17. THE SILVICULTURE OF SMALL-SCALE FOREST PLANTATIONS IN LEYTE, THE PHILIPPINES: A PRELIMINARY SURVEY

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A baseline survey was undertaken of small-scale forest plantations in the provinces of Leyte and Biliran, the Philippines as preparation for Australian Centre for International Agricultural Research (ACIAR) project ASEM/2003/052. Inspections and interviews were undertaken with plantation owners to determine the species, age, provenance, spacing, site preparation, pruning, thinning history, reason for planting and the expected market for the trees. The growth and form of the plantations was found to be poor, partly because of a lack of silvicultural management and partly because of a lack of commercial focus. Technical information concerning tree growing is difficult for farmers to access. Increased extension services and liaison between sawmillers and growers is suggested as a possible solution.

INTRODUCTION

In developing countries, there is a trend to move away from large-scale industrial forestry to community and small-scale forestry (Harrison *et al.* 2002), with plantation size often a small fraction of a hectare. This is due to a variety of factors, but one that is generic to many developing countries is that industrial forestry requires large areas of land exclusively dedicated to plantation forestry but which may not deliver benefits to a significant proportion of the local population. While industrial forestry may produce large amounts of wood which produce significant economic benefits, in the Philippines, it has only been partly successful because of poor maintenance, wildfire and low tree survival rates (Harrison and Herbohn 2001).

Successful industrial plantation forestry is achieved by defining the objectives, determining an appropriate silvicultural management regime and then maximising wood flows as early as possible (Leech 2002). However, small-scale forestry operations in developing countries are often planted and managed in a way that precludes this. Venn and Harrison (2000), described the reasons for this as being the lower investment capacity of farmers, differences in management objectives and often, insecure land tenure. When estimating the yield of small-scale plantations of Australian eucalypts in the Philippines, they applied an arbitrary growth reduction of 33% to yield table data derived in industrial plantations. This situation is at odds with the abundance of rain, sunshine and relatively fertile soil found in the focus area of this investigation, Leyte and Biliran Provinces in the Philippines.

If plantation silviculture is defined to include management decisions ranging from site-species selection, choice of seed provenance, site preparation, initial spacing, weed control, fertilisation, pruning and thinning, most of the capital expense and labour requirement is required in the first year of the plantation's life. There is an understandable reluctance on the part of smallholders to spend any but the most necessary funds or labour on a crop which will not give a return for many years. This is even more understandable in a region which is subject to typhoons and in which the most popular plantation tree species are subject to a variety of pests and diseases.

Literacy levels amongst smallholders in Leyte are variable and access to agricultural or forestry related scientific information is minimal. DENR extension material and a recently

released compact disc describing species-site compatibility (Lantican 2004) have a very limited circulation. Consequently, there is a need for smallholders in Leyte to be able to access technical advice so they can evaluate the risk of plantations as a commercial enterprise and make informed decisions. Obviously the technical information must be tailored to the needs of the clients. Therefore, as part of ACIAR project ASEM/2000/088 in Leyte, a series of interviews and field observations were undertaken in 2004 to assess the current state of silvicultural management of small-scale plantations. The information has been used as background material to prepare demonstration tree farms for ACIAR project ASEM/2003/052 *Improving financial returns to smallholder tree farmers in the Philippines*.

Objective 2 of the new project is to 'assist smallholder tree growers to satisfy market requirements and improve productivity'. A major part of the procedure for this objective is 'to identify fifteen existing tree farms to be used as sites to demonstrate the financial benefits of simple management interventions to increase the volume of merchantable timber and to produce products that better meet market requirements' (ACIAR 2005). In the project outline, the outputs for these activities are listed as:

- Output 2.4a. Higher value products from tree farms.
- Output 2.4b. Improved management regimes for tree farms.

