary forest, or well-established fruit trees, indicate reductions of 25-166 cm on very steep slopes in the UDP area. In one instance, corn cultivation on a 90% slope in the headwaters of a watershed, has reduced the soil depth by 53 cm in just five-years exposing a stone substratum (see Table 1). In the USA it took 100 years for continuous cultivation of corn on slopes less than 3% to reduce soil depth by 37 cm.

<table>
<thead>
<tr>
<th>Cultivated, fallowed or abandoned land</th>
<th>Forest or old established plantation</th>
<th>Soil Loss (Cultivated/cogon vs Tree-covered)</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope (%)</td>
<td>Soil depth (cm)</td>
<td>Slope (%)</td>
<td>Soil depth (cm)</td>
</tr>
<tr>
<td>50%</td>
<td>25</td>
<td>55%</td>
<td>51</td>
</tr>
<tr>
<td>25%</td>
<td>50</td>
<td>25%</td>
<td>75</td>
</tr>
<tr>
<td>45%</td>
<td>50</td>
<td>63%</td>
<td>89</td>
</tr>
<tr>
<td>90%</td>
<td>32</td>
<td>75%</td>
<td>85</td>
</tr>
<tr>
<td>53%</td>
<td>22</td>
<td>80%</td>
<td>87</td>
</tr>
<tr>
<td>55-70%</td>
<td>15</td>
<td>55-70%</td>
<td>40</td>
</tr>
<tr>
<td>45-60%</td>
<td>40</td>
<td>60%</td>
<td>70</td>
</tr>
<tr>
<td>35-45%</td>
<td>84</td>
<td>35-45%</td>
<td>250</td>
</tr>
<tr>
<td>60%</td>
<td>20</td>
<td>60%</td>
<td>60</td>
</tr>
</tbody>
</table>

* Slope cultivated for only 5 years. Soil loss = 10 cm per year.
* Lahar soils
2.3 Importance of soil depth

Soil stores the moisture needed for crop growth. The deeper the soil, the more moisture can be stored for plant growth. With a reduced depth of soil less moisture is available to sustain a crop during gaps between rainstorms. Shortages of moisture for just a few days during critical stages in the crop’s cycle (e.g. at flowering, or the blister stage in kernel formation of corn) can lead to a total crop failure. Already UDP staff have seen crops of corn grown on shallow soils (<25 cm) failing in the uplands because there was a five or six day period without rain during critical periods.

Unlike annual crops, which only require soil moisture during the 3-4 months of the growing season, trees require moisture in the soil throughout the year. As soil profiles erode away and become shallower, their ability to store sufficient moisture for trees to survive dry spells of several weeks is diminished. It can take several years for a fruit tree that has experienced severe moisture stress to regain its former productivity.

This illustrates just how urgent it is to impose constraints and regulate land use in the uplands to ensure sufficient depths of soil remain to support the growth of trees, and restore the infiltration capacity of watersheds.

Interestingly, when farmers are asked to compare their yields of corn with a crop of bananas, they find that bananas give two to ten times the income of corn, with fewer inputs, especially labour. There now appears to be a willingness in some areas to move away from corn towards planting bananas and other fruit trees.

Mismanagement and erosion of marginal upland soils with shallow rooting depths lead to permanent loss of soil fertility and decline in crop yields. The loss of a few centimetres of topsoil can reduce the productivity of good soils by 40% and of poor soils by over 60%1.

These figures indicate that upland farming in Southern Mindanao may be approaching a point of no return. Right now, there is still enough depth of soil in most areas for farmers to move away from cultivating annual crops such as maize and root crops and plant fruit trees or cash crops such as cacao and coffee, but action is needed urgently to accelerate this change.

2.4 Reports of soil loss in the Philippines

The loss of a 1.0 cm depth in soil in a year is, on average, equivalent to 130 t/ha/yr. 400 t/ha/yr is equivalent to 400/130 = 3.08 cm depth of soil (see Annex 1). Soil erosion rates on steep slopes in the tropics are very high. Estimates vary as the rate of erosion increases as slope steepness increases.

- Studies of the effectiveness of SALT (Sloping Agricultural Land Technology) on 18% slopes over six years recorded an average soil loss of 194.3 t/ha/year, with 340 t/ha lost in an 11 month period2. Elsewhere in the Philippines, soil losses in excess of 400 t/ha/year have been recorded3.

---


PCARRD\(^4\) cites the results of several local studies on soil erosion. In cultivated mountain slopes, the average erosion rate was 218.2 tonnes/ha/yr, with *kaingin* lands having the highest soil loss of 508 tonnes/ha/yr, (i.e. a reduction in soil depth of between 3.20 to 4.82 cm, depending on texture). In all of the three major islands of the Philippines, the erosion rate was higher in the hilly lands.

Other studies show that the steeper the slope, the more severe is the rate of soil loss. E.g.:
- in Mindanao, soil losses were found to be 4-6 times greater on slopes of 44% than on 20% slopes\(^5\); while
- in Zamboanga del Sur over 100 cm of soil has eroded away since WWII (i.e. a rate of 2 cm/year), exposing a boulder/stone substratum. Farmers have experienced an 80% decline in corn yield over 15 years\(^6\).

