Australian Government

Australian Centre for International Agricultural Research

Final report

project

Improving financial returns to smallholder tree farmers in the Philippines

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1 Acknowledgments

We would like to acknowledge the strong support that we received for the project from the current, and also the past president of Visayas State University, Dr Joe Bacusmo and Dr Paciena Milan. We would also like to thank the many tree farmers who allowed us access to their farms and who generously gave their time to discuss their activities and beliefs. We are also grateful to the many people from government agencies, particularly the Department of Environment and Natural Resources and the local government units who actively contributed to the research activities and development and implementation of pilot studies and policy recommendations. We would also like to thank the many excellent research assistants who often went beyond the normal requirements to help achieve the project objectives. The ACIAR Philippines Manager, Ms Cecelia Honrado, provided excellent support to the project.

2 Executive summary

Most upland farmers in the Philippines have incomes below the poverty line. The goal of the project has been to improve financial returns to existing smallholder tree farmers and intending tree farmers. The research strategy is reflected in the following project objectives.

Objective 1: Assist the Department of Environment and Natural Resources (DENR) to overcome policy implementation constraints to tree registration and log transport currently restricting access to markets

Objective 2: Assist smallholder tree growers to satisfy market requirements and improve productivity

Objective 3: Identify and promote livelihood systems and policies which incorporate forestry and which recognise the socio-economic circumstances of smallholders

The research had three main thrusts. First, project researchers collaborated with DENR officers and smallholders to identify and remedy impediments to timber market access. The focus was to work with the DENR Region 8 to make the existing regulations work more effectively. This resulted in immediate short-term benefits to tree farmers wishing to register trees and obtain permits to transport logs. It is anticipated that in the longer term the project outputs will influence national level DENR policy and regulations, and meetings have already been held with senior DENR officers in an attempt to influence policy. Mechanisms were developed to improve the flow of information about regulations affecting tree harvest and about transport approval, both with DENR and from DENR to LGUs and smallholders, including the development and testing of a primer for tree registration, and harvesting and log transport approval. In addition, a 'School of the Air' radio program on tree farming policies was broadcast by Radio DYAC, with formal enrolment of 'students' and with active participation of DENR personnel, municipal mayors, councillors and municipal agricultural officers.

Second, research was undertaken to identify the market requirements for timber in terms of species, type, quantity and quality required by processors. A survey of timber processors on Leyte Island (including Biliran), Samar and Cebu has been undertaken. The market potential for wood from existing tree farms in Leyte and Southern Leyte Provinces has also been assessed. This assessment involved four interrelated activities: (i) an assessment of timber quality and likely yield per product class, (ii) further financial analysis including on mixed-species agroforestry systems, (iii) modelling of timber supply and demand, and (iv) an investigation of the social and economic factors that affect the management of plantations and the types of outputs produced. The assessment of timber quality and yield was based on data collected on 5664 trees from 532 plots established on 119 tree farms. Socio-economic data have been collected from 81 tree farmers. A site index equation for Gmelina arborea was developed, along with growth and financial models for key species including G. arborea, Swietania macrophylla and Acacia mangium. The growth and financial models are expected to be of great utility to DENR.

An extension program was developed and trialled, which tested mechanisms to improve the silviculture skills of farmers. As part of this program, 'bus tours' were conducted, taking smallholder tree farmers to demonstration sites in order to deliver key information about silviculture. Rigorous evaluation indicated that these 'tours' provide an effective and cost-efficient means of delivering extension advice to smallholders but their success

is constrained by a number factors including the need to ensure appropriate protocols for contacting community members are in place. In addition, a pilot program involving cost-effective ways of linking buyers and sellers of timber has been conducted which involved the installing two large whiteboards outside the CENRO office in Maasin. . An evaluation revealed that whiteboards were found to be very useful by tree farmers, timber buyers and the DENR, but problems were found with the information becoming outdated, especially in respect to information about available timber. Plantation trials have been established on farms that demonstrate to farmers the benefits of early-age silviculture and late-age remedial thinning treatments. We also established other field trials to provide information for improved design of tree farm systems.

An analysis has been undertaken of livelihood strategies adopted by various types of smallholders and recommendations made on appropriate farming systems that incorporate forestry and that recognize the socio-economic circumstances of smallholders. University researchers have actively collaborated with DENR to develop policy recommendations based on the findings from the various project activities, which have been presented to senior DENR staff in Manila. These efforts are continuing.

It is recommended that a new project be developed which is focused on forestry and environmental services, with a particular focus on the socio-economic, policy and technical issues associated with using indigenous species in improved watershed restorations and in soil and water management in critical catchments, ensuring sustainable livelihoods in relation to a combination of production, semi-production and conservation plantings.

3 Background

This project was designed to improve the livelihoods of smallholder farmers in Leyte Province through improving financial returns from forestry.

Most upland farmers in the Philippines have incomes below the poverty line. Timber production from smallholder tree farms provides a mechanism for income generation and capital accumulation. However, current returns to smallholder tree farmers are low, for a variety of reasons. Research conducted as part of a four-year project funded by the Australian Centre for International Agricultural Research suggests that tree farmers could receive much higher financial returns from their tree farms if they had better market access and knowledge of prices, produced greater volumes of timber per unit of cost, and could better produce timber of appropriate species, log size and quality as desired by the market. In order for smallholders to access markets they must first obtain log transport permits and sometimes harvest permits. To do this, they must first register their tree farms (i.e. woodlots) with the Department of Environment and Natural Resources (DENR). There are many institutional impediments restricting the ability of farmers to register trees, and hence these act as a barrier to them gaining access to markets, thus restricting timber sales to local markets, which are often restricted and non-competitive. In addition, many smallholders lack information about how and where to market their trees, and also lack knowledge of the current market value of their trees. For these reasons, they often accept the first offered, and often low, price for their timber. Smallholders also lack knowledge about what the market requirements are for timber and as a result do not manage their tree farms to optimize the output of these desired products.

ACIAR Project ASEM/2003/052 – Improving Financial Returns to Smallholder Tree Farmers in the Philippines – commenced on 1 January 2005 and ran for four years until December 2008, with an end-of-project workshop held in February 2009. The project was designed to improve the livelihoods of smallholder farmers in Leyte Province through investigating ways of improving financial returns from forestry, and promoting the adoption of these improved management methods.

Forest industry development for both economic and environmental reasons is a high priority for the Philippines, as indicated in the Revised Master Plan for Forest Development (Revised MPFD) issued by the Department of Environment and Natural Resources (DENR) in 2003. In particular, the role of forests and forestry in poverty eradication and support of sustainable livelihood has been recognised in the Revised MPFD as being one of the important new developments in forestry in the Philippines.

Currently in Leyte, the twin problems exist of shortage of timber hence reliance on imports from other provinces and countries, and slow uptake of forestry in spite of availability of underutilized sloping land. Forest industry development warrants high priority in Leyte Province. Planting is carried out for production forestry, limited harvest and conservation purposes, which are all considered important under the Revised MPFD. At the farm and community level, this generates a timber resource for on-farm use, sometimes provides a supplementary income, and creates opportunities for value-adding from log timber. At the wider community level, forestry expansion provides environmental benefits, reduces pressure for logging of native forests and unnecessary cutting of mature coconut trees, and reduces reliance on timber imports from other regions and other countries.