Consequently, the fifteen demonstration sites will be a major focus of project activity and will have a high public exposure. In this paper the silvicultural management of small-scale forest plantations in Leyte and Biliran Provinces is described and the consequences of using inadequate or inappropriate silviculture are analysed. As tropical forest plantation silviculture is well described in the literature, generic recommendations are made about increasing the bio-physical performance of plantations in Leyte. An extension program centred around the demonstration sites and which targets silviculture, communication between sawmillers and growers and a holisitic overview of plantation establishment is proposed. Silvicultural recommendations which are appropriate to the needs of small-scale plantation owners are made for *Gmelina arborea, Eucalyptus deglupta, Acacia mangium and Swietenia macrophylla* as these are the four main species chosen for plantation forestry in Leyte.

SURVEY METHODS - INTERVIEWS AND VISUAL OBSERVATION

During two trips to Leyte in 2004, nine small-scale plantation owners, one industrial plantation owner and one community forest representative were interviewed concerning aspects of their plantations. Details of the plantations and the owners' expectations from them are described in Table 1. The plantation sites were both opportunistically selected as there are few examples of plantations with good tree growth and form in Leyte and Biliran. Owners of plantations which showed poor growth or which had failed, were not interviewed as the purpose of the survey was to investigate the silvicultural management of plantations which had potential for commercial use. Field visits were made to the plantations and the owners were interviewed on-site or as a follow-up activity. Of the nine small-scale plantation owners, five were farmers and four owners received income from outside interests.

The focus of the interviews and observations was three aspects of plantation management. The main focus was the owner's knowledge of site-species matching, site preparation and silvicultural techniques to enhance the growth rate of the trees. A secondary consideration was the degree of business planning which had underpinned the decision to plant the trees, the owner's knowledge of markets for the trees and the resources the owner was prepared to commit to increase the growth rate or add value to the trees. The third focus of the investigation was the owner's prioritisation of plantation forestry in his or her farming system.

Table 1. Area, species[1] and comments about the plantation owner for 11 plantations in Leyte and Biliran Provinces and the island of Cebu.

Plantation number and location	Area (ha)	Species.	Owner details and purpose of the plantation.
1 Biliran Island	700 (gross)	Ac, Euc, Sw, Gm,	The owner is a businessman industrialist and the plantation is the subject of an Integrated Forest Management Agreement (IFMA). The timber will supply local or export markets, as opportunity permits.
2 Alcoy (Cebu)	300 (gross)	Mixed	The owners are members of the Alcoy community and the forest is part of a Community-Based Forest Management Program (CBFMP). The plantation is intended to supply a number of local requirements from farming to timber supply to a potential eco-tourism market.
3 Ormoc	<1	Ac, Euc, Sw, Gm, Tm	The owner is a retired businessman and the main purpose of the plantations is beautification of the farm homestead surrounds. The plantation was established by Leyte State University under a memorandum of agreement with the owner.
4 Inopacan	<1	Gm, Sw	The owner has outside employment. Hence the plantation has only a secondary commercial focus, with its main purpose being site restoration of the family farm.
5 Conalum	<1	Euc	The owner is a small-scale farmer. The plantation has been planted in association with coconuts and will eventually be supplanted by them.
6 Conalum	<1	Ac	The owner is a small-scale farmer. The plantation has been planted as an under-planting to coconuts. After harvesting, the land will revert to a coconuts plantation.
7 Conalum	<1	Sw	As a farmer, the owner views the trees as a source of shade and wind control. The trees may be harvested in the future.
8 Babatngon	<2	Gm	The owner owns 45ha and is concerned about agrarian reform processes confiscating his land. Hence he has planted the trees to demonstrate environmental awareness as well as for lumber.
9 Lake Danao	<2	Ac	The owner is a small-scale farmer and the trees serve as a nurse crop to the textile palm *Abaca musilis*. Their intended use is for the furniture market.
10 Matalom	<2	Gm Vp	The land on which this plantation is planted is owned by the army even though it is adjacent to a village. Hence there is no plan to harvest the trees, which were planted for environmental reasons.
11 Baybay	<1	Gm	The owner is a small-scale farmer and the trees serve as a windbreak. Because of the poor soil, the trees may never reach commercial size.