Some UDP areas are dominated by slopes >60%, with maize planted on slopes of over 70% and cassava on slopes as steep as 85%. These slopes are much steeper than the areas studied in the PCARRD report, so the rates of erosion will be much higher. (For example, a study (about 1999) for a project the UDP consultant, Ken Proud worked on in Sumatra, Indonesia, estimated soil losses under maize on a 55% slope to be in excess of 700 t/ha/year).

The 1991 PCARRD study noted: “Recent data on topsoil depth of some upland areas reveal a soil depth of less that 10 cm. At soil depletion rate of 0.75 cm/ha/yr, it will take only some 13 years for the topsoil to be depleted. This makes it necessary for current resource users to be concerned with how the soil is being "mined" at present. If one takes a more optimistic stand and assumes a topsoil depth of 15-25 cm (a figure quoted by some respected soil scientists of the country), then it will take 20-33 years for this layer to be removed”. However, with soil losses of 2 to 4 cm a year on the very steep slopes in the UDP areas, then time to depletion is likely to be less than five years.

The World Bank\(^7\) quotes rates of 300-400 t/ha/year from tilled kaingin plots, compared with 6/ha/yr for undisturbed forest. Industrial tree plantations can be responsible for rates of up to 360 t soil/ha/yr (Table 2 below). Erosion rates of 100 tons/ha/yr are estimated to remove the topsoil completely in about 20 years\(^8\), so soil losses of 400 t/ha/yr are likely to limit the future for crop production on steep slopes to 5 or 6 years.

When the soil is too shallow to support crops will the cultivators have new locations to move to? Reduction in soil depth decreases the amount of water that can be stored in the catchments areas, to be released gradually over time and so maintain perennial stream flows. With reduced storage capacity in the soil the surplus water runs off with each storm. The result for the lowlands, where the agricultural land is most productive is floods during heavy rains, damaging crops and infrastructure, and water shortages during dry periods – again affecting crop production and the quality of human life.

### Table 2. Rates of soil loss under different land uses (after World Bank 1989)

<table>
<thead>
<tr>
<th>Land use</th>
<th>Soil loss (tons/ha/yr)</th>
<th>Soil loss (cm depth)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undisturbed forest</td>
<td>6</td>
<td>Negligible</td>
</tr>
<tr>
<td>Grassland (Philippines)</td>
<td>Up to 200</td>
<td>Up to 1.54</td>
</tr>
<tr>
<td>Tilled kaingin plots</td>
<td>300-400</td>
<td>2.31-3.10</td>
</tr>
<tr>
<td>Industrial tree plantations</td>
<td>Up to 360</td>
<td>2.77</td>
</tr>
</tbody>
</table>


\(^7\) World Bank 1989

3 Soil losses from growing corn/maize and cassava in the humid tropics

A useful website is http://home.alltel.net/bsundquist1/index.html. It contains mainly a collection of five literature reviews done to understand the global magnitude of the degradation and loss of some key life-support systems. Some of this information is reproduced below.

3.1 Soil losses under corn/maize

The erosion rates caused by growing maize on very steep slopes from Haiti (Table 3) are very relevant to the Philippines. In May/June and August/September, 2004, heavy rains falling on severely deforested mountainous terrain in Haiti triggered massive mudslides, which devastated communities lower down the watersheds.

In parts of Southern Mindanao the soil on very steep slopes, loosened by the cultivation for maize and cassava, is lying on the hill sides or piling up in small minor valleys and seasonal drainage lines. A prolonged period of rain over such areas could generate the same catastrophic mudflows as happened in Haiti.

Table 3. Soil losses (t/ha/yr) from growing maize on steep slopes in Haiti

<table>
<thead>
<tr>
<th>Soil type, Slope and Crop</th>
<th>Soil loss (tons/ha/yr)</th>
<th>Depth of soil lost (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>typic silty clay, 35% slope, maize</td>
<td>402-483</td>
<td>3.65-4.39</td>
</tr>
<tr>
<td>Silty clay loam, 70% slope, maize,beans</td>
<td>260</td>
<td>2.26</td>
</tr>
<tr>
<td>typic loam, 55% slope, maize, beans</td>
<td>168-442</td>
<td>1.29-3.4</td>
</tr>
<tr>
<td>typic soudy clay, 35% slope, maize, beans</td>
<td>74-184</td>
<td>0.70-1.75</td>
</tr>
<tr>
<td>sandy clay rhodudent, 60% slope, maize</td>
<td>370</td>
<td>3.22</td>
</tr>
<tr>
<td>sandy clay loam, 75% slope, sorghum</td>
<td>276</td>
<td>2.21</td>
</tr>
<tr>
<td>sandy clay ustropent, 55% slope, sorghum</td>
<td>384</td>
<td>3.25</td>
</tr>
</tbody>
</table>

Soil erosion rates from slopes >20% in Jamaica are similar to the Philippines, i.e. more than 400 t/ha/year (or over 3.10 cm depth of soil a year).

Table 4 shows rates of erosion under continuous crops of maize on very gentle slopes in the USA. Note the almost doubling in the rate of loss as slopes increase from 3% to 8%, and from 8% to 16%. In the Mindanao uplands, where much of the maize is grown on slopes of 40-60%, soil losses can be over 4-6 times higher (see above).

