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Upland Development Programme
in Southern Mindanao (UDP)

DEVELOPING A MODEL FOR SUSTAINABLE UPLAND FARMING IN SOUTHERN MINDANAO

Final report of the
Upland Farming / Soil & Water Conservation Specialist

Kenneth R S Proud

July - November 2005

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TERMINAL REPORT OF THE
UPLAND FARMING/ SOIL & WATER CONSERVATION MISSION

by

Kenneth R S Proud

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DISCLAIMER

The views expressed in this Report are purely those of the writer and may not in any circumstance be regarded as stating the official position of the European Commission

Cover photo: A 600 sq m corn patch set up under coconuts. Mario Carungay's farm, Second Barangay, San Miguel, San Isidro, Davao Oriental

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LIST OF ACRONYMS

AT	Agricultural Technician
ATI	Agricultural Training Institute
BEW	Barangay Extension Worker
DA	Department of Agriculture
DENR	Department of Environment and Natural Resources
DFS	Diversified Farming System
DIDP	Davao Integrated Development Project
FP	Financing Proposal
FTG	Farmers Training Group
HYV	High Yielding Variety
JICA	Japanese International Cooperation Agency
LGU	Local Government Unit
MAO	Municipal Agricultural Officer
MTR	Mid-Term Review
NVS	Natural Vegetative Strip
PFI	Provincial Financial Institution
PhP	Philippine Pesos
PPO	Provincial Project Office
RM	Resource Management
SAD	Sustainable Agricultural Development
SALT	Sloping Agricultural Land Technology
STOP	Slope Treatment-Oriented Practices
SWC	Soil and Water Conservation
UDP	Upland Development Programme in Southern Mindanao
VI	Vertical Interval

EXECUTIVE SUMMARY

The Mid-Term Review

In September 2003, The Mid-Term Review (MTR) recommended the Project make immediate efforts to define replicable and sustainable models. It pointed out that, under the Global Work Plan, distributing inputs to farmers is not an appropriate and sustainable strategy. Only proven technologies were to be promoted amongst farmers, who should be expected adopt them using their own inputs.

Rather than implement technically inappropriate projects, e.g. hedgerows on slopes over 60%, the MTR recommended technological packages be developed for each of the slope zones, in pack sizes affordable to upland farmers, that continually increase the area devoted to perennial plants, while decreasing the area devoted to annual plants. Increasing the productive efficiency per unit area of annual crops, releases land and labour to earn income from activities such as fruit orchards on-farm, or paid labour off-farm.

Major constraints to farming in the uplands

Major constraints to developing sustainable farming models in the uplands include very steep terrain and infertile fragile soils. In fact, in 1999 the uplands of the Davao Gulf Provinces were classified as unsuitable for upland crops and orchards by the Davao Integrated Development Project). Rather than move the one million people living in the uplands onto other land, the UDP opted for a pragmatic approach to reducing environmental degradation by changing the present annual corn-based cropping farming system to more appropriate permanent and diversified cropping systems.

Features of upland farming in UDP areas

Since July 2003, when the Consultant first began work on the UDP, the following features of upland farming in Mindanao have become apparent. They form the basis for developing a model for sustainable upland farming in Southern Mindano:

- Cultivating annual crops on sloping land has reduced soil profiles by 50-100 cm depth over the past 20-30 years(av.of 3 cm/yr). Skeleton soils are being formed.
- Corn and cassava are NOT suitable as upland cash crops. Production costs often far exceed the market value of the crop, causing heavy financial losses to farmers.
- The time spent on growing unfertilised “native” corn for home consumption is excessive and contributes to poverty as it prevent farmers from undertaking more productive activities which would help them support their families better.
- Promoting the use of organic fertilisers over inorganic fertilisers in the uplands increases labour inputs and costs to the farmer and may result in lowering incomes. There are no guarantees that buyers will pay premium prices for organic produce from upland farmers. Organic fertilisers by themselves are low quality fertilisers and are not appropriate for field crops, which require plenty of nitrogen for increased production. A mixture of organic and inorganic fertilisers is best, but half measures are likely to be ineffective.
- Bananas give 2-10 times the income from the same area as corn.

Causes of severe land degradation in the uplands of Southern Mindanao
Mixed cropping, in which annual crops such as corn and cassava are planted between perennial crops, is a major cause of soil losses on the steep slopes in the uplands. Soil depth reductions of 50-100 cm over 20 to 30 years (3-6 cm depth reduction/year, equivalent to 400-800 tons soil/ha/year) have resulted, placing an additional constraint on developing a sustainable model. In many areas coconut trees are now perched on pedestals of soil with only 40-60 cm depth of soil to obtain nutrients and soil moisture.

Identifying a replicable and sustainable agricultural model for the uplands
An analysis of subsistence farming systems in the humid tropics in other parts of the world aided the identification of replicable and sustainable model for permanent upland cultivation in Southern Mindanao. The conclusion is the permanent cultivation of upland in a hot humid climate "presents some of the most troublesome problems of tropical agriculture". Successful strategies adopted by smallholder farmers in the humid tropics from Central and South America, West and East Africa, South Asia and South East Asia and Australia, include: *dualistic cropping*, *multi-storey cropping*, *zero tillage and mulching*, *reduction in the area of annual crops to meeting the family's food needs*, and *intensive cultivation of vegetables in gardens*.

As these strategies have proved to be replicable in areas with hot, humid climates across countries and continents, then they should be applicable and replicable in a similar climate in Mindanao. Examples of permanent cropping which preserve the soil rely on intensive fertilising with both organic *and* inorganic fertilisers, backed up by erosion control measures, and intensive ploughing.

In support of dualistic cropping, the Consultant developed a land unit-based land capability classification to identify those sites with slope ranges suitable for either annual and/or perennial crops. A proposed name for the model is the Land Unit-based Diversified Farming System. This report outlines the various strategies associated with the model and discusses their *Relevance*, *Effectiveness*, *Efficiency*, anticipated *Impact* and *Sustainability* with regard to the Project's objectives, and in complying with the recommendations of the Mid-Term Review.

The Land Unit-based Diversified Farming Systems
Dualistic cropping, in which reduced areas of annual crops are planted separately from enlarged areas under perennial crops, is typical of smallholder cropping practices in many parts of the tropics. It is an obvious model to reduce the widespread degradation caused by mixed cropping in Southern Mindanao.

STOP 1, *Land Unit Farming,* is a land capability classification developed by the Upland Farming/SWC Consultant over the past two years to aid the *micro-level* planning of farms. It helps field technicians decide whether sites are suitable for annual crops or if they are best converted to perennial crops. STOP also lists some appropriate site-specific land care and land management strategies according to the intensity of cropping, for small areas of land in the steep terrain. It takes into account the dangers of accelerating land degradation by planting leguminous SALT hedgerows on inappropriate sites, such as long slopes, or slopes >25%.

With regard to dualistic cropping, the cultivation of annual crops in the steep terrain of Southern Mindano, STOP relocates and restricts annual crops to the very small areas of flat

to gently sloping hill tops and minor valleys. Tree crops replace annual crops on the steeper slopes, between 25-55% – preferably by direct seeding, followed by field-grafting of scions. Instead of mono-crops such as cacao, rubber, coffee, coconuts etc, the UDP model encourages *diversified farming*, in which mixtures of bananas, tree and shrub crops are planted. A range of high value annual crops is also promoted. However, the potential for supplementary watering has been greatly reduced due to severe damage to watersheds which limits the opportunities for gravity-fed irrigation of vegetable plots in otherwise suitable areas.

To date, no technologically sound or proven *sustainable* agricultural systems for the shallow soils on precipitous slopes >55% have been identified. Fruit trees may topple over when they reach maturity due to the truncated soil depths, which may not be able to store enough moisture to meet the trees' moisture requirements during increasingly frequent periods of drought. As such STOP recommends such lands be left under natural forest. The Secretary of DENR has the power to relocate people from such areas if it is in the public interest (e.g. if their actions are likely to cause landslides, floods and/or droughts affecting thousands in the lowlands).

STOP 2, *Multi-storey tree cropping,* aims to protect the soils on steep slopes by recreating the multi-layered canopy of the original rain forest by planting mixtures of tree and shrub crops of different heights. The higher incomes from this diversified cropping system enable the farmers to buy their household staples, and free their time for to earn off-farm income. Some communities in Southern Mindanao have been practicing multi-storey tree cropping long ago, and have largely abandoned growing annual crops, apart from backyard vegetable plots. These sites are used as exposure sites for other farmers.

STOP 3, *Zero Tillage and Mulching.* Zero tillage uses herbicides to control weeds, instead of buryng them by ploughing. The dead grasses and root mat into which annual crops are dibbled (e.g. seeds planted using a stick to make a hole) does not loosen or expose the soil to wind and rain erosion. There are communities in the UDP area, who discovered this approach for themselves years ago. These farmers say it saves them a lot of time and labour (and cash) in land preparation, and that it enables them to reclaim land infested with the cogon (*Imperata cylindrica*) that would otherwise be abandoned. Eventually they plant the land with tree crops. Mulching recreates the protective covering of the original forest floor with dead leaves, and revives nutrient recycling. Shallow, truncated soils may be able to support certain drought-tolerant short-term crops (e.g. mung beans, pigeon pea and pineapples) without turning the soil, provided zero tillage and mulching techniques are used. Mulching is a major contributor to soil water conservation.

As its name implies, STOP 4, *The intensive production of annual crops on small level plots*, makes use of small areas of flat to gentle slopes to grow high value vegetables, or produce corn for home consumption efficiently using improved seed-fertiliser packages on corn patches. It reduces the area planted under corn for home consumption to less than 1,000 m^2 and could save from 55 to over 85 days of labour, which can be used more productively for planting and tending perennial crops or earning off-farm income.

UDP estimates that 1.0 ha of this land unit-based diversified farming system can generate over P110,000/yr, compared with P35,000 from a mono-crop of oil palm. The Consultant coached Agricultural Technical Institute trainers, and agricultural extension technicians, in STOP and gave hands on training.

CONCLUSIONS

Land Unit Farming achieves a better match of *land use* to *land capability*, by ensuring that crops are planted on the appropriate slopes. The *STOP 1-4* strategies, based on proven experience in other countries and continents with hot, humid climates, provide the basis for sustainable land management.

Sustainable agriculture in *parts* of the UDP uplands is feasible provided a *dualistic* approach to diversifying cropping systems is adopted. The Land Unit-based Diversified Farming System is a promising replicable model.