The current project follows from ASEM/2000/088, which identified the social, economic and policy requirements for the facilitation of smallholder and community forestry in Leyte Province. All the available evidence including data from project ASEM/2000/088 and from extensive consultation with Filipino stakeholders points to the effects of regulations on market access and product quality being the dominant constraints on smallholders receiving higher returns for timber from their existing tree farms. The four highest ranked impediments from the four-community survey (i.e. 'lack of access to land for tree planting', 'lack of finance to pay for tree growing needs', 'concern over security of tenure', and 'low availability of seedlings') apply to establishment of new tree farms. Because the current project focused on existing tree farms, these constraints have not prevented landholders from planting trees – they apply to an earlier stage of the process of making the decision to plant trees – and therefore are not addressed in this project.

4 Objectives

The goal of the project was to improve financial returns to existing tree farmers and intending smallholder tree farmers. This research strategy was reflected in the following objectives.

Objective 1: Assist DENR to overcome policy implementation constraints to tree registration and log transport currently restricting access to markets

Objective 2: Assist smallholder tree growers to satisfy market requirements and improve productivity

Objective 3: Identify and promote livelihood systems and policies which incorporate forestry and which recognise the socio-economic circumstances of smallholders

In designing the project, a systems approach was used, which was applied at a number of levels. At a broad scale, a systems approach was applied in the conceptualization of the project. That is, the issues associated with improving financial returns to smallholders were conceptualized as being interrelated such that they could not be addressed in isolation (as would be the case in a reductionist approach). At a finer or operational level, systems thinking was embedded in supply or value chain management which is the framework on which many of the activities falling under Objective 2 were based. In particular, a systems approach was used to design the tree farm inventory research in order to ensure that it produced results that could be directly applied in other research activities relating to social and economic aspects of improving returns to smallholder tree farmers. Also, a systems approach was embedded in the investigation of livelihood systems in Objective 3; this approach recognizes that forestry cannot be undertaken by (or recommended to) smallholders in isolation without consideration of the broader context (or livelihood system) of which it will form a part.

5 Methodology

5.1 Selection and description of study location

This study was conducted on Leyte Island, which is located in the central Visayas region of the Philippines (Figure 1) and is divided into two provinces namely Leyte Province and Southern Leyte Province. The island is composed of 58 municipalities and four major cities, Tacloban City being the capital. A large proportion of the research undertaken in this project was focused in seven municipalities selected through Probability Proportional to Size (PPS). These municipalities (shown in Figure 1 as grey areas) are Dulag, Leyte-Leyte, Isabel, Hindang and Bato in Leyte Province and Libagon and Anahawan in Southern Leyte Province.

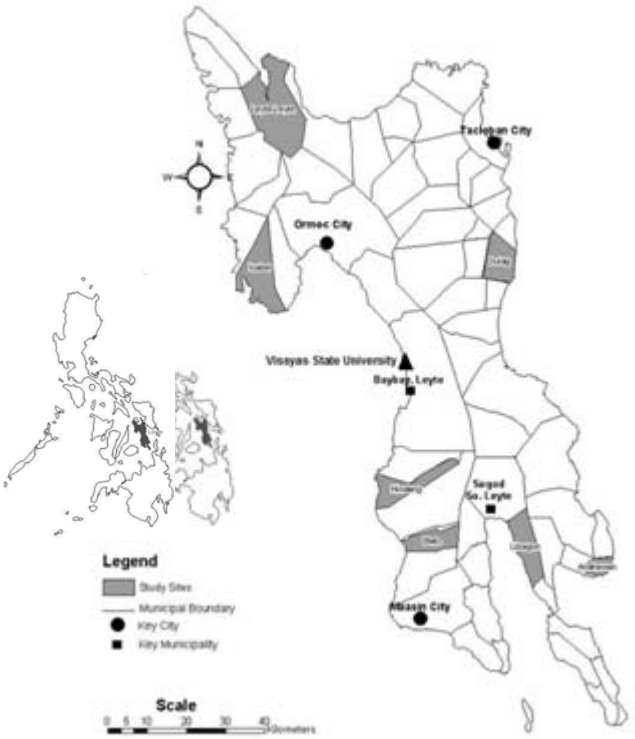


Figure 1. Map of Leyte Island showing location of main study sites (inset Philippines map)

5.2 Using systems thinking to conceptualise the project

Conceptualisation of the ACIAR smallholder tree farmer project occurred over a period of one week during a visit by researchers to the Philippines (to incorporate feedback on the initial project proposal following discussions with ACIAR as funding body). During that week, a number of visits to smallholder tree farms and communities were undertaken, and discussions held with a variety of stakeholders including tree farmers, officers from

the Department of Environment and Natural Resources and Local Government Units (LGU). These discussions, combined with experiences from the precursor four-year project (ASEM/2000/088), suggested that a complex range of interacting factors influence the lack of current uptake of smallholder forestry in Leyte. For example, it became apparent that a large number of tree farms existed that had been established about 10 years ago, with trees ready to be harvested, and smallholder farmers were asking where they could find a market for their trees, while processers were stating that they could not access locally grown timber.

Following the field visits, a workshop was held where researchers discussed the observations made over previous days. Discussions tended to focus on separate studies that could be undertaken to address one or more of the issues identified. In an attempt to integrate the disparate discussions, a brainstorming session was held to create an overall influence diagram that connected the various aspects of possible research needs. Two observations were represented by boxes placed on a blackboard, namely (i) the existence of a large number of tree farms and (ii) the need to improve current low returns to tree farmers. From this basis, researchers brainstormed the factors that influenced the current low returns and how these linked back to the existing smallholder tree farmers. The influence diagram that was developed on a blackboard is presented as Figure 2. The initial starting points are contained in elliptical shaped objects and linked by arrows.

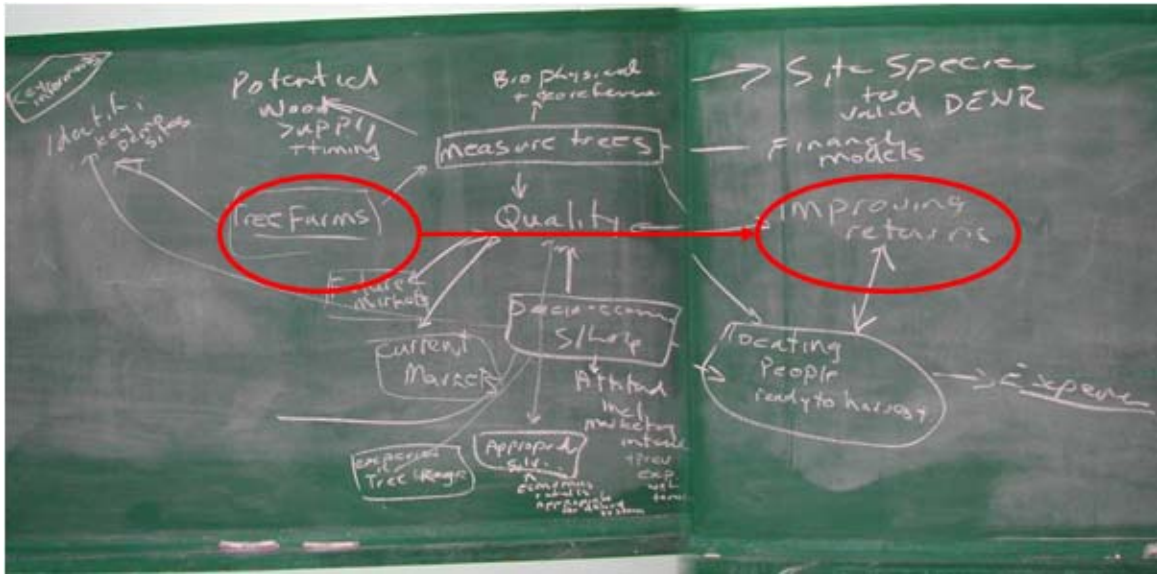


Figure 2. **Influence diagram developed for planning the research project**

The construction of the influence diagram provided a shared understanding to all of the researchers in the project of how their particular area of expertise contributed to the broader project objective of improving financial returns to smallholders. A key element that was recognised from field observations was that most of the current tree farms have been poorly managed and most of the logs that will be produced will be of low quality − hence the location of ‘quality’ between ‘tree farms’ and ‘improved returns’. Estimating (measuring) and improving the quality of logs from existing and future tree farms thus became one of the foci of project activities. In addition, the influence diagram recognises the importance of log quality for the types of markets that smallholders can currently access. In terms of identifying industry development strategies, it was also recognised