Table 4: Soil losses under continuous corn production in the USA

<table>
<thead>
<tr>
<th>Crop</th>
<th>Soil loss tons/ha/yr</th>
<th>Soil loss cm depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous corn (USA)</td>
<td>53.80</td>
<td>0.41</td>
</tr>
<tr>
<td>Corn, continuous, 0.5-3% slope (lost 36.7cm in 100 years)</td>
<td>46.00</td>
<td>0.35</td>
</tr>
<tr>
<td>Continuous corn (8% slope; 8.2&quot; runoff)</td>
<td>115.00</td>
<td>0.88</td>
</tr>
<tr>
<td>Continuous corn (WI) (16% slope)</td>
<td>199.80</td>
<td>1.53</td>
</tr>
</tbody>
</table>

3.2 Soil losses under Cassava

Cassava is very demanding in its nutrient requirements. Continuous cropping on the same land rapidly depletes the soil of its plant food reserves. The cultivation of cassava in hilly or mountainous terrain is particularly damaging, as harvesting the tubers involves digging up large lumps of soil.

Table 5 indicates the dramatic increase in soil losses under cassava from 3.0 t/ha/year on 1% slopes, to 221 t/ha/year on 15% slopes.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Soil loss (tons/ha/yr)</th>
<th>Soil loss (cm depth)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava (1% slope)</td>
<td>3.0</td>
<td>0.02</td>
</tr>
<tr>
<td>Cassava (5% slope)</td>
<td>87.0</td>
<td>0.67</td>
</tr>
<tr>
<td>Cassava (15% slope)</td>
<td>221</td>
<td>1.70</td>
</tr>
</tbody>
</table>

Source: Sundquist (2003)  

In the UDP areas cassava is commonly grown on slopes above 35%. In an extreme case (San Isidro, Sitio, Cabocan, Davao Oriental), commercial production of cassava for San Miguel Corporation is being attempted on 85% slopes. Since the soil is clay, harvesting the tubers will result in clods of soil rolling down hill as a result of gravity, as well as being washed down by run-off. Soil losses will be considerable and, with a current soil depth of only 50 cm, the farmers will be lucky if the economic life of the land lasts more than five years.

4. Consequences of soil loss through accelerated erosion

The accelerated loss of soil has several adverse impacts. For the upland farmer, it reduces soil fertility and crop yields (the loss of one centimetre can lower yields of corn by almost 100 kg per hectare). To make up for this shortfall in yield, the farmer has to either expand the area under cultivation by felling more forest to access fertile soil; or add large applications of inorganic fertiliser. With limited resources many upland farmers will simply expand the area under cultivation, and increase the problems.

When natural forest covered most of the watersheds, much of the rainfall infiltrated into the soils, and the stored moisture was released gradually, maintaining the flow of streams and rivers through the year.

The soil and water protection functions of the watersheds were lost when the forest was cut down. When the protective cover of leaf litter on the forest floor was burnt off, the fragile upland soils were exposed by cultivation to the direct impact of raindrops. Most of the rainfall, instead of infiltrating into the soil, now runs off the land scouring the soil, carrying it as sediment into streams. On steeper slopes, the run-off attains faster velocities, and the greater is the rate of soil erosion. Slope length and slope shape both affect the erodibility of the land – with long slopes and slopes with rapidly steepening convexity increasing the erosion hazard.

In the lowlands, deposition of the sediment occurs when stream channels flatten out and broaden into rivers, and gradients become gentle. A river with a channel depth filled with eroded sediment from the uplands, is no longer able to carry the increased spate flows. For

---

11 www.extension.iastate.edu/agdm/wholefarm/html/c6-80.html
the lowland farmer, the surplus water spilling over the banks causes floods that inflict enormous damage to cropland, crops and infrastructure.

The value of flood damage in the lowlands is often greatly disproportionate to the value of the corn and cassava grown in the uplands that caused the floods in the first place.

However, as soil depths in the uplands get shallower and more forests are cleared to compensate for lower yields, the future for perennial streams and springs looks bleak. It may well be a combination of loss of both soil and water supplies that depopulates the uplands.

5. Options for the Upland Farmer

Whenever UDP staff asked upland farmers to compare their yields from growing corn, with bananas (provided there is a market), bananas are found produce 2-10 times more income than corn. This is true even when farmers claimed to get kg 5,000/ha/harvest from three harvests a year.

Farmers are also surprised to discover that they are walking 13,300 m for each field operation such as planting or weeding per hectare of corn (with a spacing of 0.75 cm between rows of corn). With six field operations the farmer walks the equivalent of 80 km for each harvest! Bananas, on the other hand, require less labour, particularly weeding, and the grass cover between the stands protect the soil from erosion.

Some farmers are now reducing the area under corn and replacing it with bananas and other fruit trees. This trend needs to be encouraged, and simple measures such as grading the roads will encourage traders to drive to upland settlements to purchase the bananas.

The main point to be emphasised is that farmers currently have the option to switch to tree crops on most of their farm areas. Every season they delay, several centimetres depth of soil is lost and the potential for planting trees rapidly diminishes.

POLICIES NEEDED TO PROMOTE SUSTAINABLE UPLAND FARMING

Due to the fragile, infertile soils and rugged terrain of the uplands, the 1999 Planning Atlas for Region XI produced by JICA12, considered the general land development suitability of much of the UDP project areas either as forest conservation areas or not suitable for upland crops or for orchard development (see Annex 2).

Despite this blanket assessment, the UDP has identified several areas within the uplands of Southern Mindanao, where permanent and diversified cropping systems can be undertaken profitably. However, this requires certain soil and water conservation interventions to be carefully laid out and maintained according to specified designs, and recommended cropping practices be strictly adopted and adhered to.