The results of the interviews and visual observations were compared with the general literature relating to tropical plantation silviculture, particularly in relation to the south-east Asian region. This enabled initial conclusions to be drawn concerning the advantages of applying capital or labour intensive silvicultural techniques to the plantations. The owner's

[1] In the body of the table, the symbols *Ac, Euc, Sw, Gm, Tm, Vp* and *Mixed* refer to *Acacia mangium, Eucalyptus deglupta, Swietienia macrophylla, Gmelina arborea, Terminalia macrocarpa, Vitex parviflora* and *mixed species,* respectively.

attitudes and expectations concerning growing trees were then incorporated into recommendations for future extension activities.

SILVICULTURE AND MANAGEMENT OF THE PLANTATIONS

The results of the interviews and observations undertaken in July and August 2004 are summarised as Table 2, below.

Table 2. The table shows silvicultural management of plantations at ten field sites in the provinces of Leyte and Biliranan and one field site on the island of Cebu.

Plantation number and location	Age (years)	Seed Provenance	Below ground weed control	Spacing between trees	Fertilised	Pruned	Thinned
1. Biliran	6	unknown	none	2.5m approx	yes	no	no
2 Alcoy (Cebu)	5	locally sourced	unknown	2.5m approx	yes	no	no
3 Ormoc	1 to 6	locally sourced	none	2.5m approx	yes	yes	no
4 Inopacan	11	locally sourced	none	2.2m approx	none	no	no
5 Conalum	3	locally sourced	none	3m variable	no	no	no
6 Conalum	2	locally sourced	none	3m variable	no	no	no
7 Conalum	8	locally sourced	none	variable	none	no	no
8 Babatngon	9	locally sourced	none	2m	no	no	no
9 Lake Danao	4	locally sourced	none	variable	no	no	no
10 Matalom	6	locally sourced	unknown	3m	no	no	no
11 Baybay	3	locally sourced	none	<2m (wind-break)	no	no	no

General Comments Concerning the Plantations

Apart from the plantations at Biliran, Alcoy and Matalom, all plantations were less than 2 ha in area, with six plantations being less than 1 ha in size. This is indicative of the subsidiary role of plantations in the local farming system. On four sites, trees had been planted as secondary crops. This occurred at Conalum (two sites) where trees were planted as under-plantings to coconuts, at Lake Danao, where the trees were used as a nurse crop to provide

a continuing source of shade and at Baybay, where the trees were planted as a wind break and may never reach commercial size

Observations Concerning Site Species Matching and Seedling Provenance

Several examples of poor site-species matching were observed. *Eucalyptus deglupta* was observed growing on thin limestone soils at Conalum in conditions where it is likely to undergo drought stress. *Gmelina arborea* had been planted at high elevations (approximately 500m or more above sea level) at Biliran and at Lake Danao and the local provenance of this species does not grow well at these elevations.

The typical response from the owners of the smaller sized plantations was that they had planted the only seedlings that they could access. In several cases this had been the seedlings which were available at the DENR nursery in the city of Tacloban. Site species matching therefore was not possible, there being a shortage of seedlings of any species.

In all cases, the genetic provenance of the seedlings used for the plantations was unknown to the owners. As described above, seedlings had been provided from DENR or other local sources and there was no information concerning its source and genetic quality. DENR officials commented that often they were forced to use whatever seed they could find for their nurseries. The form of *Gmelina arborea,* was poor at all elevations, with short internodes and bent stems. *Acacia mangium* also had poor form and a tendency to form multiple stems at most locations and it was suspected that the poor form for both species is genetically influenced. However, in all plantations for all four species, the occasional *plus tree* was observed. In tree breeding parlance, a *plus tree* is a tree of conspicuously better form, size and dominance. These trees suggested themselves as a source of seed or cuttings if the opportunity and need arose.