that identifying the log quality required to access particular markets (e.g. export markets) was necessary in order to identify the type (quality) of silviculture that smallholders needed to implement to produce for instance, straight and defect-free logs of a particular length and diameter or flitches cut into particular dimensions by circular saws as opposed to chainsaws. Another key influence on the quality of logs produced is socio-economic factors such as household income, general education and specific training in forestry, as well as the way these factors affect the ability of the smallholders to access timber markets. The influence diagram also recognises the importance of gathering data on the expected yields of timber from current tree farms, data which are needed to estimate potential wood supplies and timing, and to develop financial models which can be used to both predict financial returns from existing tree farms and model likely impacts of improved silviculture and access to markets.

In that a systems approach was used in the conceptualisation of the project, this is an example of how systems thinking can be applied at a broad 'project' scale. That is, the issues associated with increasing financial returns to smallholders have been conceptualized as being interrelated such that they cannot be addressed in isolation (as would be the case in a reductionist research approach).

5.3 Systems approaches embedded in the research strategy

Systems thinking has also been applied in the research strategy for the ACIAR tree farm project. The following sections outline three key areas where this has occurred.

5.3.1 Linking Biophysical and Socio-economic Data

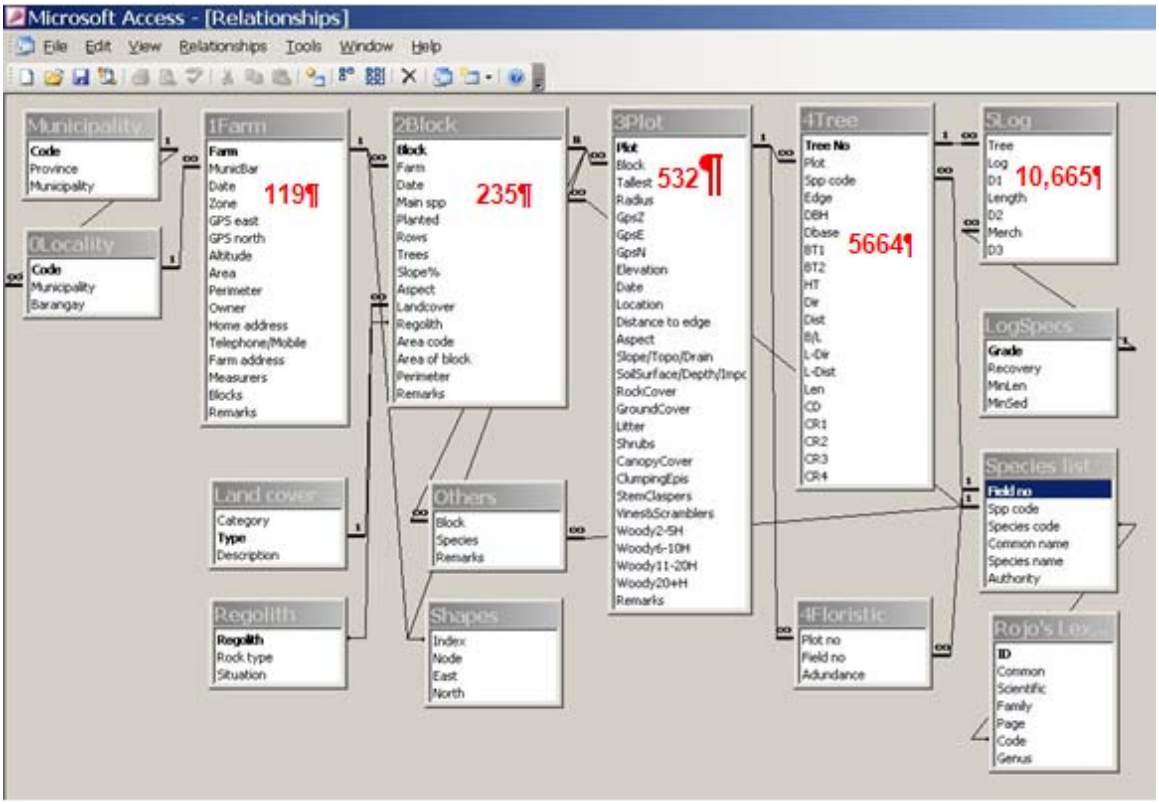
A key activity in the project has been the estimation of the yield of timber from existing tree farms. These data have been used to construct yield tables and growth models for the common species grown by smallholders, including Gmelina arborea, Swietania macrophylla and Acacia mangium. The key biophysical information collected about site, plot, tree and log variables is summarised in Figure 3. Socio-economic studies involving the estimates of timber turnoff and market modelling do not often draw on such biophysical data. These data are typically obtained from secondary sources rather than collected as part of an integrated study. Drawing such data from secondary sources usually limits their application for the desired use.

By designing the project within a systems framework, it has been possible to identify how the biophysical physical data collected from the tree farms could be used as part of other interrelated activities within the project. In particular, Figure 3 illustrates how data from the tree inventory research are linked to other project activities with an economic and social focus. Having this understanding at the outset of the project allowed sampling strategies to be designed that produced data suitable for use across a range of project activities. For instance, socio-economic project researchers outside the biophysical team also required these data to estimate the current timber inventory from smallholder tree farms on Leyte as part of their research to develop timber supply models. Stratified random sampling typically is to select lots from which to collect data on tree growth for yield tables and growth models. However, stratified random sampling would have been impractical for collection of data to estimate total timber inventories because of the need for collection of data across a suitably wide range of municipalities and barangays, which would have resulted in significant time and financial costs. As a consequence, a two-stage, probability proportional to size (PPS) sampling framework was used to select municipalities and then barangays from which tree farms were then selected (as

described in Herbohn et al. 2005). Information from the survey of timber enterprises conducted as part of other project activities has been used in developing demand-side models which in turn has fed into supply and demand and transhipment models.

Growth models based on the tree data, along with the supply and demand and transhipment models also drawing on the tree data, were linked to the financial models developed to estimate the profitability of tree farms (with linkages as illustrated in Figure 4). Data on crown diameters typically are not collected routinely during measurement of trees within inventory plots. However, such data were identified in the systems analysis as being required for modelling stocking rates and thinning regimes associated with potential agroforestry systems, and the biophysical teams included these measurements as part of their data collection activities.