These areas are mainly restricted to slopes below 55%, with loam and clay-textured soils over 100 cm deep. Within these areas the Project has identified, and is introducing, a number of low-cost, low risk, soil and water conservation measures, yield-increasing cropping strategies, and tree planting interventions. If followed correctly, these should promote a more sustainable agriculture, and improve farmers’ incomes.

On slopes above 55% slope the best protection of the soil is to revert back to a multi-storey tree cover (e.g. fruit trees, bananas, coffee, cacao, etc) with a good grass ground cover.

Direct seeding in the hills, and grafting on scions, is within the capabilities and budget of upland farmers, and ensures a deeper penetrating root system than the fibrous roots found in nursery raised trees. As mentioned above, farmers who are aware of the higher incomes per unit area to be earned from fruit trees are to expand the area under tree crops by reducing the area under annual crops.

The intended outcome is for upland communities to purchase staples such as corn and rice from the sale of fruits, copra, coffee, cacao, etc. as is already happening in parts of Davao del Sur (e.g. Santa Cruz), and in much of Davao del Norte. However, local staff and farmers must be trained to an acceptable level of competency essential for developing sound agricultural practices on these fragile landscapes.

However, there are many areas where soil and water conservation interventions cannot be safely implemented without increasing the erosion hazard, due to the configuration of the land (slope length and shape), highly erodible lahar soils, or truncated soil profiles (see Photo 7).

**Photo 7. Very steep slopes in the fragile uplands with no future for crop production**

In a policy note on upland farming in Southern Mindanao titled: *Here is the farm but where is the soil?* UDP Co-Director Mr Wiebe van Rij observed that inappropriate agricultural technologies are being applied over extensive upland areas of Southern Mindanao. The resulting severe soil erosion has not only affected the upland farmers concerned, in terms of rapidly decreasing productivity and soil fertility of their farms, but also lowland communities. This includes damage to crops and infrastructure by flooding, as mentioned above, as well as destruction of fishing grounds along the coast.

It also appears that due to various reasons such as poverty, subsistence needs, family expansion, and continuing migration to the uplands, the pressure to open up more forest land for farming is unavoidable, at least in the coming decade. It seems this reality cannot be ignored any more. To cater for this situation existing laws and regulations need to be amended in such a way that further deterioration of the uplands watersheds is minimised.
Two issues need to be addressed:

a) Initiating a form of “social fencing”, in which the communities, barangays, municipal governments and the DENR/NCIP formally agree that, based on slopes and soil depth factors, certain areas in the barangays will be declared off-limits for certain types of agricultural use (see Box 1). The agreed status of these lands will be ensured by a simple co-management MOA and scheme in which responsibilities of parties are detailed. Such a MOA and scheme would need full endorsement and resource allocation and strict enforcement by the stakeholders and linked to any UDP support for upland farming.

<table>
<thead>
<tr>
<th>Box 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under The Sustainable Forest Management Act of 2002, the following (upland) areas, are needed for environmental protection and forestry purposes and shall not be classified as alienable and disposable lands, even if they are less than 18% in slope, nor be subject to logging, mining, quarrying and such other form of land use or resource extraction activities:</td>
</tr>
<tr>
<td>− Areas less than two hundred fifty (250) hectares which are far from or not contiguous with any certified alienable and disposable lands;</td>
</tr>
<tr>
<td>− Isolated patches of forest of at least five (5) hectares in area with rocky terrain or which protect a spring for communal use;</td>
</tr>
<tr>
<td>− Ridge tops and plateaus regardless of size found within or surrounded wholly or partially by forestlands where headwaters emanate;</td>
</tr>
<tr>
<td>− Twenty-meter wide strips of land from the edge of the normal high waterline of rivers and streams with channels of at least five (5) meters wide which are not yet classified as alienable and disposable; and</td>
</tr>
<tr>
<td>− Areas considered environmentally critical because of their vulnerability to damage from landslides, volcanic eruptions, and other natural causes.</td>
</tr>
</tbody>
</table>

b) Allocate the rest of the area in the barangay for different types of agricultural uses (e.g. short-, medium-, and long-term crops, based on UDP’s slope treatment-oriented practices (STOP) land capability classification), or for settlements etc by the LGU/DENR/NCIP. In respect of agricultural development for suitable areas, there should be barangay and municipal ordinances that specify the conditions to be fulfilled before eligible farmers can expand their farmland. For example, this would include submitting expansion plans and getting prior approval that the land is suitable for the proposed use, and the proposed soil protection measures are appropriate. The emphasis is to be on growing fruit tree crops. Although UDP would still severely discourage growing of non-tree crops on slopes above 45%, it would allow some sort of DFS (Diversified Farming Systems) support to those farmers that really have no alternative farmland. Needless to say, extension staff should seriously validate those farmers in this respect before any support can be extended. Within this framework it may be necessary to modify the STOP policy in respect of farming on the steeper slopes.