RECOMMENDATIONS

The DA and DENR need to be advised of the threat that inter-cropping annual crops and perennial crops poses to the health of the uplands, so that appropriate actions can be taken. This may include developing a country-wide land capability classification in which annual cropping is restricted to a range of slopes, provided specified soil conservation measures have first been put in place, and inspected and approved as having met agreed criteria. Alternatively, LGUs can require all farmers to comply with STOP, and adopt diversified dualistic cropping, or lose locally provided benefits. The ability of the uplands to support viable plantations of perennial crops is reduced every year that annual crops continue to be grown on the slopes.

- LGUs should recognise that corn and cassava are not suitable as cash crops in the uplands and that promoting them may be contributing to poverty.

- The way forward is to encourage farmers to switch from corn to growing bananas as a short-term cash crop, and planting fruit trees for the longer term. The provision of good quality disease-free banana suckers through the "plant now, pay later" scheme should be expanded.

- LGUs should encourage food security in the uplands by providing improved corn seed-fertiliser packages on a "plant now, pay later" basis to encourage upland farmers to grow corn for home consumption on small corn patches of level land.

- More farmers need exposing to the income-generating potential of growing vegetables on permanent raised beds. Viable vegetable seeds should be made available.

- Increase crop yields by improving crop husbandry (optimum spacing weeding, pruning etc).

- Set up model farms as close to perfect as possible. If a farmer copies a near perfect demonstration and gets it 70% correct he will have better success than a farmer copying a half perfect model and getting it 95% right.

- Involve LGUs, ATs and BEWs in setting up the show case models of the STOP technologies on farms belonging to selected FTGs. Each technician should set up two farms under close supervision, with the assistance of other technicians in the areas.

The farm chosen should have a representative range of land units occurring in the area. Neighbouring farmers should be invited to assist in setting up the farms to give them a sense of ownership.

- Engage the services of ATIs, and local experts, in training farmers to be proficient in plant propagation, planting, pruning, spraying, mulching, harvesting, etc as managing tree crops involves different kinds of work and skills from those of arable farming. Poor plant development, unskilled pruning, and delay in pest control may lower production of the fruit crop for years to come.

- Take farmers on exposure visits to areas where multi-storey tree cropping is practiced; e.g. San Isidro, Davao del Norte; and Santa Cruz, Davao del Sur.

- Demonstrate the savings in time and labour, and reduction in soil loss, by spraying herbicides to kill grass cover rather than ploughing the land and loosening the soil, by take farmers in cogonal areas on exposure visits. They can see for themselves why farmers in New Bataan, Compostela Valley, and in Tibulao, Carmen, Davao del Norte, recommend applying herbicides and using inorganic fertilizers to overcome the problems of cogon and low soil fertility.

- Seek MAO support in terms of HYV seeds and fertilisers to set up more (preferably) roadside corn patches for growing corn for home consumption. Also set up corn patches at learning sites ands show case farms. Ensure that neighbouring farmers understand the purpose of the demo.
- Inform farmers of the low costs, in terms of labour, seeds and fertiliser, compared with the man-days taken to grow unfertilised native corn over large areas; and the costs of making up shortfalls in corn needed by the household.
- Demonstrate how inter-planting or relay planting beans in the corn patch of HYV seed- fertilizer package can increase yields, and reduce inorganic inputs. Plough in the maize and bean residues to help with maintaining fertility.

- Seek MAO support in terms of vegetable seeds, plastic mulch, mosquito screening etc, to set up demos of permanent raised beds at learning sites, and selected farms,
- Monitor the yields and short-term incomes.
- Advise upland farmers how to obtain the identified low cost loan packages so they can implement the agricultural model.

MAIN REPORT

PART 1

INTRODUCTION

1.1 PROJECT OBJECTIVES

The specific objectives of the UDP are to:

- develop and test a replicable model for sustainable management of the natural resources in the uplands of five provinces of Region XI (Mindanao); and
- enable upland communities producing new marketable surpluses through sustainable marketed agricultural development.

Component policies for Sustainable Agriculture Development (SAD) and Resource Management (RM), as outlined in the FP (IB/1037/97-EN) are given in Annex 1. In summary, these component aim to increase subsistence food production through improved seeds, implementing vegetative soil conservation measures and diversifying farm production, and to develop farm models aimed at substituting the corn-based mixed farming to perennial crops and agroforestry. A summary of the Rapid Preliminary Environmental Impact Assessment (from the FP, Annex 4) is also given in Annex 1.

1.2. UPLAND FARMING/ SOIL & WATER CONSERVATION MISSION

1.2.1 Background to the Upland Farming/SWC Specialist's Mission

The Consultant continued to address the short-comings identified by the Mid Term Review mission of September 2003 concerning economic development in the upland areas. These included improving extension mechanisms, encouraging farmers to adopt better soil and water conservation practices, and matching crops to soils and slopes.

1.2.2 Terms of Reference (TORs)

The Consultant's TORs for the July to November 2005 assignment are given below.

TORs

The Consultant is tasked with the following:

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
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
3. Conduct hands-on training to extension staff where appropriate and feasible
4. Assist with developing extension materials for the DFS programme
5. Establish and strengthen contacts with appropriate government and non-government agencies regarding the introduction of improved planting material.
6. Conduct any other assignment in the context of this TOR given by the Co-Directors of UDP.

1.3 LAND SUITABILITY ISSUES

1.3.2 Uplands of Davao Gulf Provinces classified as *Unsuitable* for crops

Field observations by the Consultant since July 2003 tend to confirm JICA's assessment that the uplands of the Davao Gulf Provinces, are generally *not suitable* for upland crops or for orchard development due to the fragile and infertile upland soils. (see maps from the DIDP/JICA 1999 *Planning Atlas* for Region XI in Annex 2). However, provided correct land management practices are adopted, there are localized areas where permanent and annual crops can be grown on a sustainable basis.

1.3.2 Severe land degradation and reduction in soil depths

Declining crop yields and periodic crop failures due to soil erosion are the result of cultivating crops such as corn and cassava on infertile and fragile soils on steep slopes[1]. Estimated reductions in soil depth of 2-3 cm per year under *kaingin* and coconuts on sloping land indicate that earlier World Bank calculations of soil losses have continued unabated since the 1980s. Farmers throughout the UDP area say soils are now 50 cms shallower than 20 years ago. In some areas, land degradation has reduced soil depths to 25 to 50 cm - far less than half the depth in which they were originally planted [2].

There are indications that extensive areas are degrading into skeleton soils, in which the fine clay and silt particles have been washed away, leaving only the granular, gravelly and stony elements behind[3]. Such "soils" are useless for agriculture and have no potential for reforestation. Several areas in South Cotabato are beginning to exhibit this phenomenon, e.g. Sitio Melina, Lampitak, Tampakan; Tapicong and Albagan.

In other areas, some farms have soils too shallow to store enough water to support a corn through a week without rainfall (e.g. Brgy Rio del Pilar, in PPO 4).

1.4 PROSPECTS FOR FARM DIVERSIFICATION IN UDP AREAS

1.4.1 UDP's pragmatic approach

Despite JICA's pessimism about the potential of the uplands, the UDP opted for a pragmatic approach (see Section 12.1 of Annex 4 of the Financing Proposal). This acknowledged that it is too late to move the one million people living in the uplands onto other land. However, it concluded that the solution to arresting the environmental degradation in the uplands can only be tackled by changing the "present farming system of annual corn-based cropping to one which is more appropriate with permanent and diversified cropping systems".

While JICA's blanket assessment that the uplands are unsuitable for upland crops and orchards holds true at the *macro-level*, there are localized areas at the *micro-level* where annual and perennial crops can be grown sustainably. Consequently, over the past 18

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[1] Proud, KRS, & Viloria, BH (2004). *Problems with cassava production in the uplands of Southern Mindanao*. Report for the Upland Development Programme in Southern Mindanao, The Philippines. 25 October 2004

[2] Proud, KRS (2004). *The reduction in depths of upland soils in Southern Mindanao, their causes and consequences*. Report for the Upland Development Programme in Southern Mindanao, The Philippines. 16 October 2004

[3] Proud, KRS (2005). The making of skeleton soils – a major unseen threat to upland productivity in Southern Mindanao. EU News Vol 3, Issue 7, June 2005. Delegation of the European Commission of the Philippines

months, the Consultant developed a slope treatment-oriented practices (STOP) land suitability classification to identify these sites and to the micro-level planning of farms.

1.4.2 Identifying sites suitable for annual and/or perennial crops

By taking into account the wide range of soil and environmental conditions, farm sizes and farmer objectives that occur in the project area, the STOP 1 Land Unit Farming enables field technicians to identify the appropriate site-specific land management strategies for a given farm, often on areas of a few hundred square metres. Significantly, STOP recognises that leguminous hedgerows (e.g. SALT) are not effective in controlling soil erosion on long slopes. Their use is restricted to short slope lengths on the hill tops where the slope range can change from 25% to 50% over distances as short as 10 m. At these sites, cross-slope barriers of napier and vetiver grasses and contour cultivation induce terrace formation converting 2-metre wide strips of 55% slopes into outwardly sloping benches for cultivating annual crops. Since the volumes and velocities of run-off are low and slope lengths are very short on the hill tops, the risk of erosion is kept to acceptable levels.

In this farm-level land capability classification, the cultivation of annual crops is restricted to flat to gentle slopes, or upper slopes where terrace formation has reduced slope gradients, and to minor valleys. Steeper slopes are reserved for planting mixtures of tree crops that reflect the multi-storey canopy of the original rain forest (STOP 2).

Some areas with shallow, truncated soils may be able to support certain short-term crops (e.g. *monggo* (mung beans), pigeon pea and pineapples) without turning the soil, provided zero tillage techniques are used to plant the crops through deep layers of mulch (STOP 3).

Small areas of flat to gentle slopes can be used to grow high value vegetables, or produce corn for home consumption efficiently using improved seed-fertiliser packages (STOP 4).

UDP estimates that 1.0 ha of DFS, over a number of land units with suitable slopes, can generate P110,000/yr compared with P35,000 for oil palm. By comparison, ATI training sessions calculated incomes of P114,000/ha from the DFS models.

1.4.3 UDP should not go where angels fear to tread

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. UDP should resist attempts “to do something” on such sites as the chances of success are very low. 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 exploit these lands.

1.5 THE MID-TERM REVIEW AUGUST – SEPTEMBER 2003

The Mid-Term Review (MTR) made several recommendations relating to the SAD Component’s activities. PART II outlines how the Consultant assisted SAD in complying with these recommendations and, as far as is possible, assesses their relevance, effectiveness, efficiency, impact and sustainability. Table 1 summarises the SAD response to addressing these short-comings.