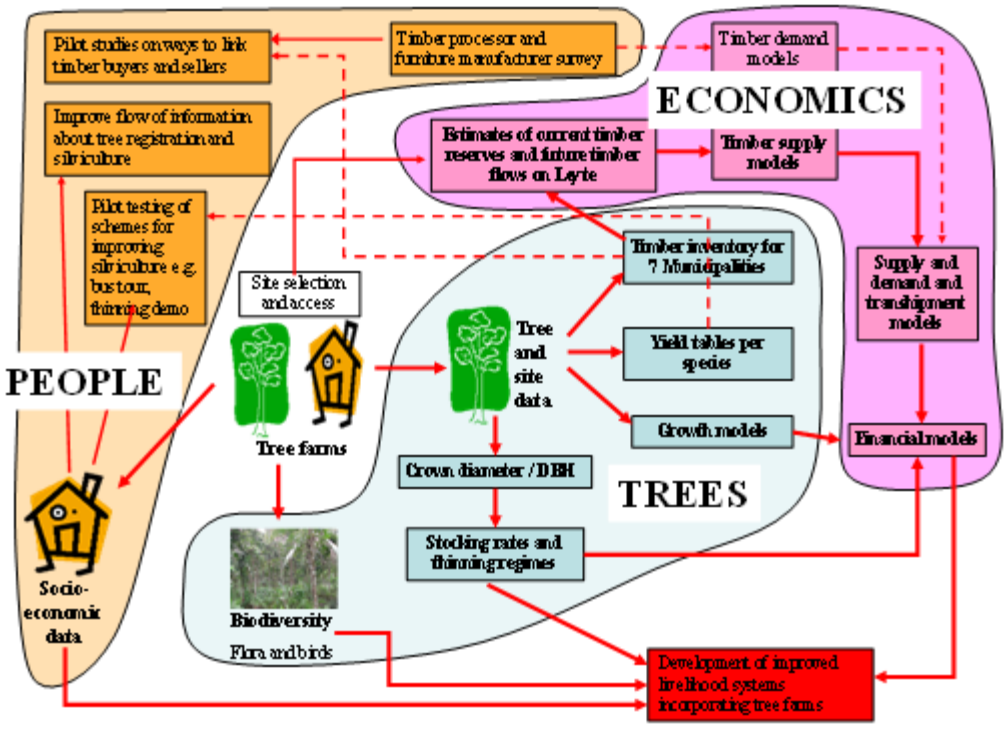
Figure 3. **Screenshot of ACCESS relational database illustrating key site, plot, tree and log data collected from smallholder tree farms. Numbers in red represent total individual records in each category e.g. data from 119 tree farms were collected and measurements were made on 5664 trees were made.**



Biodiversity data collected from each tree farm, along with socio-economic data collected from the owners of the tree farms. The Microsoft ACCESS database illustrated in Figure 3 was updated to include results from the socioeconomic survey of smallholder tree farmers, thus allowing researchers to directly link the socioeconomic and biophysical data.

The financial models could also be used to explore ways to improve financial returns to smallholders (including demonstrating to smallholders the benefits of improved silviculture) and the need to improve the flow of information about regulations affecting tree registration, log transport and harvesting (Figure 4).

Figure 4. **Major linkages between biophysical and socio-economic research activities in the project. Not all linkages are shown**



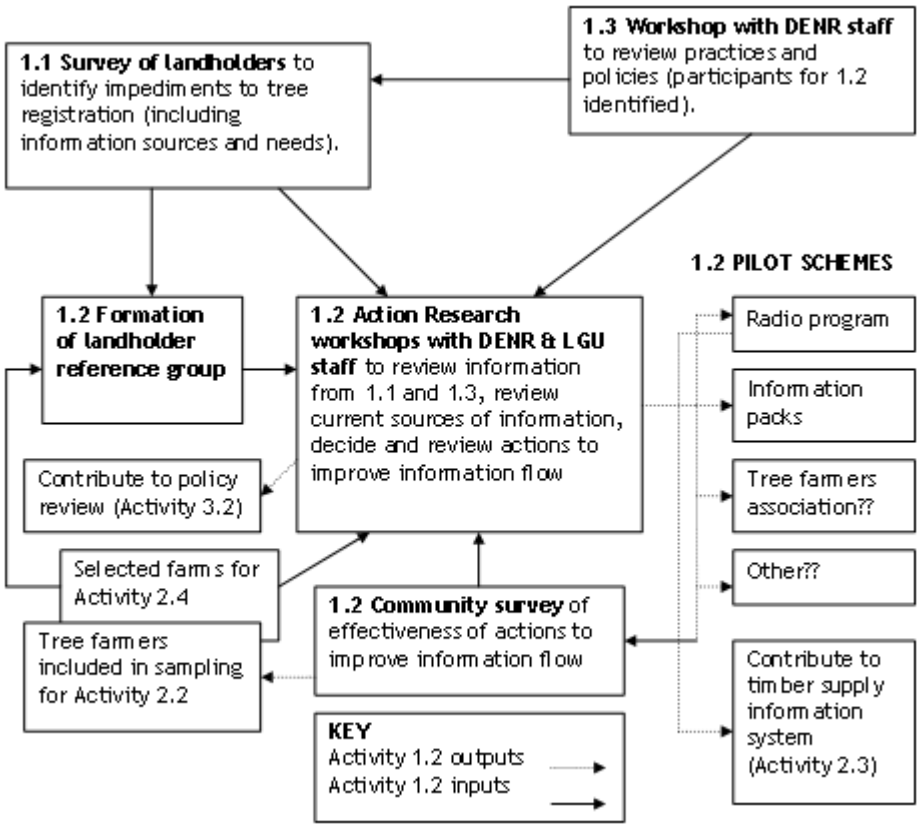
5.3.2 Improving the flow of information for forestry regulation

In conceptualising the smallholder tree farm project it became apparent that tree registration and log transport regulations enforced by DENR appeared to be restricting the access of smallholder tree farmers to timber markets. Rather than the regulation per se, this barrier seemed to be the result of how regulations are enforced due to lack of funding to the DENR, and the lack of understanding of the regulations by smallholders. If the individuals with the greatest influence on the flow of information were directly involved in recognising the existing problems and formulating solutions to these problems, there was a greater likelihood that strategies would lead to sustainable changes. In order to achieve these changes, the motivations and actions of the various stakeholder groups had to be examined in the light of the institutional arrangements governing them. It was also essential that the strategies devised for improving information flow linked closely with other project activities so that the changes would occur at three levels (i.e. farm households and community, DENR staff operations, and policy). A systems approach was therefore an implicit component.

Figure 5 shows the relationship between various project activities and the action research workshops which lie at the core of the suggested approach for improving the flow of information concerning tree registration, harvest and transportation approval mechanisms. The action research workshops provided opportunities to (i) monitor and report via information bulletins, what the tree farmers involved in the project demonstration plots were required to do to register their trees, and (ii) to report and compare this information across the project. The steps involved in bringing the action

research teams to life were to (i) confirm the aim with key stakeholders, (ii) secure sponsors' commitment, (iii) enlist the participants, (iv) design and schedule regular workshops, including a training workshop, (v) secure the necessary resources for the project activities, (vi) conduct workshops and implement activities to improve information flow, and (vii) reflect on achievements and implement changes.