From a purely silvicultural point of view, the incorporation of superior genetic stock is one of the few avenues of improvement left open to foresters as many of the other silvicultural techniques have been well researched. In Leyte, *Gmelina arborea* is an obvious candidate for genetic improvement because the trees are of very poor form with short internodes and this can only partly be improved by planting at close spacings (CAB International (3) 2004).

In an evaluation of different (world wide) provenances of *Gmelina arborea,* Lauridsen et al. (1995), found differences in basal area growth of 20 m^2/ha in some provenances where the mean of all provenances was 55 (m^2/ha). Improvements of this size are too large to ignore and the consequences of plantation owners in Leyte not being able to access provenances of *Gmelina arborea* suited to higher elevations are that this species cannot be grown on much of the higher elevation land which is potentially available to plantation forestry.

One approach may be to access superior *Gmelina arborea* genetic stock which has been developed by the industrial plantation companies. This may involve some altruism on their part. The approach taken by Howcroft (2002) to tree breeding of balsa at Rabaul in Papua New Guinea offers an alternative. Following the virtual destruction of the industry following a volcanic eruption in 1994 which wiped out most of the balsa plantations, the International Tropical Timber Organisation (ITTO), sponsored the rejuvenation of the industry which encourages the selection of ‘plus’ trees to propagate seedlings of superior form and growth. Between 1996 and 2004 the program was able to re-establish local small-scale plantations and ensure the sawmills had a continual supply of timber. This program lacked the intensive selection and breeding characterised by clonal selection programs and the capture of the potential genetic gain is much less. However, from the author’s observations, the trees are far superior in form and growth than wild populations in the same region.

As a parallel aim to improving species provenance, there is a need match species to site. In site species matching, two components of the climate are of overriding importance, namely the amount and distribution of the rainfall and temperature extremes (Evans 1986). In Leyte, which is hot throughout the year, rainfall is a more important factor than temperature. For example, a moist lowland species such as *E deglupta* grows best where rain falls every month with a total of 2000-5000 mm per annum whereas *Gmelina arborea* tolerates dry periods.

In Leyte Province the east is characterized by pronounced rainfall from November to January. Climate in the west is characterized by rainfall that is relatively evenly distributed throughout the year. Generally there is no distinctive wet or dry season but because of the central cordillera, the climate in the north-west differs slightly from that of the north-east and that in the south-west from the south-east. The western side generally receives less rainfall than the eastern side. Despite average rainfall being 2600 mm at Baybay, temporary droughts occur, particularly between February to May (SLE 2001). This suggests that although *E. deglupta* may grow well in deeper soils at Baybay, it is not suited to shallow soils where it may become drought stressed. At present farmers have little information available to them concerning site-species matching and the potential advantages from using trees with appropriate provenance.

Site Preparation and Weed Control to Achieve Rapid Initial Growth

Questions about weed control generally elicited a response that weeds had been cleared, usually by slashing with a bolo at time of planting and thereafter, as necessary. Chemical weed control had been only used in one plantation because it is considered too costly for normal use. From observation, weeds grow quickly in the tropical conditions of Leyte and weed control is required every few weeks until the trees are established and have grown to approximately 2 m high. Seedlings may also be completely overgrown and even bent over with smothering vines and these vines must be kept in check until they are shaded out. The plantation owners indicated that they had controlled weeds above ground level and this is supported by the high survival in all of the plantations. However, *below ground* weed control was restricted to very limited cultivation at planting.

The traditional approach to site preparation involves cultivation of the ground to increase the seedling root' ability to colonise the soil. In smallholder plantations this has been restricted to cultivating the ground with a mattock. In industrial forestry, to maximise the retention of nutrients (principally nitrogen) and to minimise erosion on steep land, spot mounding or ripping has become common. These new practices have been highly rewarding for foresters, as for example, minimisation of erosion and retention of organic matter (logging slash) increased volume production of trees by 29% in infertile coastal pine plantations in south-east Queensland (Simpson *et al.* 2001).