Table 1 Recommendations of the Mid-Term Review (MTR) Aug-Sept 2003

MTR conclusions/recommendations	SAD response
1. The Project makes immediate efforts to define replicable and sustainable models.	*Dualistic farming system model identified: (annual crops are grown on flat to gentle slopes separately from perennial crops).*
6. Global Work Plan states the appropriate and sustainable strategy is not to distribute inputs to farmers. Farmers should adopt the technologies using their own inputs.	*SAD now promotes the planting of fruit tree seeds and banana suckers that farmers can afford with low risk. Seedlings given as basis for scion groves.*
13. Technologies such as nature farming and organics, are viewed as inappropriate within the context of poor upland farmers. Only proven technologies are promoted amongst farmers	*Organic fertilisers are low quality fertilisers only effective on a few alluvial sites or some volcanic soils in a hot, humid climate. Inorganic fertilisers are essential to move from low levels of production. Use scarce supplies of manures and composts for backyard vegetable production*
17. Technically inappropriate projects are being implemented e.g. hedgerows on slopes over 60%. SAD should develop agricultural technologies based upon slope zones using skills developed during the agri-ecological zoning.	*Slope Treatment-Oriented Practices land capability classification developed (STOP 1, Land Unit Farming) limiting actions to 55% slope.*
22. Technological packages should be developed for each of the slope zones that …. will continually increase the area devoted to perennial plants and decrease the area devoted to annual plants. Increasing the productive efficiency per unit area of annual crops will release land and labour for other cash-generating activities such as fruit orchards on-farm, or paid labour off-farm.	*STOP 2* – Multi-Storey Tree Cropping, *STOP 3* – Zero tillage and mulching *to reclaim cogonal lands and control weeds*; *STOP 4 – Corn patch and Veg Production on raised beds. A corn patch of 600 m^2 planted with HYV corn and applying inorganic fertilizers, can yield half the family's needs (of 300 kg) for home consumption using 5-6 days of labour (cf. 30-54 days to get a similar yield of corn using traditional varieties and methods)*
28. As the distribution of free inputs to farmers is not sustainable for LGUs, the Model Farm Cooperators should provide their own hedgerow seeds and fruit tree scions. Marketing centres should stock external inputs required in pack sizes affordable to farmers.	a) *Package of 4 kg of fruit tree seeds (P100)* *b) 550 banana suckers @ P5 (P2,750),* *c) A P535 package of HYV seeds hybrid corn and fertilizer* *d) P180 for herbicide and fertilizer to clear planting sites in cogon land for30 fruit trees*

1.6 OTHER ACTIVITIES UNDERTAKEN BY THE UPLAND FARMING/ SWC CONSULTANT

While finalising the development the sustainable model for upland agriculture the Consultant was involved in a number of other activities. These are listed in Table 2.

Table 2. Other activities undertaken by the Upland Farming/SWC Consultant

ACTIVITY	MONTHS
Attending farmers field days	Jul, Aug, Sep, Oct, Nov
Drafting STOP 4 (Intensive Cultivation of small level plots. The Corn Patch and Vegetable Production in Permanent Raised Beds)	Jul, Aug, Sep,
Finalising STOP 1-4 booklet for editing	Jul
Validating DFS farms	Jul, Aug, Sep, Oct, Nov
Tender Evaluation Committees	Aug.
Management Committee meetings	Jul,
Visit Kenram oil palm plantation, Sultan Kudarat	Aug
Attend Watershed Management Forum	Sep
Participated in AT and BEW workshops reviewing STOP	Sep, Oct, Nov
Set up Corn patch trials	Sep, Oct, Nov
Set up permanent raised bed trials for vegetable production	Oct, Nov
Participated in ATI Training of Trainers workshop	Oct, Nov
Accompanied Pre-Completion Report Mission	Oct, Nov
Meetings with Mindanao Rural Development Project staff	Oct, Nov

A list of handouts produced for the SAD Component between July 2003 and November 2005 is given in Annex 3.

PART 2

IDENTIFYING SUITABLE SUSTAINABLE MODELS FOR PERMANENT UPLAND CULTIVATION

2.1 FARMING SYSTEMS ANALYSIS

One of the steps taken by SAD in identifying replicable and sustainable models for permanent upland cultivation in the humid tropics was to review analyses of farming systems in similar climates in other parts of the world[*]. Ruthenberg's analysis emphasises that the permanent cultivation of upland in a hot humid climate "presents some of the most troublesome problems of tropical agriculture". However, he identifies successful strategies adopted by smallholder farmers in the humid tropics from Central and South America, West and East Africa, South Asia and South East Asia and Australia, namely: *dualistic cropping*, *multi-storey cropping*, *zero tillage and mulching*, *reduction in the area of annual crops to meeting the family's food needs*, and *intensive cultivation of vegetables in gardens*. If these strategies are replicable in areas with hot, humid climates[+] across countries and continents, then they should be applicable and replicable in a similar climate in Mindanao.

The very few economically viable systems of permanent upland farming that exist are found on very fertile alluvial or volcanic soils. Examples of permanent cropping which preserve the soil rely on intensive fertilising with organic and inorganic fertilisers, supplemented by erosion control measures, and intensive ploughing (e.g. in Taiwan). However, intensive ploughing is clearly impractical on the steep slopes in the uplands.

2.2 PROVEN TECHNOLOGIES FOR PERMANENT UPLAND CULTIVATION IN HOT, HUMID CLIMATES

Proven technologies and development pathways for permanent upland cultivation in hot, humid climates include dualistic cropping, multi-storey cropping, and zero tillage and mulching. The traditional solution is vegetable gardening especially where the population density is very high, where labour is cheap, and where profitable markets are at hand. Locations such as La Trinidad, Benguet Province, and the Banaue rice terraces are in the tropical highlands, which have different climates to the UDP areas.

2.3 DUALISTIC CROPPING: A MODEL FOR UPLAND FARMING

The SAD Component's model for sustainable agriculture in the uplands is based on modifications of the above systems. These are discussed below.

Increasing the area under cash-generating perennial crops and growing the household's food requirements, on smaller, separate arable plots, is a characteristic of a *dualistic* system of cropping. Because of the very steep slopes, and factors such a fluctuating market prices,

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[*] Ruthenberg, H (1983). *Farming Systems in the Tropics*. Third edition. Oxford University Press and Beets, W C (1990). *Raising and Sustaining Productivity of Smallholder Farming Systems in the Tropics*. AgBé Publishing. Alkmaar, Holland

[+] Humid climates have 7 or more humid months (>1,400 mm/yr). A very humid climate has 9 wet months

rather than mono-cropping, UDP advocates a *diversified farming system* approach in which a range of perennial trees are planted on the slopes and high value vegetables are grown on small intensively cultivated plots of flat to gentle slopes

2.2.1 Relevance

- Dualistic cropping is practiced by small holder farmers throughout the tropical areas with hot, humid climates. These include the cacao holdings in Ghana, Nigeria and Trinidad; rubber holdings in Malaysia; coffee holdings in Kenya; banana holdings in Central America; as well as the coconut palm holdings in the Philippines. Most of these holdings were planted on flat to gently rolling terrain where soil erosion can be easily controlled.
- Dualistic cropping systems start with mixed cropping, i.e. corn and root crops, grown amongst the perennial crops. In time, the area under perennial crops is increased at the expense of the annual crops, resulting in a *dualistic system* in which annual crops are grown on small plots separately from perennial crops.

2.2.2 Effectiveness

- Curtailing intercropping of annual and perennial crops on steep sloping land reduces erosion and prevents damaging the lateral roots of the trees which reduces yields.

2.3.3 Efficiency

- Compared with mixed cropping, dualistic systems allow yield-increasing innovations such as fertilizer application and plant protection to be applied more easily, enabling marketable surpluses to be produced, which is the Project's second objective.
- Farm planning ensures that higher yields, produced with reduced labour, secure the farmers' basic household needs for food (see STOP 4) and frees labour for other uses.

2.3.4 Impact

- A hectare of diversified crops (e.g. with 1,000 m^2 of vegetable garden and the rest dominated by fruit trees and bananas) has the potential to generate over P100,000 a year. This compares with P35,000/ha of oil palm. The monthly estimated income of P9,000 is a great improvement on the P2,000 - 4,500 currently earned by farmers.
- There is a detectable trend of UDP farmers moving, or intending to move, from mixed farming, towards dualistic systems of cropping, with an increase in the area under tree crops. In Laak, Compostela Valley, for example, farmers have largely abandoned growing corn as a cash crop and switched to bananas.

2.3.5 Sustainability

- Seeds, suckers and scions can be easily obtained, either from the existing crops, or from LGUs on a *plant now pay later* basis. E.g. banana suckers are P5-10 each and banana corms are P2-5 each. Seeds of fruit trees cost about P25 per kg and, in the case of mangoes, an output of P100 for 4 kg seeds can result in 132 grafted mango seedlings established in the field (after taking mortality rates into account).

2.3.6 Compliance with Recommendations of the Mid-Term Review Aug-Sep 2003

Table 1 (above) outlines the SAD's response to each of the MTR recommendations.

a) MTR Section 18.1: General

The Dualistic Cropping Model is an adequate response to the recommendation of the MTR *Section 18.1 General*

> Recommendation
> *The Project make immediate efforts to define replicable and sustainable models possibly including a market driven model implemented through third parties*.

b) MTR Section 18.3: Efficiency

In its Conclusion 13, the MTR noted that technologies, such as nature farming and organics, have been introduced to poor upland farmers. These are viewed as inappropriate. The MTR recommended *Only proven technologies are promoted amongst farmers.* The following sections describe the proven technologies

2.4 LAND UNIT FARMING (STOP 1)

Unlike shifting cultivation or fallow systems, the cultivator in a permanent system can no longer select the land best suited to a particular crop. Land unit farming (STOP 1) provides guidelines on assessing the suitability of the different slope classes for a range of crops, and recommends the soil conservation measures best suited to the slope and soils.

2.4.1 Relevance

- Matching crops to appropriate soils and slopes is standard practice in planned agriculture.
- Hedgerow spacing was often based on Vertical Interval (VI). The conventional VI formula is *not appropriate* for designing the spacing between cross-slope barriers such as hedgerows and natural vegetative strips (NVS) that merely slow down the run-off and let it filter through the barrier. The VI procedure is meant for designing channel terraces intended to intercept and drain the run-off from the land above it[4].

[4] Hudson, N (1992). *Land husbandry*. London. Batsford (page 98).