Figure 5. **Relationship between activities concerning the development of strategies for improving information flow about tree registration, harvest and transportation regulations and approval mechanisms (1.1, 1.2 and 1.3 are the numbers of specific project objectives).**



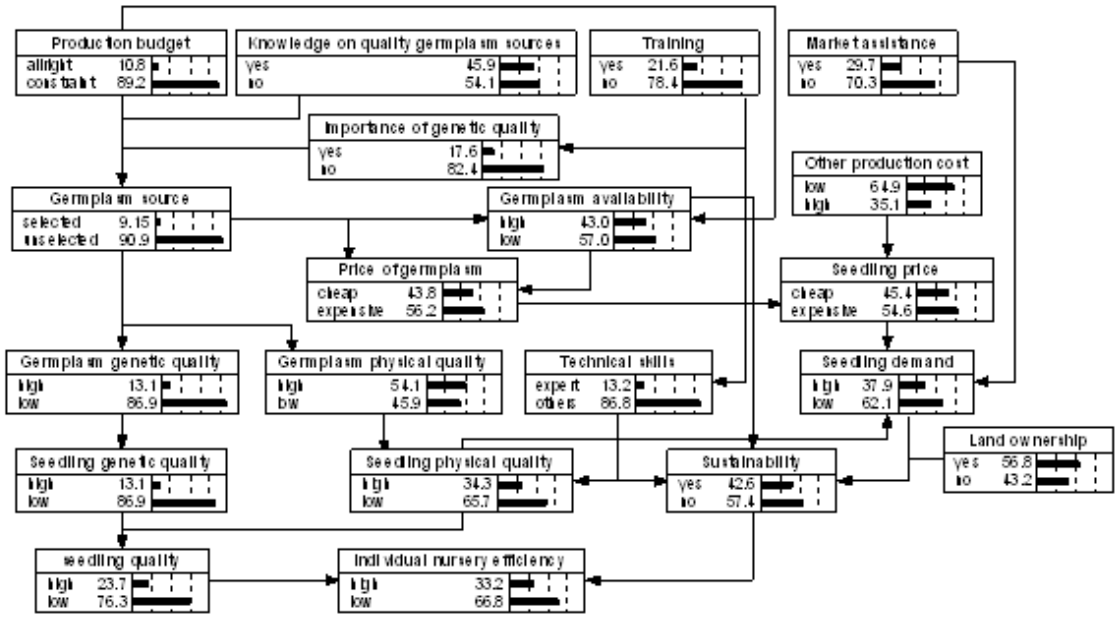
5.3.3 Making sense of the tree nursery sector in Leyte

Systems thinking had also been applied to understand the factors affecting the production of high quality tree planting stock and to investigate the impact that a variety of policy interventions may have had on improving the quality of planting stock available to smallholders.

To conceptualise the nursery sector, a Bayesian Belief Network (BBN) was constructed for each of the nursery sub-sectors (private, community and government). The data to construct the model (Figure 6) were obtained from a combination of quantitative and qualitative methods. For example, surveys were used to collect responses from nursery operators in Leyte and Southern Leyte Provinces, and the nominal group technique, as well as individual discussions, was used to collect expert opinion. This model is an example of a dynamic systems model which can be used to explore the likely impacts of a range of policy interventions on a particular industry or sector and which was constructed using data obtained from a range of stakeholders using surveys and other

social research methods, including focus group discussions and the nominal group technique. The model has subsequently been used to identify which factors have the greatest influence on key outcomes such as seedling quality, nursery sustainability and nursery efficiency. In addition, it has been used to explore the likely impact of various policy interventions including developing training programs for nursery operators.

Figure 6. **Nursery efficiency BBN for an individual nursery group**



Source: Gregorio (2006)

5.4 Research strategy

The research strategy to address the project aim had three components. First, the university researchers collaborated with DENR officers and smallholders to identify and pilot test remedies to impediments to timber market access. The focus was to work with DENR Region 8 to make the existing regulations work more effectively. This resulted in immediate short-term benefits to tree farmers wishing to register trees and obtain permits to transport logs. It is anticipated that in the longer term the project outputs will influence national level DENR policy and regulations, and meetings have already been held with senior DENR officers in an attempt to influence policy. The research first identified why there are large differences in the rates of tree registration between Community Environment and Natural Resource (CENR) offices and how higher rates of tree registration can be facilitated. Mechanisms were developed to improve the flow of information about regulations affecting tree harvest and about transport approval, from DENR to LGUs and smallholders. Papers in the Proceedings of the **IUFRO 3.08 Conference on Improving the Triple Bottom Line Returns from Small-scale Forestry, held in Ormoc City, June 17−21 2007 and the End of Project Workshop** outline these activities, especially related to the development and testing of the primer for tree registration, and harvesting and log transport approval. In addition, a 'School-on-the-Air' radio program on tree farming policies was broadcast, with formal enrolment of

'students' and with active participation of Department of Environment and Natural Resources personnel, municipal mayors, councillors and municipal agricultural officers.

Research was also undertaken to identify the market requirements for timber in terms of species, type, quantity and quality of timber required by processors and resellers. A survey of timber enterprises on Leyte Island (including Biliran), Samar and Cebu had been undertaken. The market potential for timber from existing tree farms in Leyte Province has also been assessed. This assessment involved four interrelated activities: (i) an assessment of timber quality and likely yield per timber product class, (ii) further financial analysis (iii) modelling of timber supply and demand, and (iv) an investigation of the social and economic factors that affect the management of tree farms and the types of outputs produced. The assessment of timber quality and yield was based on data collected on 5664 trees from 532 plots established on 119 tree farms. Socio-economic data were collected from 81 tree farmers.

An extension program was developed and trialled, which tested mechanisms to improve the silviculture skills of farmers. As part of this program, 'bus tours' were conducted, taking smallholder tree farmers to demonstration sites in order to deliver key information about silviculture. During 2005 and 2006, four pilot tours were undertaken and the lessons learnt from each tour were then used to improve the subsequent tour. In addition, a pilot program involving cost-effective ways of linking buyers and sellers of timber was conducted which involved installing two large whiteboards outside the CENRO Maasin office. One board provided details of smallholders and the woodlots (species, area, location and plot registration number) tree farmers had available. The other board provided details about processors including timber species they wanted to purchase and purchase prices according to sawn timber dimensions. Plantation trials were established on farms to demonstrate to farmers the benefits of early-age silviculture and late age remedial thinning treatments. Other field trials were established (from funds external to those provide by ACIAR) to provide information for improved design of tree farm systems. Some useful information from these trials had already been obtained and further monitoring will continue until at least 2010.

An analysis has been undertaken of livelihood strategies adopted by various types of smallholders and recommendations made on appropriate farming systems that incorporate forestry and that recognize the socio-economic circumstances of smallholders. University researchers have actively collaborated with DENR to develop policy recommendations based on the findings from the various project activities, which have been presented to senior DENR staff in Manila. These efforts are continuing in conjunction with ACIAR Project ASEM/2006/091.

5.5 Information on detailed methods and individual studies

The preceding sections have provided an overview of the methodology applied in the project and were not intended to be an exhaustive account of all methods and analyses used in project. Further details on individual studies can be found in the numerous publications arising from the project. In particular, the End-of-Project Workshop Proceedings contain detailed descriptions of the methods applied in individual studies. In addition, further information can be found in the various journal articles that have already arisen from the project including special issues of Annals of Tropical Research. In addition, a special issue of Agroforestry Systems is near completion. Full details of the project publications are provided in Section 10.

5.6 Researchers involved in the project

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6 Achievements against activities and outputs/milestones

Objective 1: Assist DENR to overcome policy implementation constraints to tree registration and log transport currently restricting access to markets

No.	Activity	Outputs/ milestones	Completion date	Comments
1.1	Survey of smallholders with tree farms to identify impediments to tree registration (PC and A)	1.1a Completion of data collection by Yr 2 m 3 1.1b Final report completed by Yr 2 m6 1.1c List of policy recommendations to DENR by Yr 3 m6	June 2007	1.1a Survey of tree farmers had been completed 1.1b This survey was incorporated into the much larger socio-economic survey of tree farmers in 2.2. The data set was far more extensive than originally envisaged and analysis was undertaken as part of the extension activities. 1.1c Various recommendations were widely discussed at project workshops and meetings and outlined in papers presented at the end of project workshop. These were also summarised into a brief 'policy' document and presented to senior DENR officials as part of a briefing session in October 2008.
1.2	Improving flow of information about tree registration and harvest and transport approval mechanisms (PC and A)	1.2a One stop shop established and radio segment commenced (Yr 1 m 9) 1.2b Dissemination of material to LGUs and communities (Yr 2 m 3) 1.2c Impact assessment completed (Yr 3 m 9)	September 2007 but with further work in extension period	1.2a The planning action research workshops recommended against a one stop shop approach. The radio segments were developed and run in 2007. Data were collected on the effectiveness of the segments. 1.2b Wide dissemination of project related material occurred. 1.2c Data for impact assessment is complete.
1.3	Improvements in institutional framework (PC)	1.3a Workshop 1 held and recommendations passed on to DENR Regional Director (Yr 1 m 9) 1.3b Workshop 2 held and recommendations passed on to DENR Regional Director (Yr 3 m 9)	September 2007	1.3a This was completed. Two actions research workshops were held which involved DENR staff. The Primer was a direct result of the first workshop. 1.3b Both workshops were held as scheduled and was highly successful.