Industrial forest plantations often use chemical weed control and this is too expensive for small-scale farmers in Leyte even though *Imperata cylindrica* is easily controlled by herbicide. Slashing the ground around newly planted seedlings removes competition from grass blades above the ground, but not rhizomes below the ground. Fortunately, *Imperata cylindrica* is intolerant of shade and once a plantation is established to the point of canopy cover, no further control is required.

The advantage of mechanical cultivation is that it is also a surrogate method of weed control, by drying out the roots or rhizomes of weeds. Hence Nasayao *et al.* (2001), for tree planting in Leyte, recommend digging a hole 30 cm wide and 45 cm deep and keeping a ring of 1m diameter weed free. Where the main weed is *Imperata cylindrica,* this is insufficient to prevent the rhizomes from growing inwards to the roots of the newly planted seedling. DENR (2001) compared the growth of *Gmelina arborea* between two site preparation treatments.

One treatment was three complete cultivations of the soil in strips 1.5 m wide and a planting hole of 30 cm wide and 30 cm deep. The other was slashing a strip 1m wide and a planting hole 15 cm wide and deep. At an age of 5.5 years, the mean diameter growth (at 1.3 m above ground level) of the first treatment was 12.1 cm with the second treatment being only 8.8 cm. Similarly, the mean height growth was 6.8 m and 4.7 m for the two treatments, respectively. These differences are substantial and at age 5.5 would indicate the difference in growth rate is permanent.

Farmers recognise the need for above ground weed control, but are unwilling or unable to achieve below ground weed control. The consequence is that newly planted seedlings suffer competition from the roots of weeds and their growth is reduced. *Imperata cylindrica* competes for light with small seedlings and when water becomes limiting, the extensive root system will access water more effectively than planted seedlings. In *Imperata cylindrica* grassland in Kalimantan, Indonesia, *Acacia mangium* almost trebled volume production up to 64 m3/ha/annum at 30 months of age (Turvey 1995) as a result of effective weed control. Similarly, an 11 fold increase in the production of *Europhylla* to 21.3 m3/ha/annum was achieved at age 30 months. Effective weed control is therefore essential for the establishment of eucalypts and other species in these areas.

The consequences of poor site preparation and weed control are that the growth of the plantation is reduced and the time period to achieve canopy closure is lengthened. Fires are a constant hazard to plantations in Leyte and one of the most effective methods of protection is to achieve canopy closure with a consequent reduction in the grass layer below. The interviews indicated that farmers were following established custom in their establishment practices and had no ides of the potential gains which may accompany intensive site preparation.

Use of Fertiliser at Time of Planting

Many of the deforested areas in Leyte, particularly those dominated by *Imperata cylindrica* are nutrient deficient. From observation, soil structure is poor and frequent burning has reduced the organic matter component.

Apart from the industrial plantation at Biliran, the community-based plantation at Alcoy which had been established with foreign aid funding, and a small plantation which had been established by Leyte State University, none of the plantations had been fertilised with inorganic fertiliser. In several instances, the owner stated that the reverse was the case - the plantation was intended to fertilise the soil by drawing up nutrient from the soil and supplying much to the topsoil, thereby improving its nutrient level and structure.

Research into fertiliser use in industrial plantations in the tropics are often aimed at the need to establish the elements that are in critical supply and the level at which tree growth response to fertilizer begins to enter the “luxury” phase of application where additional inputs of fertilizer result in little increased growth Richards (1993). The Leyte plantation owners who were interviewed in this investigation indicated that for them this was not a realistic approach because of the expense of inorganic fertiliser. While the primary aim of plantations might be to grow timber, often a secondary aim was to improve soil structure and organic matter. On two sites, the primary purpose of the plantations was to increase the fertility of the soils for a succeeding crop of coconuts.