Due to the dominance of steep slopes, and the infertile and fragile nature of upland soils, the best option is to give priority to applying soil and water conservation measures to protect those limited areas with the highest potential for diversified agricultural production. These are the land units such as hilltops, crests, ridges upper slopes and minor valleys, where slopes tend to be shorter and are less steep. The cultivation of erosive crops such as maize and cassava should be restricted to these areas, provided slope gradients have been reduced by appropriate soil and water conservation measures.
Soil erosion is to be reduced by two approaches: the barrier approach and the cover approach.

a) In the barrier approach, contour-planted hedgerows or strips of Napier or Vetiver grass act as permeable barriers slowing the rate of water flow so that soil particles are deposited and infiltration of water into the soil is increased. The build-up of soil behind these cross-slope barriers can gradually lead to the formation of terraces. This process can be reduced to 4-5 years by contour ploughing with carabao.

It is recommended that use be made of bayanihan and mobilise as many carabaos that are available for hire in the barangay for that purpose. Such bayanihan could be contracted out to the UBA and financed by UDP, barangay and municipal LGU. Strict supervision by technical experts would be necessary during the application of any of these technologies.

b) The cover approach, when combined with the barrier approach, involves mulching to cover the soil exposed by cultivation between barriers using hedgerow prunings or crop residues.

When cross-slope barriers are not appropriate, the best cover (after natural forest) is a combination of tree cover with grass (but not cogon).

When slopes are too steep or soils are too shallow to apply STOP interventions, or when there is no future for any form of cropping systems (see Photos 7 and 8), the policy should be to pass the decision on land use to the DENR. Where such lands have already been declared as alienable and disposable, the law allows the DENR Secretary to reclassify them as forest lands to form part of the forest reserves.

It is up to the DENR to decide if continued cultivation of very steep slopes is in the public interest, or whether the lands should be kept in a vegetative condition sufficient to prevent erosion and adverse effects on the lowlands and streams. If the activities of a few persons are endangering the livelihoods of many, he is empowered to take the necessary steps to expropriate, cancel effective titles, reject public land application or eject the occupants from the area. The only potential for land in the condition shown in Photo 8 is as a threat to the lowlands.

Under the Forest Code, lands already covered by existing titles or approved public lands application, or which have actually been occupied "openly, continuously, adversely and publicly for a period of not less than thirty years as of the effectivity of the Forest Code of the Philippines", shall be kept in a vegetative condition sufficient to prevent erosion and adverse effects on the lowlands and streams, if not yet part of a well-established community, This needs to be enforced.

However, when public interest so requires (e.g. if there is a risk of Haiti-type mudslides), the DENR Secretary can take the necessary steps “to expropriate, cancel effective titles, reject public land application or eject occupants thereof”.

Finally, it should be emphasised that soil erosion is seen by the scientific community to be as big a threat to human welfare as global warming (see Annex 3).

---

13 SALT hedgerows are only effective on slopes below 25%, while terracing using Napier grass should be restricted to a distance of 10-15 m down from the hill top, to overcome the problem of having to divert and dispose of surplus run-off every few metres down the slope.
Photo 8. Eco-terrorism! Precipitous slopes cleared for unsustainable arable agriculture
ANNEX 1

CALCULATING DEPTHS OF SOIL LOST PER HECTARE

- The loss of 1.0 cm depth represents 100 m³ soil lost per hectare (see Box below).

<table>
<thead>
<tr>
<th>Box 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 cm = 0.01 m</td>
</tr>
<tr>
<td>1.0 ha = 100 m x 100 m</td>
</tr>
<tr>
<td>Loss of 1.0 cm depth of soil = 0.01 x 100 x 100 = 100 m³/ha/yr</td>
</tr>
</tbody>
</table>

- The weight of 1.0 m³ soil varies according to the soil texture, which affects the Bulk Density of the soil. The Bulk density is the weight\(^{14}\) of a given volume of soil including the pore spaces. An average value would be 1.3 g per cm³ (= 1.3 t/m³). Coarse textured soils usually have a higher bulk density because they have less pore space than fine textured soils. (See Box 2).

<table>
<thead>
<tr>
<th>Box 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texture</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Sand</td>
</tr>
<tr>
<td>Loam</td>
</tr>
<tr>
<td>Clay</td>
</tr>
</tbody>
</table>

\(^{14}\) Bulk density (i.e. soil dry weight/soil volume) can be easily measured by gently pressing a small cylinder of known volume into the soil, and removing the core. The core is dried in oven to remove the water contained in the pore space then weighed.
ANNEX 2

Land suitability issues

The 1999 *Planning Atlas* for Region XI\(^1\), considers the general land development suitability of much of the UDP project areas either as *forest conservation areas* or *not suitable for upland crops* or *for orchard development*. The JICA land capability classification maps of the Davao Gulf Provinces classify over 90% of the UDP-covered barangay areas as not suitable for upland crops (Map 1); with about 50% of the UDP area considered unsuitable even for orchard crops (Map 2).

From JICA’s assessment it would appear that sustainable agricultural development is not possible in the uplands of the Compostela Valley, Davao Oriental and Davao del Sur. JICA does not provide information on Sarangani and South Cotabato as these provinces are outside JICA’s study area.

**Map 1. Land capability of the Davao Gulf Provinces for Upland Crops according to JICA**

---

Map 2. Land capability of the Davao Gulf Provinces for Upland Orchards according to JICA
Soil erosion as big a problem as global warming, say scientists

Tim Radford in Seattle learns how soil threatens humanity

Saturday February 14, 2004
The Guardian

Erosion of topsoil - already a serious problem in Australia, China and parts of the US - threatens modern civilisation as surely as it menaced societies long since vanished, researchers warned yesterday.