- The STOP guidelines base the spacing of cross-slope barriers on depth of soil, slope and cultivation requirements. Provided the soil profile is 100 cm deep, the spacing between barriers given in the STOP table ensures that at least 50 cm of soil remain at the back of the bench, once it has levelled off over time.
- No hedgerows are needed if the farmer only wants to plant tree crops. A good ground cover of a sod-forming grass, such as carabao grass, is adequate protection.
- Poor hedgerow layout and design can increase the damage to a farm, if cultivation is carried out in the belief the land is adequately protected. The high banks formed between the terraces give the impression of successful interception of soil. However, these appearances can be misleading. In some cases the bulk of the material retained is the heavier, coarser sands and gravely lahar. Under some circumstances, most of the beneficial silt and clay particles have been washed off the hillside leaving the beginnings of skeleton soils. (See Annex 4). A good example can be seen above the road cutting close to the Sitio Melina learning site, Lampitak, South Cotabato.
- The lesson learned is that to apply the STOP I table, *at least 100 cm depth of soil must be present* on the slope if gentle outwardly sloping terraces for cultivating annual crops are to be formed. The specified spacings must not be exceeded. If hedgerows are spaced too far apart[5] the whole inter-hedgerow area can result in soil depths at the back of the terrace being too shallow to support crop growth. If bad land use has reduced soils to less than 100 cm then the traditional ways of cultivating annual crops behind hedgerows are not advisable.

2.4.2 Effectiveness

- Soil and water conservation measures are effective when applied to the appropriate slope gradients and slope lengths. STOP 1 indicates the circumstances where SWC measures are effective in forming benches for cultivating annual crops. Soil conservationists consider SALT hedgerows to be ineffective barriers against soil erosion when applied to slopes greater than 20-25%.
- Confining hedgerows to the hill tops, where slope lengths are short and the volume and velocity of run-off is low, lowers the risk of undercutting the terraces by falling run-off and reduces the maintenance requirements.

2.4.3 Efficiency

- A much smaller area needs protection with hedgerows. If the farmer only wants to plant trees, hedgerows are not needed. The length of hedgerow planted is also reduced as are labour costs.
- An improved design of cross-slope barrier, which incorporates a 2-m wide NVS below the hedgerow, further reduces the number of hedgerows per unit area.

[5] Most of the hedgerows were planted before the Slope Treatment-Oriented Practices (STOP) model had been developed.

- The prescription forms, and the small size of the units (often less than 1,000 m^2) enable the farmer to estimate potential income and to decide which crop to plant. The prescriptions can also help the farmer decide whether to obtain a small loan to purchase inputs such as improved seeds, fertilisers etc.

2.4.4 Impact

- Perennial crops are starting to replace corn-based mixed farming on long slopes
- The production of highly erosive crops, e.g. corn and cassava, are being relocated to sites receiving little or no run-off.
- Planting cross-slope barriers is restricted to short lengths of upper slopes. Doing away with the need for hedgerows if there are no plans to plant annual crops reduces the risk of increasing the erosion hazard when hedgerows are incorrectly laid out, e.g. planted off-contour, or too far apart. (Unfortunately, incorrectly laid out SWC measures frequently cause more erosion than if no action is taken).
- The cultivation of annual crops on small areas of level land (see Section 5) enables slopes to be planted with perennial crops or left under remnant natural forest.
- More farmers are opting for tree planting because hedgerows are not needed.
- Reduced soil losses means higher agricultural production potential yearly.
- A formalised landscape is created and the market value of the farm is increased.

2.4.5 Sustainability

- The farm maps and land unit prescriptions provide the farmer with a long term development plan for his whole farm – unlike the original design where only 1.0 ha of "currently cultivated" land was developed (which often meant that high potential land with good soils and slopes was excluded from receiving UDP inputs).
- Some municipalities and barangays are producing ordinances requiring farmers to apply soil and water conservation measures on the land. Often these do not include design specifications. The STOP 1 guidelines provide this detail.
- Without model farms, laid out from scratch on STOP principles, show casing land unit farming there is a danger that the idea will fade from memory when the project ends. Farmers attending training courses at the current learning sites tend to reproduce what they saw during their visit. In many instances this resulted in unnecessary and poorly laid out hedgerows. (The former policy of *No hedgerows, No inputs* is still entrenched in many minds). Farmers need to see for themselves what the land unit-based diversified farming system actually looks like and what it entails in terms of inputs and outputs. Setting up model STOP farms, demonstrating the different diversified production units, and the expected costs and incomes, will provide a permanent reminder of what the dualistic cropping system entails.

2.4.6 Compliance with Recommendations of the Mid-Term Review Aug-Sep 2003

The MTR concluded that technically inappropriate projects are being implemented e.g. hedgerows on slopes over 60% (*Section 18.4 Effectiveness)*. STOP 1: *Land Unit Farming* guides agricultural development away from unsuitable land, thereby fulfilling the recommendation of the MTR*:*

> Recommendation:
> *SAD develop agricultural technologies based upon slope zones using skills developed during the agri-ecological zoning.*

2.5 MULTI-STOREY TREE CROPPING (STOP 2)

Multi-storey tree cropping involves planting slopes with a mixture of trees and shrubs as cash crops in imitation of the protective multi-storey canopy of the original rain forest.

2.5.1 Relevance

- Greatly reducing the area under annual field crops and increasing the area planted with perennial crops is one of the proven development pathways for achieving a balanced system of high productivity in the humid tropics.
- Multi-storeyed coconut cropping systems practiced in other tropical countries give higher incomes per hectare than monocultures of coconuts. For example:
  - Coconut plantations underplanted with ipil ipil (*Leucaena*) to support vanilla plants and provide forage for livestock (e.g. Indonesia),
  - Intercrops for coconuts on sloping lands in Malaysia and Papua New Guinea include cacao, coffee, citrus, cloves, banana and papaya
- Multi-storey tree cropping has long been accepted practice in some municipalities; e.g. Brgy Mamasang, San Isidro, Davao del Norte; and Santa Cruz in Davao del Sur. Farmers earn cash from the sale of copra, bananas and fruits and buy their staples such as rice and corn. Annual cropping is reduced to small vegetable plots for home consumption, with surplus produce sold to supplement incomes. Off-farm income is used to improve family welfare (better permanent housing, education, clothing etc).

2.5.2 Effectiveness

The layered canopy formed by trees of different heights dissipates the erosive energy of raindrops reducing detachment of soil particles. Multi-storey tree cropping also:

- Recreates the multi-level canopy of the original rain forest through a mix of fruit and cash crop trees with some leguminous species.
- Gradually covers the soil with a thick layer of protective mulch through leaf fall from the trees providing nutrients for tree growth, while improving infiltration of rainfall and run-off and retaining soil moisture.
- Eventually restores the process of recycling of organic matter and nutrients occurring in natural forests.

- Creates an under-storey environment for planting and multiplying traditional medicinal plants that are under threat in the scattered patches of natural forest.

2.5.3 Efficiency

- Planting banana suckers, and direct seeding of fruit trees followed by field-grafting of scions are low cost, low risk strategies (financially) that enable the farmer to replace extensive areas of corn on sloping land with permanent crops.
- Bananas give much higher incomes per unit area than corn, cassava and cotton, producing almost as much energy per hectare as root crops with less labour per unit of starch.
- Banana groves protect the soil better and improve its fertility.
- Fruit trees give increasing yields and incomes with time, while corn and cassava yields (and hence income) decline.
- The right choice of planting material can make a big difference in incomes. For example, Farmer A gets a loan to buy 12 mango seedlings for PhP 600. Farmer B opts to buy 120 banana suckers. After 18 months Farmer A has no income from his mangoes, but Farmer B's bananas sell for PhP 2,400. He buys 120 more banana suckers for PhP 600, spends P hP600 on12 mango seedlings, and pays off his loan. In another 18 months Farmer B earns PhP 4,800 from his bananas, while Farmer A still has no income. By buying 12 mango seedlings and 120 banana suckers with a portion of his banana sales, Farmer B will have 360 banana plants by 54 months with 24 mango seedlings planted in the field, as well as cash in hand of over PhP 10,000. Farmer A will just be getting the first fruits from his 12 mango trees.

2.5.4 Impact

It is currently too soon to detect a discernible impact from multi-storey tree cropping, as it takes 5-7 years before fruits re produced, but some groups of farmers (e.g. some indigenous peoples in Malalag) predict that their incomes and welfare will start to improve in 2-3 years time. The following are realistic effects:

- The 2.5 – 4 months labour, saved by switching from growing corn for consumption to producing fruit for sale, can be used more productively, e.g. earning off-farm income; tending vegetable gardens of high value crops; tending fruit trees.
- With surplus income, farmers can send their children to school. The educated children may prefer to work in the lowlands rather than returning to the uplands.
- Perennial crops are now being viewed as a "pension fund" by upland farmers. That is, they are investing in the future. This change in planning time scale from a few months to a few years is very encouraging.
- The area of open sloping land being planted with trees is increasing.

2.5.5 Sustainability

Long-term sustainability depends on expanding markets and well-maintained roads, to encourage traders to take their trucks into the uplands. The following ensure that the development and expansion of multi-storey cropping can be done without outside assistance:

- Fruit tree seeds, banana suckers and scions for field-grafting are available locally. Seedlings of new varieties should be available from the LGUs and these can be a source of scions for future grafting
- A number of low cost packages, giving high returns, have been identified which are within the budget of the upland farmer
  - *Package of 4 kg of mango seeds (@ P25 / kg) available from LGUs. Farmers to obtain scions locally.* ***Result:*** *132 field-grafted mangoes established on the farm. (Normal cost P45-P60/seedling)*
  - *550 banana suckers @ P5 each, provided by the LGU under the"plant now, pay later" basis.* ***Result:*** *harvest in 18 months returns P11,000 (assuming 10 kg bananas/hill sold @ P2/kg)*
  - *Package of HYV seeds hybrid corn and fertiliser for basal- and side-dressings for 600 m2 corn patch costs <P600.* ***Result****: gives 300 kg of corn for consumption that costs P5,100 to buy @ P17/kg.*
- Most of the farmers have been trained in grafting and budding techniques.
- Some farmers indicate a preference for starting with bananas as they don't have to rely on traders for inputs. This avoids falling into the debt trap.
- The LGUs and farmers should ensure that only the more vigourous narrow-leaved sword suckers are used for expanding banana groves, not the inferior broad-leaved water suckers.

2.5.6 Compliance with Recommendations of the Mid-Term Review Aug-Sep 2003

a) MTR Conclusion 6

The MTR points out that the Model Farm strategy described in the Global Work Plan "did not provide for the distribution of inputs to farmers (18.2 Relevance). Farmers were expected to adopt the technologies using their own inputs, or to borrow money from a PFI if necessary, to do so. This strategy is viewed as appropriate and sustainable". By promoting the planting of fruit tree seeds and more productive sword suckers, which farmers can afford with low risk, the SAD Component is moving towards ensuring sustainability, as per the following MTR recommendation.