PC = Partner Country, A = Australia

Objective 2: Assist smallholder tree growers to satisfy market requirements and improve productivity

No.	Activity	Outputs/ milestones	Completion date	Comments
2.1	2.1 Survey of timber enterprises PC and A)	2.1a Survey complete 2.1b Report completed	July 2005	2.1a Survey was completed. 2.1b Results published in EOP workshop proceedings
2.2	2.2 Assessment of existing tree farms (PC and A)	2.2a Field data collection completed (Yr 2 m 6) 2.2b Yield tables compiled (Yr 2 m 9) 2.2c Financial models completed and given to DENR (Yr 3 m 3) 2.2d Modelling of supply and demand completed (Yr 3 m 6) 2.2e investigation into social and economic factors completed and management strategies developed (Yr 3 m 3)	June 2007 - but with further work in extension period	2.2a Data collection completed 2.2b Yield tables and growth and site index models developed for key species i.e. Gmelina arborea, Switennia macrophylla, Acacia mangium). Models will be disseminated to DENR and other stakeholders. 2.2c A financial model has been developed. 2.2d Modelling of timber supply and demand undertaken. This will be expanded upon by a John Allwright Fellow (Edwin Cedamon) as part of his PhD program 2.2e Analysis has revealed some interesting results, for instance, ther yield from tree farms owned by farmers who have attended training in silviculture is significantly higher than for other tree farms. This has been reported in project publications. Further systematic analysis of the data will be undertaken by a research fellow within the School of Integrative Studies
2.3	Pilot scheme to bring together buyers and sellers of timber (PC and A)	2.3 Pilot scheme operational (Yr 1 m12) and impact assessed (yr 3 m 9)	September 2007 but with assessment rescheduled to 2008	2.3 A pilot scheme using whiteboards at CENRO Maasin was implemented with follow up assessment reported in the EOP workshop proceedings.
2.4	Participatory approach to improved tree farm management (PC and A)	2.4a Demonstration tree farms identified and management strategies developed (Yr 1 m3) 2.4b Impact assessment completed (Yr 3 m 9)		2.4a Demonstration sites have been used for four pilot bus tours. 2.4b Impact assessment completed for pilot bus tours. Results presented in conference papers and journal papers. This formed part of a PhD project and the student is expected to submit in July 2009.

PC = Partner Country, A = Australia

Objective 3: Identify and promote livelihood systems and policy which incorporate forestry and which recognise the socio-economic circumstances of smallholders…

No.	Activity	Outputs/ milestones	Completion date	Comments
3.1	Identification of tree farming systems (PC and A)	Recommendations developed and communicated to DENR		Socio-economic questionnaire developed and interviews completed. Data has been analysed as part of the broader analysis of the socio-economic survey with results reported in the EOP workshop proceedings.
3.2	Identification of policy implications	Recommendations developed and communicated to DENR		Recommendations have been communicated to DENR through the two project policy workshops and through personal contacts with DENR staff and an end of project workshop. A briefing session for senior DENR officials was held in Manila in October 2008.

PC = Partner Country, A = Au

7 Key results and discussion

There has a been a wide variety of results generated from the project, with many of these results being reported in detail in formal publications including three sets of proceedings (of the IUFRO Group 3.08 Conference in Ormoc in June 2007, the Planning Workshop (2005) and the End-of-Project Workshop in Ormoc in February 2009), and in special issues of Annals of Tropical Research. A number of journal articles are currently in press or in preparation. The key findings are presented now, in order of the three project objectives.

7.1 Achievements with regard to Objective 1: Assist DENR to overcome policy implementation constraints to tree registration and log transport currently restricting access to markets

Filipino tree farmers are required by law to register their planted trees in order obtain harvest and transport approvals and thus allow them to sell timber. However, survey evidence reveals that only a small proportion of tree farmers register their trees. Germano et al. (2007) interviewed staff in six Community Environment and Natural Resources Offices (CENROs) – four in Leyte Province, three in Southern Leyte Province and one in Biliran – to establish baseline information on tree registration. In general, the rate of tree registration was found to be low, except in CENRO Maasin, where during 1997 to 2006 a total of 2799 tree farms were registered, covering an aggregate area of 2807 ha and with about 1.3 M trees registered. The highest number of tree farms registered in CENRO Maasin took place in year 2004, when a total 531 were registered, covering an area of about 373 ha.

7.1.1 Smallholder perceptions about tree registration and reasons for registering planted trees

The socio-economic survey (described in more detail later) provided some information about attitudes to tree registration. Out of 81 total respondents, 37 (45.7%) declared that the trees they had planted were registered with the DENR. About two thirds of these respondents had obtained information from the DENR, one third from friends, and three from radio, a LGU or a lumber buyer. Just over half of those who had registered their trees claimed they had done so on their own initiative without assistance from anyone else. A few had been assisted by DENR personnel, barangay officials or friends. About 73% indicated they had not experienced any problems in registering their trees.

For those landholders who had registered their trees, ease in harvesting and selling timber trees (43.2%) and legality and security or to avoid penalties or imprisonment (27.3%) were given as the most important reasons for tree registration. Some mentioned that they had registered their trees because it is a DENR policy, encouragement from friends, or concerns that their land would be placed under the Agrarian Reform Program. Only a few (8.1%) had registered their trees at planting; about half had registered when trees were aged 6 to 10 years.

Respondents who said their trees had not been registered with the DENR were asked why they were unable to register trees. Nearly 60% did not provide an answer to this question, while 18.2% stated that they were not aware of tree registration. Some claimed

they did not have any information about the requirements for registering trees. Others speculated that the DENR personnel would ask for some amount other than the required fees for tree registration to facilitate the processing.

Out of 44 respondents who had not registered their planted trees, 40.9% said that they had attempted to register but had failed to do so. Reasons for failure included: CENRO is very far from their place of residence, and they take their time in processing the required documents; no financial capability; and it seems laborious to register the planted trees with the DENR.

7.1.2 Forestry governance research steps

The system of tree registration (and harvest and transport approval) has been controversial because of the disincentive effect that it appears to have had on smallholders who wish to grow plantations, an activity with important socio-economic and environmental benefits. Tree farmers in some cases have to travel long distances to CENROs at their own expense (including fares and time costs), and may have to make multiple visits (when the relevant DENR staff are found to be not available). A further impediment to tree farming is that local governments sometimes impose harvest fees (over which the DENR has no control). Lack of secure land tenure is another major impediment to tree planting (Herbohn et al. in preparation), and in fact TR is only possible for smallholders with 'tax declaration' title if they have applied for permanent land tenure.