Jared Diamond, a physiologist at University of California Los Angeles and author of Guns, Germs and Steel, told the AAAS yesterday that Iraq, part of the Fertile Crescent in which agriculture started 10,000 years ago, was once the wealthiest, most innovative, most advanced country in the world. But today it was a "basket case", mainly because of "soil problems, salinisation, erosion, coupled with problems of deforestation".

Although more than 99% of the world's food comes from the soil, experts estimate that each year more than 10m hectares (25m acres) of crop land are degraded or lost as rain and wind sweep away topsoil. An area big enough to feed Europe - 300m hectares, about 10 times the size of the UK - has been so severely degraded it cannot produce food, according to UN figures.

In many places, soil is being lost far faster than it can be naturally regenerated. Attempts to irrigate arid lands have produced soils so salty that nothing will grow. One speaker, Ward Chesworth of the University of Guelph, Ontario, told the conference that farming had produced an "agricultural scar" on the planet that affected a third of all suitable soils.

Societies in the past had collapsed or disappeared because of soil problems. Easter Island in the Pacific was a famous example, Prof Diamond said. Ninety per cent of the people died because of deforestation, erosion and soil depletion.

"Society ended up in cannibalism, the government was overthrown and people began pulling down each other's statues, so that is pretty serious. In another example, Pitcairn and Henderson island in the south-east Pacific, everybody ended up dead. Another example was Mayan civilisation in the Yucatan peninsula of Mexico and Guatemala. Again, people survived but about 90% of the population was lost," he said.

Other examples, he said, include Iceland, where about 50% of the soil ended up in the sea. Icelandic society survived only through a drastically lower standard of living. He said the media focused on fossil fuel problems, climate change, biodiversity, logging and forest fires, but not on the soil because it was less spectacular.

"There are about a dozen major environmental problems, all of them sufficiently serious that if we solved 11 of them and didn't solve the 12th, whatever that 12th is, any could potentially do us in," he said. "Many of them have caused collapses of societies in the past, and soil problems are one of those dozen."
ANNEX 7.2

PROBLEMS WITH CASSAVA PRODUCTION IN THE UPLANDS OF SOUTHERN MINDANAO
Upland Development Programme in Southern Mindanao (UDP)

PROBLEMS WITH CASSAVA PRODUCTION IN THE UPLANDS OF SOUTHERN MINDANAO

Report by

K R S Proud
Upland Farming Systems/Soil & Water Conservation Consultant
&
Ben-Hur Viloria
Sustainable Agriculture Development Coordinator

25 October 2004

A partnership programme sponsored by
the European Commission (EC) and the Government of the Philippines (GoP)
and executed by the Department of Agriculture (DA)
TABLE OF CONTENTS

SUMMARY
1. Introduction 1
2. Past experiments in continuous cropping of cassava 1
3. Soil losses under Cassava 1
4. Commercial production of cassava on steep slopes, San Isidro, Davao Oriental 2
5. The future for cassava production in the uplands 4

RECOMMENDATIONS 4

List of Tables
Table 1. Soil losses under Cassava 1
Table 2. Site details of cassava planted under contract in Davao Oriental 3

List of Photos
Photo 1. Farmer indicating depth of soil intercepted by Napier hedge in one year 2
Photo 2. Cassava planted for commercial production on 85% slopes 3
SUMMARY

Cassava production, even on the gentlest of slopes, causes unacceptable amounts of soil loss and damages the agricultural potential and economic value of the farm. To maintain the health of the land, UDP should only support the cultivation of cassava (and other root crops) when it is to grown in the flat, valley bottoms, or on areas where level (0-3%) terraces have already been formed by well-established cross-slope barriers.

Cassava requires heavy applications of commercial fertiliser to obtain maximum yields, because continuous cropping on the same land rapidly depletes the soil of its plant food reserves. Very low yields are obtained on impoverished soils.

Soil losses under cassava increase dramatically with small increases in slopes. For example, from 3 t/ha/yr lost on a 1% slope to 221 t/ha/yr lost on a 15% slope. Studies in Mindanao indicate that the erosion from a 44% slope is 4-6 times that from a 20% slope. In the UDP areas, cassava is commonly grown in hilly or mountainous terrain on slopes above 35%, so soil losses will be very high.

A number of cooperatives in San Isidro, Davao Oriental, have signed memoranda of agreement with San Miguel Corporation (SMC) to plant 400 hectares for the production of cassava, to be increased to 1,200 hectares in the next three years.

Cassava has been planted on slopes of 37% to an extreme of 85%. Massive soil losses of 1,300 t/ha/yr can be expected. With soil depths of only 50 cm, the economic life of the farms may only extend to a second harvest of cassava, after which the land will only support cogon grass.

A recent UDP study indicated that cultivation of corn and cassava, and other annual crops, has reduced soil depths by between 25 to 166 cm on very steep slopes in the UDP area – in one case by as much as 10 cm per year over five years.

Given the fragile, highly erodible and infertile nature of upland soils, it must be concluded that continued cultivation of cassava and corn, even on gently sloping land, is unsound land husbandry. If the uplands are to have a future for providing sustainable incomes, farmers must be persuaded to move away from growing of highly erosive annual crops (cassava and all other root crops, corn, etc).

The DENR needs to decide whether commercial cassava cultivation on sloping land is in the public interest. If the law requires the lands to be kept in a vegetative condition sufficient to prevent erosion and adverse effects on the lowlands and streams, then the necessary steps should be taken to prevent further cultivation of cassava after the current crop has been harvested.