> *For reasons of sustainability the programme only provides inputs for the Model Farms (one per sitio) to demonstrate the agricultural technologies and cease providing free inputs to other farmers. Adopters should then be defined as those farmers adopting the technologies using their own resources.*

b) MTR Conclusion 22

By expanding the area under tree crops at the expense of annual crops, the *STOP 2 – Multi-Storey Tree Cropping* technological package satisfies the MTR recommendation under Conclusion 22:

> *Technological packages be developed for each of the slope zones that contributes towards the long term aim of enabling the farm enterprise to move profitably along a trajectory that will continually increase the area devoted to perennial plants and decrease the area devoted to annual plants.*

c) MTR Conclusion 28

The low cost packages identified by the UDP SAD Component for expanding the area under perennial crops conform with MTR recommendations regarding Conclusion 28, (i.e. that the distribution of free inputs to farmers is not sustainable for LGUs), namely:

> *Model Farm Cooperators to provide hedgerow seed and fruit tree scions. Marketing centres to stock external inputs required in pack sizes affordable to farmers. Establishment of community level nurseries.*

2.6 ZERO TILLAGE AND MULCHING (STOP 3)

"Agricultural innovations have drastically changed the fertility problem in permanent upland farming in the tropics. Technical solutions are available. A major problem is that small amounts of fertilizer seem to be relatively ineffective. Permanent arable cultivators apparently have to chose either between production at a low-level equilibrium or with rather heavy chemical inputs. 'In-between' situations do not seem to work….
High yields depend on soil fertility, which itself is a function of fertilizer inputs and a full crop with lots of crop residues)." [*]

2.6.1 Relevance

- Zero tillage is a recognised technology for permanent upland cultivation in the humid tropics. "Improved permanent upland cultivation in a hot humid environment depends on purchased inputs: with herbicides replacing the function of tillage for weed control, and inorganic fertilizers and mulching maintaining zero tillage systems".[*]
- The application of herbicide is particularly effective in returning to productive use land infested with the pernicious weed, cogon (*Imperata cylindrica*).
- Inorganic fertiliser maintains the fertility of the soil, a function previously the role of fallow vegetation. Inorganic fertiliser is essential to move away from low-level production.

[*] Ruthenberg, H (1983). *Farming Systems in the Tropics*. Third edition. Oxford University Press

- The cultivation of annual crops on steep slopes has severely reduced soil depths in many of the UDP sites. Mulching of crops will help conserve the limited amounts of soil moisture that can be stored in the shallow soils. This may be critical for crop survival during extended dry periods

2.6.2 Effectiveness

- Case studies from Sitio Mamada, Brgy Andap, New Bataan, Compostela Valley, support Ruthenberg's* observations that improved permanent upland cultivation in a hot humid environment depends on purchased inputs: with herbicides replacing the function of tillage for weed control, and inorganic fertilizers and mulching maintaining zero tillage systems. "Virtually 100%" of the farmers in the Brgy Andap area are reported to use herbicides and inorganic fertilizers.
    - Candelaria Oripaypay cleared two hectares of dense cogon grass with P2,000 worth of systemic herbicide before he planted contour hedgerows (on 50% slopes). It took 2-3 mandays. He said it was impossible to grow maize before that. It usually took 20 man-days of labour (@ P100/day) to clear the area, but the cogon needed several more cuttings to eliminate it. He recommends that farmers with a cogon problem should use herbicides. He plans to extend the area planted with fruit trees by reducing the area under maize as he considers maize cultivation to be unsustainable**.**
- Phosphate fertilisers in contact with soil become "fixed" by the soil and cannot be readily absorbed by the plant roots. Applying inorganic fertiliser on top of mulch prevents this from happening.
- Without the use of systemic herbicides to kill the subterranean rhizomes of Cogon in 3-m diameter planting sites ($7m^2$), the reclamation of cogon-infested lands for planting fruit trees would be very time-consuming. The risk of the seedlings getting choked by the cogon is higher and the investment made in the seedlings lost.

2.6.3 Efficiency

- At Brgy Tibulao, Carmen, Davao del Norte, a ridge top used for annual crops usually took the farmer, Mario Alburo, 40 days to clear using four ploughings with a carabao at a cost of PhP 12,000. Conversely, the cost of land preparation by spraying herbicide to kill cogon was PhP 2,720 over 2-3 days. The early planting of corn enabled him to follow up with a crop of beans giving him extra income.
- An outlay of PhP 181 for herbicides and inorganic fertilizer is sufficient to establish 30 trees in cogon lands (i.e. PhP 25 for herbicide to clear the 210 m^2 of cogon covered land (at 7 m^2 per tree) and PhP 156 for 12 kg inorganic fertiliser for 30 trees in the first year @ 100 g/tree/quarter after the first year).
- Inorganic fertilisers cost about PhP 650 a 50 kg sack, compared to PhP 150 per 50 kg of organic fertilizer. It has been reported that some provincial governments are promoting organic fertilizer, in the belief that it is cheaper than inorganic fertilizer.

For example, The Star newspaper[6] writes that "farmers still prefer to use chemical fertilizers because of "slow effects" of organic fertilizers, aside from using more bags to fertilize a hectare. Organic fertilizers contain only 2% nitrogen while urea contains 46% nirtogen, so farmers need to use at least 80 bags of organic fertilizer for a hectare riceland, as compared to only five to six bags of urea (and 12 bags for a corn field)". (12 sacks of inorganic fertilizer cost PhP 7,800 while 80 sacks of inorganic cost PhP 12,000. The cost of transporting 80 sacks is also a lot higher).

2.6.4 Impact

- Clearing sites with gentle slopes for planting corn takes the pressure of sloping land and the fertile soils under remnant stands of forest.
- Provided the corn crop is planted using a pointed stick to punch planting holes (*dibbling*), the dead layers of grass and root mat form a thick mulch protecting the soil from exposure to rain and reduces soil erosion.
- The beneficial impact of spraying $7m^2$ patches of cogon for planting fruit trees (i.e. $700m^2$/ha) becomes greater as the tree canopies expand, eventually killing most of the cogon in the field by shading it out.
- The impact of herbicides is very localised as it used on small cogon-covered areas.
- Adverse environmental impacts are likely to be insignificant.

2.6.5 Sustainability

- The use of herbicide and inorganic fertilizers is an effective, one-off operation to rapidly clear small areas of land with flat to gentle slopes with low risk of erosion, and bring them into production, e.g. for planting a corn patch (see Section 5). The alternative is for the farmers to continue clearing extensive areas of steep slopes with massive losses of soil through erosion.
- The use of herbicides is seen as a temporary measure as the shade from the established trees and mulching will suppress the cogon in future.
- The cost of herbicides is within the farmers' budgets. Group action to share a bottle of herbicide and the sprayer is recommended.

2.6.6 Compliance with Recommendations of the Mid-Term Review Aug-Sep 2003

Zero tillage and mulching are technological packages that meet the following recommendation associated with Conclusion 22 of the MTR:

> *Technological packages should be developed for each of the slope zones that …. will continually increase the area devoted to perennial plants and decrease the area devoted to annual plants.*

[6] *Sun Star* Sunday, Feb 02, 2003. Price hike in imported fertilizers affecting farmers. *By Yolanda S. Fuertes*

2.7 STOP 4: INTENSIVE PRODUCTION OF ANNUAL CROPS ON SMALL LEVEL PLOTS

2.7.1 Relevance

Gardening[7] is the traditional solution to the problems of permanent cultivation of upland in a hot, humid climate.

2.7.3 Effectiveness

- The Corn patch is an effective way of producing the household's staple food,
- Reducing the area used to grow corn for home consumption from between 0.75 to 1.0 ha to less than 0.1 ha also reduces soil losses from the hills by 90-94% and frees land for growing more productive tree crops
- Concentrating the limited amounts of compost and manures onto the vegetable gardens makes them more effective in providing nutrients to the crops than scattering them over a wider area.
- Improving vegetable production improves the family's diet as well as generating substantial returns from small areas.

2.7.3 Efficiency

- A corn patch of 600 m^2 planted with HYV corn and applying inorganic fertilizers, would yield half the family's needs (of 300 kg) for home consumption using 4-5 days of labour (compared with 30-54 days to get a similar yield of corn from 6,000-10,000 m^2 using traditional varieties and methods).
- The Corn Patch frees an average of 55-85 days of labour per year for vegetable growing, or tending fruit trees. Rather than spending off-farm income on buying corn to eat, it can be used to improve the family's welfare (i.e. health, education, etc).
- Growing corn and vegetables separately from tree crops gives higher returns. With mixed cropping, actions such as ploughing and weeding operations, which sever or damage tree roots, and the shading of annual crops by trees, reduce the potential crop.
- The Corn patch presents a quick, relatively low risk strategy to enable a subsistence farmer to "get his foot on the ladder" for loans. The normal rule for being eligible for a maximum first loan of PhP P3,000 is to pay it off weekly at an interest rate of 3% per month. A loan of PhP 600, to buy HYV corn seeds and 24 kg of inorganic fertiliser for the basal and side dressings, can be paid off within 8 days from off-farm work (at PhP 80 to PhP 100 a day).

[7] Garden cropping is distinguished by(1) production of small amounts of produce from a great number of different food crops: (2) small plots; (3) proximity to the house; (4) fencing; (5) mixed or dense planting of a great number of annual, biennial and perennial crops; (6) a high intensity of land use; (7) land cultivation several times a year; (8) permanence of cultivation; and (9) cultivation with hand implements.

Having promptly paid off this first small loan, plus the PhP 18 interest, the farmer becomes eligible for further, larger, loans perhaps to set up permanent raised beds for vegetable growing. E.g. to buy pipes to supply supplementary water for the vegetables, or plastic mulch, or improved seeds, or mosquito screening to minimise rain drop damage to tomato flowers, etc.

2.7.4 Impact

- Too soon to assess, but a dramatic reduction in the area of slopes cultivated for corn (and hence land degradation) and increase in area under tree crops is expected, once farmers realise the time and savings in labour a corn patch provides.
- Increase in off-farm incomes and subsequent improvement in quality of life and welfare of upland farmers.

2.7.5 Sustainability

- Municipal Agricultural Officers (MAO) are giving favourable comments regarding the STOP 4 technologies and volunteering to provide improved seeds and fertilisers for road side demonstrations.
- The corn patch is a short-term food security strategy that can be abandoned when bananas and fruit trees start generating enough surplus cash to buy household staples. The corn patch can then be converted to the more profitable vegetable gardens or orchards; and can easily be brought back into corn production when needed.
- Small vegetable plots can use all the compost and manures produced on the holding. Farmers are being taught composting techniques.