Farmers have no way of determining if the growth responses are permanent or ephemeral as is sometimes found in other tropical plantations (Nester *et al.*1999). Recent DENR (2001) research indicates that on soils derived from limestone in the Philippines, a significant growth response is achieved to *Gmelina arborea* seedlings from intensive site preparation or fertilizer, but that the combination of these two factors produces no further increase in

growth. Response to fertiliser varies according to the chemistry of the soil, so these results cannot be extrapolated to other soil types. In addition fertiliser is often taken up by grass competition. However, in soils low in nutrient, a small application of fertiliser at time of planting often assists seedlings to establish. A small application of fertiliser is excellent 'insurance', for wealthier landowners who can afford fertiliser but whether to fertilise is a more difficult decision for less wealthy landowners.

Early Age Pruning to Produce Knot Free Wood for Furniture Grade Timber

Except for the plantation established by Letye State University, none of the plantations had been pruned to initiate clear wood growth over branch stubs. Several plantations at Conalum and Lake Danao had been pruned with a bolo or machete. This involves cutting off the branch at a distance of 10 to 20 cm from the tree trunk, using a slicing action with the bolo. Occasionally the branch stubs are left so that the owner can climb up the tree at a later date to cut off higher branches. This is common in cultures where the leaves are harvested for forage, but in Leyte it is sometimes done so the leaves can be used for mulch.

The high cost of labour in developed countries has caused a re-examination of the cost effectiveness of pruning in recent years. Pruning is not considered as imperative as it once was and is only undertaken where there is a clear indication that wood processors will pay for the cost of pruning (with interest), in their purchase price. The literature from industrial forestry sources (e.g. Williamson 1993; Huxley 1999) assumes that trees will be pruned to grow clear wood over branch stubs. For small-scale plantation owners, the Agroforestry Technology information Kit Vol. 5 (1992), recommends that pruning be undertaken in the same way, keeping branch stubs short and not damaging the collar of soft bark tissue adjacent to the branch stub

The perennial problem with pruning is that the tree grower spends time and effort early in the rotation to hopefully add value to the tree. Some years later, if the sawmiller refuses to pay extra for the knot free wood, then the tree grower has increased his costs with no commensurate return. Farmers need guidelines from sawmillers on what they are prepared to pay extra for the knot free wood produced, even though there is a long lead time between pruning and milling. Cutting off branches with a bolo and leaving a long stub is the worst practice of all, as this potentially promotes decay from the stub into the bole of the tree. Pruning practices using pole saws or secateurs are well described in much of the agro-forestry literature and a pair of secateurs only costs 75 pesos. The problem at the moment seems to be lack of technical advice.

Tree Spacing and Initial Stocking

In industrial plantations, tree spacing has evolved in recent years from square spacings to increasing the number of trees planted along the row and widening the inter-row space. This has the effect of reducing walking time for the tree planter and minimising machinery operation because there are fewer rows to cultivate or spray. The silvicultural aim is for the trees to 'capture' the site and to suppress weeds. While height growth of the trees is not affected over a wide range of stockings, tree diameter plunges exponentially with increased tree density and competition (Baskerville 1962). Farmers in Leyte use close spacings for their trees (2.5 m or less) in the hope of inducing *Gmelina arborea,* particularly, to grow straight with small branches. This does not occur and as described above, these traits being clearly under genetic control (CAB International 2004).

Thinning to Remove Weaker Trees

None of the plantations had been thinned from the original stocking. Several plantations had been planted at a spacing of 2.5 m or less and the owners commented that the spacing was

kept close in order to achieve quicker canopy close and rapid weed suppression. Survival of the trees in all the plantations was very high (estimated as above 80%) and except for plantations with trees aged three years or less, the trees were suffering competitive stress. The competition had caused suppression in some trees, with others having an intermediate growth form and other being clearly dominant. Also, none of the owners indicated that there was any intention to thin the plantations in the traditional way *from below*, by using the traditional criteria of tree vigour, form and spacing to select the best trees for retention and the worst trees for removal. In contrast, several owners indicated that they intended to harvest the best trees as they were required and that they would then let the rest of the plantation to grow on. The author interpreted this as an opportunistic method of harvesting rather than the silvicultural treatment, in forestry parlance, *thinning from above*.