The economic as well as ecological advantages for growing fruits should be emphasized. Bananas give 2-10 times the income than corn or cassava, make more efficient use of labour, and protect the soil.
RECOMMENDATIONS

• Cassava production, even on the gentlest of slopes, causes unacceptable amounts of soil loss and damages the agricultural potential and economic value of the farm. To maintain the health of the land, UDP should only support the cultivation of cassava (and other root crops) when it is to grown in the flat, valley bottoms, or on areas where level (0-3%) terraces have already been formed by well-established cross-slope barriers.

• The cassava production contracts between the SMC and the Cooperatives in Davao Oriental should be cancelled. One way this could be achieved is for DENR to decide if continued cultivation of very steep slopes is in the public interest, or whether the law requires the lands to be kept in a vegetative condition sufficient to prevent erosion and adverse effects on the lowlands and streams. The DENR Secretary is empowered to take the necessary steps to expropriate, cancel effective titles, reject public land application or eject the occupants from the area.

• Involve MED in advising farmers, via UBAs and UCOs, on the profitability and marketability of various crops, citing the comparative value of crops such as bananas and pineapples compared to cassava and corn.

• Establish banks of both Vetiver grass and Napier grass on the learning sites (particularly where there are minor valleys) to meet the needs of neighbouring farms for material for cross-slope barriers. Napier grass is more effective at intercepting eroding soil than leguminous hedgerows. However, it is not as effective as Vetiver grass when planted in a single row as the gaps between stems are too wide for it to control the flow of soil and water after a heavy rainstorm.

• Protect all gentle crests, plateaux and upper slopes against erosion by planting appropriately spaced cross-slope barriers. Short- and medium-term crops should be planted on the terraces that develop. (A farmer is more willing to fell a banana tree, than a mature mango or durian tree, for example, should there be a need to return to annual crops in the future).
Problems with Cassava production in the Uplands of Southern Mindanao

1. Introduction

Cassava is very demanding in its nutrient requirements. Heavy applications of commercial fertiliser (300-400 kg of complete fertiliser/ha) are required to obtain maximum yields of cassava (average 20 t/ha per crop with moderate inputs in terms of land preparation and weeding). Continuous cropping on the same land rapidly depletes the soil of its plant food reserves. Cassava can survive on impoverished soils but very low yields are obtained.

The average growth period for cassava for commercial starch production is 14 months. Some varieties mature in shorter periods of time but yields are markedly reduced. Two crops of corn a year would give a better income, with similar soil erosion losses. Bananas would give even higher income with much reduced erosion risk.

2. Past experiments in continuous cropping of cassava

Trials of cassava (Java Brown variety) interplanted with “Hawaiian Giant” ipil-ipil, carried out on Hacienda San Jise, Makar, General Santos City, in 1976, involved a one year-old stand of “Giant” ipil ipil closely drilled in rows spaced one metre apart, and cut back to 10 cm stumps. Stems and leaves were laid in the space between every other row of ipil ipil. 25 cm long cassava stem cuttings were planted at 50 cm intervals in spaces between rows to which the green manure had not been added. One month after planting the cassava, the ipil ipil regrowth was cut back (and then every two months) and the cut material laid along both sides of the cassava rows as an organic fertiliser.

The estimated yield was 40 MT/ha of occupied area. However, since every row was not planted to cassava (as every other row was used for piling the voluminous ipil ipil cuttings from one year), the actual yield for the area of the farm was 20 MT/ha.

Although this trial system gave excellent results the first time, ipil ipil leaf production may not be adequate for successive crops of the nutrient-demanding cassava, due to severe competition for available light.

3. Soil losses under Cassava

The cultivation of cassava in hilly or mountainous terrain is particularly damaging, due to massive soil losses caused by loosening the soil when the tubers are harvested. Table 1 indicates the dramatic increase in soil losses under cassava from 1% to 15% slopes. (It took 100 years in the USA for continuous cultivation of corn on slopes of less than 3% to reduce soil depth by 37 cm).

<table>
<thead>
<tr>
<th>Crop</th>
<th>Soil loss (tons/ha/yr)</th>
<th>Soil loss (cm depth)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cassava (1% slope)</td>
<td>3.0</td>
<td>0.02</td>
</tr>
<tr>
<td>Cassava (5% slope)</td>
<td>87.0</td>
<td>0.67</td>
</tr>
<tr>
<td>Cassava (15% slope)</td>
<td>221.0</td>
<td>1.70</td>
</tr>
</tbody>
</table>

Source: Sundquist (2003)

A UDP cooperator in Sitio Cabocanan, Mr Santos Bidiot, is growing cassava on a gently sloping crest (15-20%) between cross-slope barriers of Napier grass. He says he can see the soil moving downhill when it rains. More than two centimetres of soil were intercepted by the Napier grass hedges in one year (see difference between height of farmers’ knees in Photo 1). With one centimetre of soil equating to 115-130 tons/ha/yr, the soil losses of 230-260 t/ha/yr are in the range for the 15% slope indicated in Table 1.

Photo 1. Farmer indicating depth of soil intercepted by Napier hedge in one year

Extrapolating the findings of erosion studies in Mindanao, which indicated soil losses 4-6 times greater on slopes of 44% than on 20% slopes\(^2\), then soil losses of between 900-1,350 t/ha/yr can be expected from growing cassava on 45% slopes (i.e. a reduction in the depth of a clay soil of 7-11 cm per year). In Haiti, corn cultivation on 35% slopes resulted in soil losses of 402 t/ha/yr\(^3\) (a soil depth reduction of 3.7-4.4 cm).