2.7.6 Compliance with Recommendations of the Mid-Term Review Aug-Sep 2003

a) MTR Conclusion 13

The MTR viewed some technologies, such as nature farming and organics, as inappropriate within the context of poor upland farmers, and recommended that only *proven technologies be promoted amongst farmers*.

Traditional forms of intensive fertilization use a lot of labour in preparing compost and collecting animal manure. Transport of organic fertilisers is also difficult in the uplands. As the tendency is to concentrate the fertiliser on the gardens near the homestead, the promotion of intensive vegetable gardening on small level plots is a proven technology.

Inorganic fertiliser is of primary importance to improved upland production. Compared with organic fertilizers it proves to be labour-saving because of its high nutrient concentration and relative ease with which it can be transported. Studies show that small amounts of fertilizer seem to be relatively ineffective. The choice is one of production at a low-level equilibrium or one with rather heavy chemical inputs, albeit on a very small scale. 'In-between' situations do not seem to work. As Ruthenberg writes: *High yields depend on soil fertility, which itself is a function of*

fertilizer inputs and a full crop with lots of crop residues. Using inorganic fertiliser for producing HYV corn for home consumption, and ploughing in the trash, is therefore a valid strategy.

b) MTR Conclusion 22

The great savings in time and labour made possible from growing corn for home consumption in a corn patch attains the recommendation relating to the MTR's Conclusion 22 (MTR *Section 18.5 IMPACT*), i.e.:

> *Increasing the productive efficiency per unit area of annual crops will release land and labour for other cash-generating activities such as fruit orchards on-farm, or paid labour off-farm.*

PART 3

3. RECOMMENDATIONS FOR IMPROVING THE LAND-UNITED BASED DIVERSIFIED DUALISTIC FARMING MODEL

3.1 PHASES OF ADOPTION

The process of adoption has five main phases: *awareness*, *interest*, *evaluation*, and *trials* followed by full *adoption*. Information on the cost of inputs (both labour and purchased items) as well as the yields expected enables farmers to evaluate the technologies. Adoption rates become high if there are rapid and strikingly visible results; costs are relatively low; the innovations are easy to apply and can be used on small areas; and returns are high.

The land unit-based diversified farming system meets these criteria. However, although many farmers are aware of STOP and DFS and are interested in applying them, there is little production data to enable them to evaluate the results properly. More trials should be set up, which the farmers can monitor over the years. Interventions that give high returns with low costs will be adopted long after the project has ceased.

3.2 RECOMMENDATIONS FOR DUALISTIC CROPPING

- The DA and DENR need to be advised of the threat that inter-cropping perennial crops with annual crops poses to the health of the uplands, so that appropriate actions can be taken to prevent it . This may include developing a country-wide land capability classification in which annual cropping is restricted to a range of slopes, provided specified soil conservation measures have first been put in place, and inspected and approved as having met agreed criteria. Alternatively, LGUs can require all farmers to comply with STOP, or lose locally provided benefits. The ability of the uplands to support viable plantations of perennial crops is reduced every year that annual crops continue to be grown on the slopes.

3.3 RECOMMENDATIONS FOR LAND UNIT FARMING (STOP 1)

3.3.1 STOP 1, Land Unit Farming

STOP 1, *Land Unit Farming*, achieves a better match of *land use* to *land capability*, by ensuring that crops are planted on the appropriate slopes. However, there some problems with the process:

- Many of the ATs and BEWs are “stuck” on the old concept of planning the production on one hectare of land, where their activities were limited to ensuring hedgerows had been put in and handing over the fruit tree seedlings. They need practice in mapping the whole farm, assessing the agricultural potential of each land unit, preparing the relevant land use prescriptions, and estimating possible incomes from each land unit.

- The current learning sites, set up on "one hectare of currently cultivated land" design, are not always good examples to show to farmers. For example, hedgerows have been planted unnecessarily on long steep slopes (i.e. when the farmers only wanted to plant fruit trees), without following the contours and with too wide spacing between the hedgerows, etc. Consequently, farmers exposed to such sites have returned home with the wrong impression, and copied what they saw. The "*no hedgerows, no inputs*" viewpoint still occurs in some areas, and farmers still put in hedgerows by eye producing badly aligned soil conservation measures that concentrate rainfall run-off to low points and end up causing more damage than if they hadn't been put in at all.

The STOP strategies, based on proven experience in other countries and continents with hot, humid climates, provide the basis for sustainable land management. However, while there is awareness of and interest in STOP, there are only a few widely scattered sites where farmers can be taken on exposure visits. Most of farmers will probably not return to the site after the Project ends. Although SAD has made estimates of expected yields and incomes to be obtained from applying STOP, none of the learning sites are monitoring the costs and returns to assist farmers evaluate the innovations. Sites are needed within each sitio where farmers can monitor the progress of the innovations from week to week and season to season and see how the incomes of the beneficiary farmers change. For this reason it is important that relatively poor farmers are selected as the beneficiaries.

Show case farms must be set up to be as close to perfect as possible. If a farmer copies a near perfect demonstration and gets it 75% correct he will have better success than a farmer copying a half perfect model and getting it 95% right.

Recommendations

- The 18 months remaining of the project is adequate to train the ATs, BEWs and FTGs in setting up farms to show case the STOP technologies, particularly the land unit-based diversified farming system. Each technician should be able to set up two farms under close supervision, with the assistance of other technicians in the areas (see Annex 5 for outline budgets).

- When selecting farms to demonstrate Land Unit Farming each group of farmers should be asked to choose one of their neighbours to be the beneficiary. The farm chosen should have a representative range of land units occurring in the area. Neighbouring farmers should be invited to assist in setting up the farms to give them a sense of ownership, as well as basic training. It should be made clear to every one that the inputs, such as Napier and Vetiver grass, improved varieties of fruit trees etc, provided for developing the farm will form the source of materials for neighbouring farmers to develop their farms when they are satisfied that the innovations are profitable.

3.4 RECOMMENDATIONS FOR MULTI-STOREY TREE CROPPING (STOP 2)

3.4.1 Development pathways for systems with perennial crops

- The shift from arable crops to perennial crops will depend on making arable cropping efficient and effective. Improved management and production of arable crops helps to

reduce the area cultivated. Farmers need to intensify production of annual crops on the limited areas of gentle sloping land on their farms, where the risk of erosion is lower and the soils tend to be deeper (see 3.4 below). The extent of diversification will depend on the location, and the distance to markets.

- STOP (Slope Treatment-Oriented Practices) is a land capability classification based on soil depths, soil textures and slope steepness. Used correctly it can provide production models for each slope class and soil type, and indicate the recommended crops and cropping system for the soil type. These could be replicated onto similar agro-ecological zones in neighbouring areas.
- Managing tree crops involves different kinds of work and skills from those of arable farming. Train farmers increasing the areas planted with perennial crops in plant propagation, planting, pruning, spraying, mulching, harvesting, etc. Farmers must be proficient in these new skills as poor plant development, unskilled pruning, and delay in pest control may lower production of the fruit crop for years to come. ATI involvement in this training is recommended.
- Take farmers on exposure visits to areas where multi-storey tree cropping is practiced; e.g. San Isidro, Davao del Norte; and Santa Cruz, Davao del Sur. At these locations, the tree farmers buy most of their food and meet their household needs from selling copra, fruits and bananas, while obtaining off-farm employment to further boost their incomes. The visitors should learn what this entails.

3.4.2 Interventions for perennial crops to increase yields and incomes

Interventions that increase output per hectare of perennial crops, as opposed to extending the area under cultivation, include[1]:

- Use improved planting material which give high yields of good quality produce.
- Adopt cheap and practicable methods of propagating the improved planting material. E.g. direct seeding and field grafting of scions from improved varieties. Selecting healthy, narrow-leafed banana sword suckers, and rejecting broad-leafed water suckers, helps ensure higher yields and better quality fruit.
- Give more time to caring for young trees, to obtain a full stand of plants that grow vigorously and reach the productive stage as quickly as possible.
- Apply sound horticultural practices, such as optimum spacing, shade management, windbreaks, pruning etc. E.g. Removing unwanted suckers before they grow larger than 30cm can increase yields by 25%.
- Improve soil management practices, such as soil conservation, cover crops, weed control, mulching, and fertility management, that maintain soil fertility and sustain high yields. Remove perennial grasses from around banana hills and mulch the weeded area with split sheaths and dried leaves spread on surface.
- Control pests and diseases.
- Use herbicides to reduce labour costs and improve bush and weed control.

[1] Webster, C.C., and Wilson, P.N. (1967). *Agriculture in the Tropics*. Longman, London

3.5 RECOMMENDATIONS FOR ZERO TILLAGE AND MULCHING (STOP 3)

3.5.1 Exposure trips

- Demonstrate the savings in time and labour, and reduction in soil loss, by spraying herbicides to kill grass cover rather than ploughing the land and loosening the soil.
- Take farmers in cogonal areas on exposure visits so they can see first hand why farmers in New Bataan, Compostela Valley, and in Tibulao, Carmen, Davao del Norte, recommend applying herbicides and using inorganic fertilizers to overcome the problems of cogon and low soil fertility.

3.6 RECOMMENDATIONS FOR THE INTENSIVE CULTIVATION OF SMALL LEVEL PLOTS (STOP 4)

1.1.1 Interventions for annual crops.

Modern arable cropping in a humid climate should aim at maintaining a continuous crop cover, either by:

- Mixed cropping (two or more intermingled annual crops),
- Intercropping (two or more annual crops in different but proximate rows), or
- Sequential cropping (one sole crop after the other).

1.1.2 The Corn Patch

- Seek MAO support in terms of HYV seeds and fertilisers to set up more (preferably) roadside corn patches for growing corn for home consumption. Also set up corn patches at learning sites ands show case farms.
- Ensure that neighbouring farmers understand the purpose of the demo. Spontaneous adoption is more likely if passing farmers observe the development of the corn crop through the season, and witness the high yields obtained from the low labour inputs.
- Inform farmers of the low costs, in terms of labour, seeds and fertiliser, compared with the man-days taken to grow unfertilised native corn over large areas; and the costs of making up shortfalls in corn needed by the household.
- Demonstrate how inter-planting or relay planting beans in the corn patch of HYV seed- fertilizer package can increase yields, and reduce inorganic inputs. Plough in the maize and bean residues to help with maintaining fertility.