Thinning practices have been described in the literature for many years (Toumey and Korstian 1937) and have undergone considerable recent change in industrial plantations. Thinning schedules which optimise overall growth and often favour larger log sizes have been modified to reduce the number of thinnings. This is because logging machinery causes soil compaction. Also modern sawmills are designed to utilise small diameter logs and improved tree breeding has also meant that there are less defective trees in the stand. Where thinning is still undertaken in monoculture plantations, however, the criteria to determine priority for removal is still tree vigour, form and spacing. For *Acacia mangium, Eucalyptus deglupta* and *Gmelina arborea* plantations in the Philippines, Williamson (1993) recommended multiple early thinnings (year 2 to 3) from below. Williamson also advocated that farmers thin *Gmelina arborea* within this time-frame because the species does not respond to late thinning. This is supported by Lauridsen (2002) and Agus *et al.* (2000) who noted a rapid reduction in increment in *Gmelina arborea* after the seventh year.

Intuitively, extension activities should encourage thinning of plantations because revenue from firewood is often the only early financial return that the farmer will receive before clear felling the plantation. Thinning also concentrates growth on the best trees. Farmers are notoriously reluctant to thin their plantations because it takes time and capital to get trees established and it goes against the grain to cut them down early. The worst-case scenario with *Gmelina arborea* is a late thinning, from above, in which the remaining trees do not respond to release. As with pruning, the problem is a lack of technical advice

Marketing and Business Planning for the Plantations

The most surprising aspect about responses to questions about the marketing arrangements or business plan for the plantations was the vagueness of the answers. Only two of the owners had harvested trees from their plantation and in one case, this was the cutting up of a single tree. The owners responded that a market for the trees would be easily found and several indicated that they would supply the general lumber or furniture market. None, however, could estimate the volume or value of their plantation. The only owner who could specify a particular sawmiller to cut up the trees was the owner of the Biliran plantation who owns his own sawmill.

DISCUSSION AND SUGGESTED DIRECTION FOR FURTHER WORK

Analysis of the interview responses and visual observations showed that the plantations were all managed according to a similar silvicultural regime, but that the owners had widely different rationales underpinning many of their silvicultural decisions. The greatest cause for optimism in all the plantations was they had achieved a high rate of survival of the trees. The plantations were all successful in terms of restoring a tree cover to land that was previously, in most cases, *Imperata cylindrica* (cogon) grassland. Nevertheless, the use of minimal silvicultural inputs has produced trees with limited commercial usefulness. Growth of most of the plantations was poor and individual tree form was often very poor. The plantations were

often overstocked and although this has reduced branch diameter, diameter growth of all trees is suffering, being shared between too many trees. There has been no silvicultural value-adding to trees in preparation for a future end use and this indicates the lack of liaison between growers and sawmillers.

The bio-physical growing conditions on Leyte are generally favourable for forestry but there is little silvicultural information available to farmers. The silviculture applied to plantations is poor and is preventing the trees from realising their bio-physical potential. Farmers readily acknowledge their lack of technical expertise concerning silviculture and clearly assistance would be appreciated, provided it fitted in with the farming system of the family farm.

Another issue is that the collapse of the sawmilling industry on Leyte has lead to a dearth of communication between growers and sawmillers. Until a commercial focus can be given to plantations, farmers will be planting trees without a marketing objective and this will reduce the adoption and diffusion of small-scale forestry. Effecting liaison between growers and sawmillers should be a major focus of any extension program at demonstration sites.

Of these issues, silviculture can be addressed by a technically oriented extension program involving demonstration sites where farmers are invited to see how simply applied silviculture may produce a faster growing and more valuable timber product. The challenge is to provide a range of learning opportunities and practical activities at each site as well as being a meeting ground for growers, sawmillers, DENR and local government.

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