4. Commercial production of cassava on steep slopes, San Isidro, Davao Oriental

In the UDP areas cassava is commonly grown on slopes above 35%, so soil losses will be high. In a recent development, a number of cooperatives in San Isidro, Davao Oriental, have signed memoranda of agreement with San Miguel Corporation (SMC) to “initially establish a minimum of four hundred (400) hectares for the production of cassava, which shall be increased to one thousand two hundred (1,200) hectares in the next three years for the production of corn and/or cassava”.

---


Problems with cassava production in the Uplands

October 2004

Under the contract, SMC provides technical assistance to the farmers for training, including farm visits for observational purposes. But the costs of the technicians and their farm visits have to be paid for by the cooperatives.

The TA Upland Farming Systems/Soil and Water Conservation Consultant visited some of the farms with Noa Paciencio, Project Development Officer; Felix Agut VII, Agriculturalist, and Nador Galagar, Barangay Captain on 8 September, 2004 (see site observations in Table 2).

Table 2. Site details of cassava planted under contract in Davao Oriental

| PPO 2 San Isidro Sitio Cabocanan SIDOUCO | Site 1: Approx 1 ha |
|                                         | 37% slope, Clay loam. Soil depth: 50-100cm. No hedgerows. Cassava planted in maize trash. |
|                                         | Site 2: 2-3 ha |
|                                         | 85% slope, Clay loam. Soil depth: 50 cm. Young hedgerow 3 m spacing (Indiofera, Rinsones, Flemingia). |
|                                         | Site 3: Approx 1 ha |
|                                         | 45% slope, Clay loam. Mixed cropping with hedgerows 4-5 m spacing, durian, cacao, mango, lansones, banana, coconut. Fairly well shaded. |

In the extreme case of commercial production of cassava being attempted on clay soils on 85% slopes (see Photo 2), massive soil losses can be expected after the first harvest. The Consultant estimated soil losses could exceed 1,300 t/ha/year - equivalent to a potential reduction in depth of 11 cm/year. With a current soil depth of 50 cm, the economic life of that particular piece of land may only extend to a second harvest of cassava, after which the land will only support cogon grass.

The DENR should be asked to decide whether it is in the public benefit for the land to be exploited in this way, and then take action as necessary (see Recommendations).

Photo 2. Cassava planted for commercial production on 85% slopes
5. The future for cassava production in the uplands

A recent UDP study\(^4\) examined soil depths on cultivated or abandoned agricultural land and the relatively undisturbed soils with similar slopes in nearby remnant patches of secondary forest, or well-established fruit trees. The results indicated that cultivation of corn and cassava, and other annual crops, has reduced soil depths by between 25 to 166 cm on very steep slopes in the UDP area.

Given the fragile, highly erodible and infertile upland soils, it must be concluded that continued cultivation of cassava (and corn), even on gently sloping land, is unsound land husbandry. If the uplands are to have a future for supporting agriculture, farmers must be persuaded to move away from growing of highly erosive annual crops (cassava and all other root crops, corn, etc).

The economic as well as ecological advantages for growing fruits are obvious. Corn, growing on shallow soils, will fail to produce any grain if there is a dry spell of a few days. Bananas, on the other hand, give 2-10 times the income than corn or cassava (generating up to P200 compared with P15-95 per 10m\(^2\) of farm), make more efficient use of labour, and protect the soil. Well-mulched pineapples, if properly spaced, can produce up to P420/10m\(^2\), and are drought-resistant.

Recommendations

- Cassava production, even on the gentlest of slopes, causes unacceptable amounts of soil loss and damages the agricultural potential and economic value of the farm. To maintain the health of the land, UDP should only support the cultivation of cassava (and other root crops) when it is to grown in the flat, valley bottoms, or on areas where level (0-3%) terraces have already been formed by well-established cross-slope barriers.

- The cassava production contracts between the SMC and the Cooperatives in Davao Oriental should be cancelled. One way this could be achieved is for DENR to decide if continued cultivation of very steep slopes is in the public interest, or whether the law requires the lands to be kept in a vegetative condition sufficient to prevent erosion and adverse effects on the lowlands and streams. The DENR Secretary is empowered to take the necessary steps to expropriate, cancel effective titles, reject public land application or eject the occupants from the area.

- Involve MED in advising farmers, via UBAs and UCOs, on the profitability and marketability of various crops, citing the comparative value of crops such as bananas and pineapples compared to cassava and corn.

- Establish banks of both Vetiver grass and Napier grass on the learning sites (particularly where there are minor valleys) to meet the needs of neighbouring farms for material for cross-slope barriers. Although Napier grass is more effective at intercepting eroding soil than leguminous hedgerows, it is not as effective as Vetiver grass when planted in a single row. The gaps between stems are too wide for it to control the flow of soil and water after a heavy rainstorm. Double rows of Napier are advisable.

• Protect all gentle crests, plateaux and upper slopes against erosion by planting appropriately spaced cross-slope barriers. Short- and medium-term crops should be planted on the terraces that develop. (A farmer will be more willing to fell a banana tree, than a mature mango or durian tree, for example, should there be a need to return to annual crops in the future).