3.6.3 Raised bed vegetable gardening

- Seek MAO support in terms of vegetable seeds, plastic mulch, mosquito screening etc, to set up demos of permanent raised beds at learning sites, and selected farms,
- Monitor the yields and short-term incomes.
- Develop low cost loan packages.
- Set up demonstrations on composting.

ANNEXES

ANNEX 1

COMPONENT POLICY ACCORDING TO THE FP (IB/1037/97-EN)

1. Sustainable Agriculture Development (SAD)

The SAD component is "aimed at increasing the subsistence food production through improved seeds, implementing vegetative soil conservation measures and diversifying farm production….and, in the longer run, tree crops (fruit, timber, firewood)…"

2. Resource Management (RM*)*

The objectives of the RM component include the development of farm models aimed at "substituting the corn-based mixed farming to perennial crops and agroforestry. Grassland will be converted to agroforestry and mixed farming."

3. Rapid Preliminary Environmental Impact Assessment (FP, Annex 4)

Significant environmental impacts outlined in Annex 4 of the FP included:

i) Sustainable Upland Agriculture Component

On-farm measures:
Farm models:

- conversion of corn-based mixed farming to perennial crops and agroforestry;
- change from coconut-based farming to multi-level cropping;
- conversion of grassland (notably *Imperata cylindrica*) to agroforestry and mixed farming.

Positive impacts: reduced soil erosion, improved biodiversity.
Negative impacts: risk of individual cases of excessive use of chemical fertilisers, but leaching and run-off of surplus fertilizers are reduced due to the biological erosion control effectuated.
Remarks: the measures projected contribute to the transition from shifting cultivation to permanent small-scale upland farming systems that are instrumental for maintaining the upland agriculture resource base.

ii) Resource Management Component

On-farm measures:
Planned features:

contour ploughing, grass strips, trash bunding, terracing, establishment of hedgerows and nitrogen-fixing trees.

Positive impacts: reduced soil erosion, long-term increased agricultural production.
Negative impacts: None.

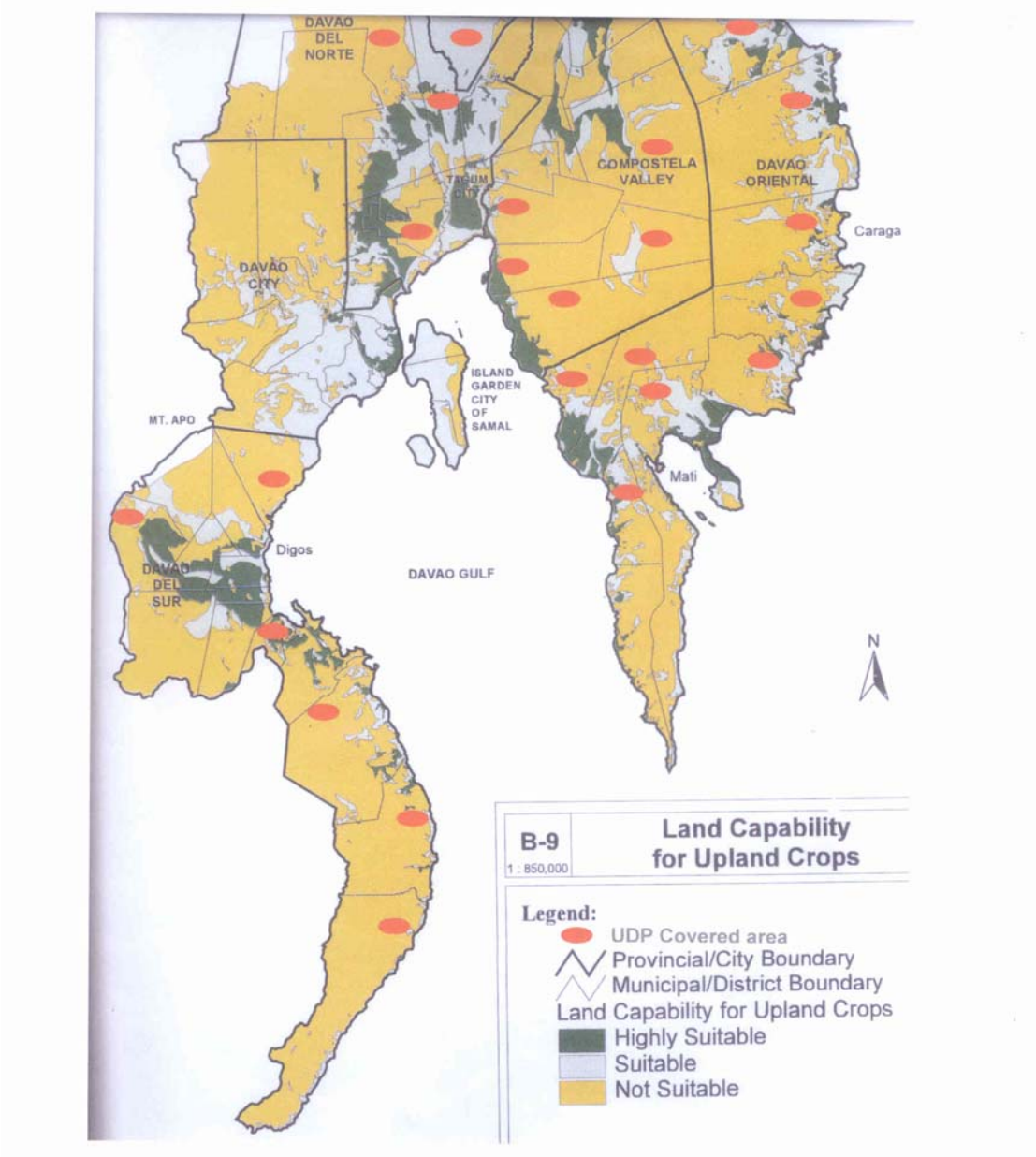
Caution: Most conservation measures serve to reduce the amount of land available for cultivation. The effect might be an intensified cultivation on the remaining land by applying increased amounts of fertilizers. On the other hand, forage from the hedgerows is transformed to manure put back as organic fertilizer.

ANNEX 2

LAND SUITABILITY ISSUES

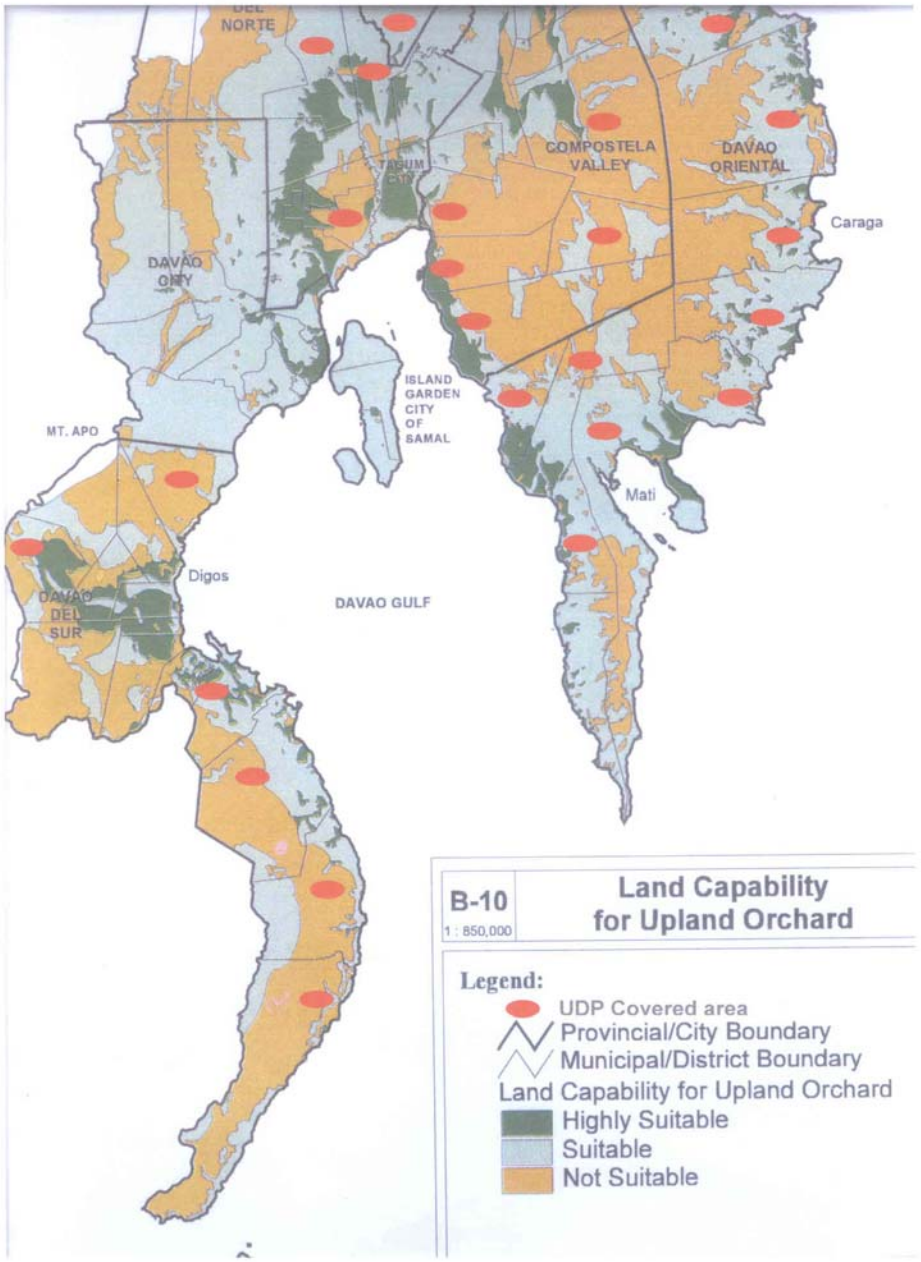
The 1999 *Planning Atlas* for Region XI[1], considers the general land development suitability of much of the UDP project areas either as *forest conservation areas* or *not suitable for upland crops or for orchard development*. The JICA land capability classification maps of the Davao Gulf Provinces 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 *Not Suitable* even for orchard crops (Map 2).

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



[1] Japan International Cooperation Agency (JICA), March 1999. *Davao Integrated Development Project (DIDP), Planning Atlas*. Pacific Consultants Internatonal.