There is evidence of smallholders mostly growing timber for on-farm use, or receiving lower prices because they sell timber locally without registration, or being captive to timber merchants who carry out the registration procedures for them but pay low log prices. Tree regulation is also a costly and difficult task for the DENR. Tree registration policies are dominated by environmental imperatives, i.e. concern to prevent illegal logging. To a large extent, this is imposed upon the Forest Management Bureau of the DENR by both local factors (flood and mudslide related loss of life) and international pressure (by funding bodies).

The question therefore arises as to whether the tree registration system could be simplified and made into less of an impediment to smallholder forestry, while maintaining an acceptable level of environmental and legal protection. The disincentive effect for smallholders relates to complexity, cost and time requirements of tree registration, and fear prosecution for committing a perhaps inadvertent illegal action. Tree registration also has some positive externalities, in providing greater harvest security, and targeting silvicultural extension. Any reform has to be viewed in this context. Of course, regulatory measures and changes in them must be viewed in terms of implementation cost, transaction cost and interaction with related natural resource management policies.

A number of research steps were undertaken to understand the tree registration process, its impacts on tree farming, and possible regulatory reform. Senior officers of the Department of Environment and Natural Resources were members of the project team, providing interpretation of current rules and regulations concerning tree regulations.

Initial policy workshop

A policy workshop was held in Tacloban City, Leyte, in April 2005, to examine the opportunities for policy reform with respect to tree registration, and harvest and transport approvals. The objectives of the workshop included: gaining a clear understanding of

current forestry property rights and regulations facing tree farmers (both registered and unregistered), and the way in which these are implemented; identifying any weaknesses or limitations in the current regulatory arrangements for tree registration and transport approvals; identifying policy and regulation aspects of forestry property rights where reform is worthy of consideration, and potential alternative policy regimes; and identifying information needs for evaluating the current property rights regime and alternative arrangements. The workshop was attended by representatives from each of the Community Environment and Natural Resource Offices (CENROs) in Leyte and Southern Leyte provinces, as well as representatives of local government units (LGUs) and other agencies. Each CENRO representative gave an account of tree registration in their district. Tape recordings were taken of the meeting. It became apparent at this workshop and subsequent meetings that there was a lack of understanding of the rather complex regulatory arrangements for tree registration (and associated harvest and transport approvals) among representatives of government agencies.

Action research program and development of the extension primer

An action research or extension planning workshop followed the policy workshop; this identified information needs and set up Action Research groups to investigate and report back on these areas, one of which was a forest policy group (Russell et al. 2005). The AR workshop initiated the development of a tree regulations Primer or extension booklet (Gordon 2007).

Primer validation workshop

This was held at Leyte State University, attended by representatives of the various CENROs and other government agencies (including the Philippines National Police). There was at times surprising uncertainty and even disagreement on the interpretation of tree registration and associated regulations. A small group further refined the primer, and DENR head office approval was obtained, after which the primer was widely distributed by the DENR, in English and the Cebuano and Waray Waray dialects, supported by a School Of The Air program on Radio DYAC of Leyte State University. With ACIAR project support, the VSU Development Communications unit enlisted a sample of farmers to provide feedback on the radio broadcasts, and carried out a survey of smallholder reactions to the Primer, from which various improvements to the illustrations have been identified, to form a basis for further refinements.

Smallholder socio-economic survey

The socio-economic survey of tree farmers (see later section) included a number of questions designed to elicit details of experiences with – and attitudes to – tree regulations. Some preliminary findings from the survey are reported by Severe et al. (2007) and Avela et al. (2009).

Identification of variations in implementation of tree regulations

While a common set of the tree regulations exist throughout the Philippines, there is latitude for some variations in the way in which these regulations are implemented. DENR statistics from their tree registration database revealed that the rate of tree registration is notably high in CENRO Maasin in Southern Leyte Province. Therefore, a visit was made to this CENRO and discussions held on the measures adopted to increase seedling production, disseminate information about tree registration, and conduct cost-effective tree farm inventories.

Further information on tree regulations have been obtained from a case study reported by Gordon (2006), the above-mentioned survey on CENR staff involved in tree registration reported in Germano (2007), and literature review.

7.1.3 Tree registration reform measures

A variety of recommendations and suggestions for improving the system of tree registration and associated approvals have been generated. In general terms these involved greater information dissemination, replacement or refinement of the current regulatory framework to improve incentives or reduce cost, and encouragement of innovation in implementing the regulations.

Increasing the availability of information on tree regulations to smallholders

Potential measures include: conducting an information, education and communications (IEC) campaign about tree farming to smallholders, including development and distribution of extension materials; providing improved information on TR regulations, within government agencies and between government agencies; greater training of forest rangers in TR procedures; and monthly office-in-the-park days to make information available to farmers in a more relaxed environment.

Refinement of tree regulations to reduce cost, time and other impediments to compliance

Lack of funding and recognition within the DENR for staff involvement in tree registration appears to be the root cause for fieldwork cost of tree registration officers passing costs onto tree farmers. Designating tree regulation as a key responsibility area (KRA) and increasing funding would be a practical means to overcome this problem. There is also the possibility that suitably qualified people outside the DENR could carry out tree registration tasks, and for a time registered foresters were permitted to undertake this task. This would make access to tree registration personnel easier for smallholders. Greater responsibility could also be given to LGUs, for example in the distribution of application forms, and providing assistance and checking of completed applications. Improved organisation and adoption of new technology offer the opportunity for more cost-effective inventorying of planted trees. For example, an approach reported in CENRO Maasin is to carry out multiple inventories for a group of farmers in the same barangay with a team of forestry officers. Geographic positioning systems potentially offer time savings over compass and chain methods for mapping planted tree areas, but in general appear not permitted for this task. It is doubtful whether 100% inventorying is trees is necessary, particularly for relatively young or large plots (although this is technically required by the Forestry Code); sequential or quota sampling would yield equally reliable information for a much lower time requirement, and in fact some though not all CENROs adopt sampling schemes for large plots.

Improvement of the incentive system for tree registration and associated processes

Availability of free seedlings seems to be a critical driver in establishment of tree farms. The volume of seedling production in CENROs has fallen sharply in the last few years. Some CENROs (and also municipalities) put considerable effort into raising seedlings. In some cases, funding is attracted from additional sources to support seedling production, e.g. CENRO Maasin has obtained financial support from the congressional fund. Availability of silvicultural information and assistance with timber marketing seem to be

frequently identified as critical ingredients to promoting smallholder forestry. To the extent that these can be provided to smallholders who register their trees, this is likely to stimulate tree registration. Some disincentives to tree farming arise which are not under the control of the DENR, e.g. LGUs sometimes impose high taxes on tree harvests, and sometimes restrictions are imposed on movement of timber out of a municipality. These imposts are not unlawful, but their removal might be achievable by negotiation and moral suasion. In that the PNP rather than the DENR are likely to confiscate timber deemed to be transported illegally, it is critical that officers of the PNP understand the regulations concerning timber transport.

Encouraging innovation in implementation of tree regulations

In that some flexibility exists for the way in which tree regulations are implemented in CENROs, there appears to be scope for innovations to increase the rate of tree registration and achieve greater cost-effectiveness. For example, in a district which has a large number of tree growers but very small areas for each, it might be desirable to use group registration and 100% tree inventorying, as is the practice in CENRO Maasin. Another CENRO district which had larger tree farms might gain considerable efficiency by a tree sampling method. In this context, some of the measures adopted in CENRO Maasin appear to provide examples of best practice. There seems to be a strong case to replace compass and chain methods in inventorying by use of geographic positioning system (GPS) devices.