Map 2. Land capability of the Davao Gulf Provinces for Upland Orchards according to JICA



ANNEX 3

HANDOUTS PRODUCED FOR THE SAD COMPONENT BY KRS PROUD

1) Tree Crop Consultancy (Sep-Oct 2003)

a) *A Guide to Improving the Survival of Seedlings*
b) *Banned or Restricted Chemicals and their Harmful Effects*
c) *Some Simple Pest Control Measures*
d) *A Guide to Constructing Micro-basins*
e) *A Guide to Tree Planting*
f) *A Guide to Mulching Fruit Trees*
g) *How to use the Treatment-Oriented Land Capability Classification**
h) *The Slope Indicator**
i) *How to use the Slope Indicator**
j) *Hand Tests to Determine Soil Texture in the Field**

2) Vegetative Soil & Water Conservation Consultancy (Nov 2003-Feb 2004)

a) Soil and water conservation messages for Upland Farmers
b) Establishing a Vetiver hedgerow
c) Backyard Gardening Technologies: Extracts from:DENR's Agroforestry Technology Information Kit, and IIRR's Bio-Intensive Approach to Family Food Gardens.

1) Family Backyard Piggery Project.
2) Fertiliser from Livestock and Animal Wastes.
3) Basket Composting.
4) Bio-Intensive Gardening (BIG) with Agroforestry.
5) Bed-preparation for a BIG (Option No. 1).
6) Bed-preparation for a BIG (Option No. 2).
7) Bed-preparation for a BIG (Option No. 3).
8) Crop planning.
9) Layout for a small-scale Household Level Vegetable Production Unit.
10) The 14-Day Method of Composting.

3) Tree Crops/Diversified Upland Farming Systems (Mar-Apr 2004)

a) *Slope Management for Sustainable Agriculture in the Uplands*
b) *Land qualities for some crop production systems**
c) Blank *Land Unit Prescription Form**

4) Upland Farming/Soil & Water Conservation (Jun-Dec 2004)

a) Form to compare inputs and yields of Corn with Bananas
b) *STOP 1. Land Unit Farming**
*c) STOP 2. Multi-Storey Tree Cropping**
*d) STOP 3. Zero-tillage and Mulching for Crop Production on Shallow Soils**
e) An Improved Design for Cross-slope Barriers
f) A Guide to Rehabilitating and Managing Cross-slope Barriers
g) Bolo Hygiene against Banana Bunchy Top Disease
h) Using Cogon to Control Cogon
i) Take the pressure off your carabao's neck with a Goyod
j) Setaria splendida. Another species for use as a cross-slope barrier
k) Land unit prescription form comparing incomes from bananas and fruits with corn

l) Report on the Causes and Consequences of a Reduction in Soil Depths in the Uplands of Southern Mindanao
m) Report on Problems with Cassava Production in Southern Mindanao

5) Upland Farming/Soil & Water Conservation (Jan-May 2005)

a) *The making of skeleton soils – A major unseen threat to upland productivity*
b) *A guide to intercropping coconuts*
c) *Strategies to offset the effects of drought and control land degradation under coconuts*
d) *Moisture-stress avoidance strategies for coconuts.*
e) Growing pineapples on shallow soils
f) The need to regulate land use in the uplands of Southern Mindanao. A photo essay of soil erosion and its control

6) Upland Farming/Soil & Water Conservation (Jul-Nov 2005)

a) *STOP 4. Intensive Production of Annual Crops on Small Level Plots: the Corn Patch and Vegetable Gardening on Permanent Raised Beds*[*].*
b) *Improving the quality of cacao beans*.

[*] Now bound together in the STOP 1-4 handbook

ANNEX 4

PROBLEMS ASSOCIATED WITH POOR HEDGEROW DESIGN AND PLACEMENT

Figure 1 illustrates what happens between hedgerows planted on long, steep slopes, without taking into consideration soil depth and spacing. Contour cultivation, aided by rainfall run-off and gravity, moves soil down hill. Hedgerows slow down the rate of run-off allowing soil to be deposited. In the process, the soil at the back of the terrace gets shallower while the soil at the front gets deeper. However, when fine silt or clay soils overlie coarser sands, the light-weight fines get washed out by run-off leaving the coarse particles behind. The high banks between the terraces give the impression of successful interception of soil. However, these appearances can be misleading. In some cases the bulk of the material retained is the heavier, coarser sands and gravely lahar, while the more beneficial silt and clay particles get washed off the hillside.

A good example can be seen above the road cutting close to the Sitio Melina learning site, Lampitak, South Cotabato. Hedgerows of Guinea grass planted at 6-8 m spacing on a 40-50% slope form very porous hedgerows with 30 cm-wide gaps between the grass clumps. In the patch of forest on a slope of 70-80%, immediately to the right of the hedgerows, there is a 50 cm deep layer of black silty soil overlying coarse, sand and gravely lahar. The cultivated area has little or no black soil for 4-5 metres below the hedgerows. Cassava plants growing here are stunted. Immediately above the grass clumps only 5-7 cm of silty top soil remains – the light weight particles loosened by ploughing, having been washed away in the run-off between the clumps. Cassava plants are taller here. The large amounts of eroded material trapped behind the grass clumps are manly sand and gravel. A skeleton soil is being formed.

Fig. 1 Stages in terrace formation on too widely spaced terraces

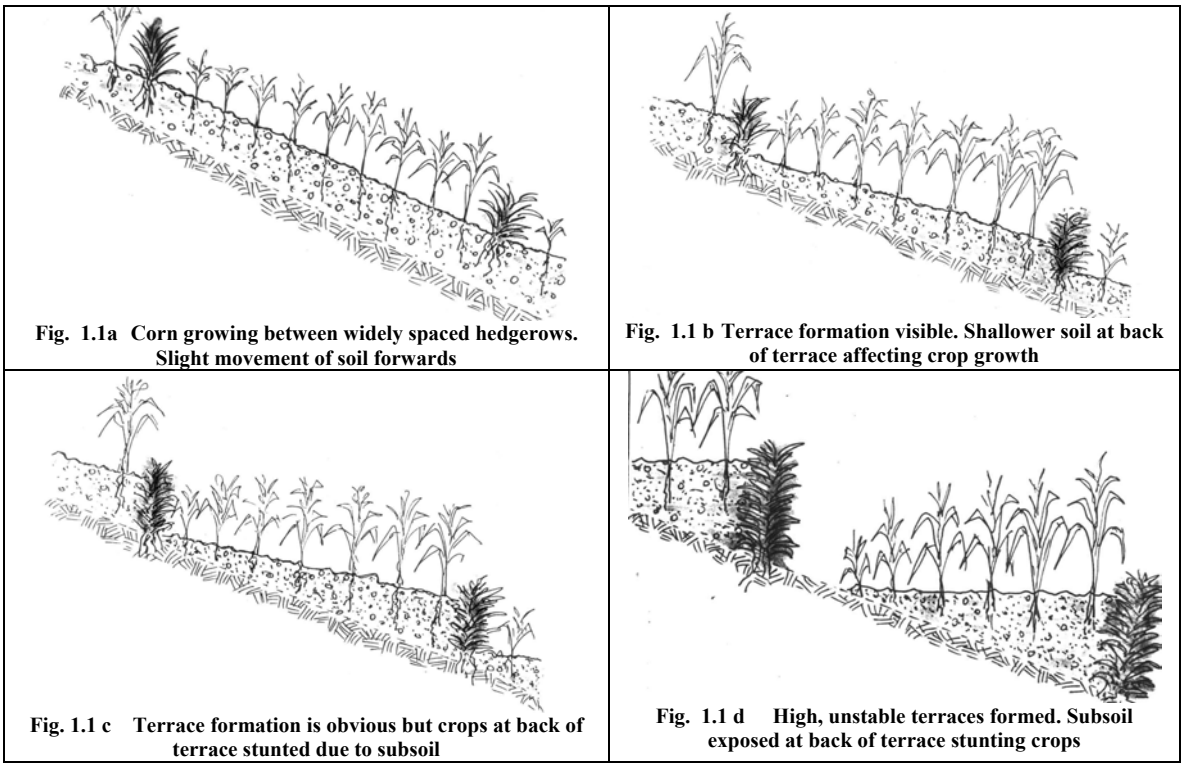


Fig. 1.1a Corn growing between widely spaced hedgerows. Slight movement of soil forwards

Fig. 1.1 b Terrace formation visible. Shallower soil at back of terrace affecting crop growth

Fig. 1.1 c Terrace formation is obvious but crops at back of terrace stunted due to subsoil

Fig. 1.1 d High, unstable terraces formed. Subsoil exposed at back of terrace stunting crops

ANNEX 5

PROPOSED STOP DEMONSTRATION SITES/SHOWCASE FARMS FOR AWP 2006

Potential showcase:	150 AT supervising 2 farmers each	= 300 farmers
	150 BEWs supervising 2 farmers each	= 300 farmers
	Total Programme wide (6 provinces)	= 600 farmers

Projected Inputs per Farmer for the Showcase Farm

60 Fruit trees* x P 100.00	=	P 6,000.00
1,100 Banana suckers x P 5.00	=	P 5,500.00
600 m2 Corn Plot	=	P 2,500.00
Raised vegetable bed	=	P 7,500.00
2 Livestock w/ Forage Plots	=	P 6,000.00
Vetiver splits	=	P 2,500.00
		P 30,000.00
Visitor Center/Shed/Signboard	=	P 10,000.00
Overall inputs per farm	=	**P 40,000.00**
600 farms x P 40,000.00	**=**	**P 24 Million**

Assumptions:

1. This techno demonstration activity will apply only to new areas (replication or co-management) which have minimal UDP intervention i.e. no DFS or SALT type of project has been proposed yet. For this activity to be effective and for the intervention to be measurable, farmers will start from zero. This will also show the effectiveness of a showcase farm as a tool for upland agriculture extension.
2. Farmer cooperator will be selected by a group of 10 farmers. Instead of availing the P 3,000.00 worth of inputs, the group will opt to let the chosen farmer get the P 30,000.00 worth of inputs and demonstrate STOP technologies in his DFS farm. The group will monitor the progress of the farmer. The 10 farmers will eventually be the beneficiaries of dispersed inputs from the chosen farmer.
3. The breakdown of the P 30,000 STOP input is stated above. The cost for constructing a visitor center/shed and signboard will be considered as the LGU's equity.
4. The major considerations for farmer and site selection are:
    a. Site is very accessible and ease of transport to and from the farm
    b. Farm sites should showcase all land units- plain land either on crests (hill tops) or valleys, slightly rolling land (12- 25%), steep to very steep (26 to 55%) where STOP can be applied, and precipitous slopes (above 55%) where there are no proven sustainable agricultural interventions.
    c. No land ownership problems (preferably titled).
5. The whole agriculture extension network – FTGs, BEWs and ATs will help in the supervision and monitoring of the showcase farms.

* This will be a mixture of fruit tree seedlings and seeds