Devolution of localization of tree registration

At a more fundamental level, partial or complete transfer of tree registration responsibilities from the DENR to local government has been identified as a means to make the system more farmer-friendly. A proposal for increased local government involvement has been developed by Mangaoang et al. (2009). There does not appear to be major legal impediments to localization (Poculan 2009). Local governments appear interested to play a greater role in TR, but, of course, would also face funding constraints and may need training programs to understand the regulatory requirements.

Land survey and titling is taking place in the Philippines, if at a slow rate, and will provide a critical contribution to more secure tenure and disposition towards tree farming and its associated livelihood benefits.

7.2 Achievements with regard to Objective 2: Assist smallholder tree growers to satisfy market requirements and improve productivity

Various research and extension activities were carried out concerning timber supply and demand aspects, particularly relating to silvicultural management, timber marketing and stakeholder perceptions about strategies for the industry.

7.2.1 Estimated timber yields and growth models

A key activity in the project has been the estimation of the yield of timber likely to be obtained from existing tree farms. These data have been used to construct yield tables and growth models for the common species grown by smallholders, including Gmelina arborea, Swietania microphylla and Acacia mangium. The data collected from tree farms in the project were far greater in volume and utility than envisaged at the start of the

project. Substantial analysis and application of the data has already occurred but there is also substantial further analysis that could be undertaken.

Sampling of tree farms (see Herbohn et al. 2005) provided 531 plots, including 247 plots in stands dominated by gmelina (yemane). The height of the tallest tree on the plot was measured with a laser dendrometer, and each stem was measured for diameter (dbh, using a girth tape), bark thickness (using a bark thickness gauge), and upper stem diameters (with a hypsometer i.e. laser dendrometer). The key biophysical information collected about site, plot, tree and log variables is summarised in Figure 3.

By designing the project within a systems framework, it has been possible to identify how the biophysical physical data collected from the tree farms could be used as part of other interrelated activities within the project (Figure 5).

Biodiversity data collected from each tree farm (though not formally a project activity and funded from additional funds from UQ), along with socio-economic data collected from the owners of the tree farms, will also be used in the development of improved livelihood systems. The ACCESS database illustrated in Figure 6 is currently being updated to include results from the socioeconomic survey of smallholder tree farmers, thus allowing researchers to link directly the socioeconomic and biophysical data.

Site index equation for gmelina

Gmelina arborea is the most common species planted by smallholder treefarmers, both in Leyte and other regions of the Philippines. Substantial data have been collected from measurements made on tree farms. These data has been used to develop a site index equation for Gemlina. Linear regression analysis on data collected for gmelina suggested that a simple relationship between height and age ($Ht=\beta0 + \beta1 Log(Age+0.5)$) provided an adequate and parsimonious fit to the data. A Box-Cox test indicated that no transformation of the dependent variable (Ht) was needed because the variance was homogeneous. The transformation of the predictor variable (Log(Age+0.5)) was a subjective choice to ensure reasonable predictions in young stands, but statistical analyses confirmed that this transformation provided a good fit to the data. Several environmental variables (e.g. aspect, slope, soil type and depth) were considered as possible covariates, but none offered a significant improvement to the fitted relationship.

The fitted height-age relationship has been estimated for stand-level data as:

$Ht = 6.971 \times \log_e(Age+0.5)$ (s.e. 0.1365, d.f. 93, $P<0.0001$; Eqn 1).

The corresponding regression fitted to the individual plot data resulted in a similar parameter estimate (6.902, s.e. 0.1086, d.f. 215, $P<0.0001$). In both cases, the estimate of the intercept ($\beta0$) was not significantly different from zero ($P>0.5$) and was omitted. Figure 7 illustrates that this equation provides a reasonable basis to classify site productivity.

$$Ht = SI \times Log(Age+0.5) / Log(Yr+0.5) \quad \text{(Eqn 2)}$$

or may be used to estimate site index directly as

$$SI = Ht \times Log(Yr+0.5) / Log(Age+0.5) \quad \text{(Eqn 3)}$$

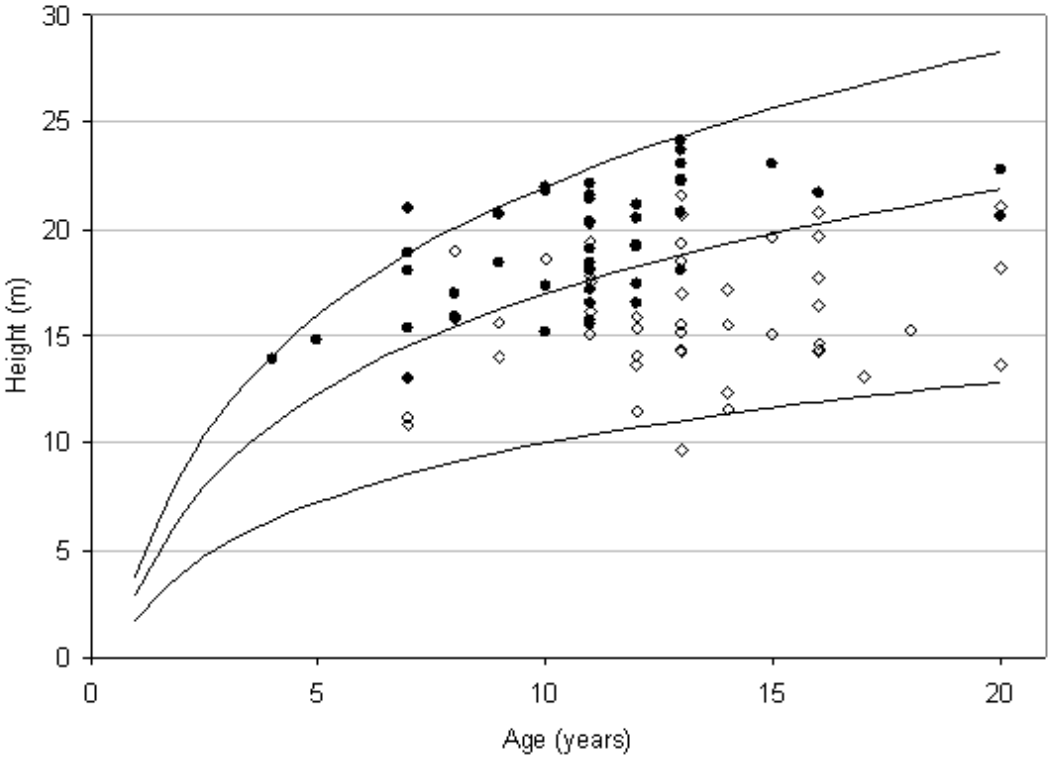
where SI is the site index and Yr is the reference age.

Equation (3) is only useful in situations where there are established trees, and is unsuited for the appraisal of bare land. The relationship between site index and the physical environment was investigated using environmental variables recorded in the inventory (Monterola et al. 2007), and led to the following relationship:

$$SI = 8.9 + 1.6 \times SoilDepth + 0.8 \times Slope \quad \text{(Eqn 4)}$$

where SoilDepth (1: skeletal <0.05m, shallow 0.05-0.15, medium 0.15-1m, 4: deep >1m) and Slope (1: level 0-3°, gentle 4-8°, moderate 9-16°, steep 17-26°, very steep.27-45o, 6: precipitous >45°) are categorical variables. While this equation explains only 15% of the variation, all the parameter estimates are significant (P<0.0001; s.e. 1.4, 0.35, 0.18 respectively). The equation may prove useful in 'greenfield' situations where no crop trees are present. There is no detectable effect of latitude or proximity to the coast on site index.

Figure 7. **Raw data and fitted model (Equation 1)**



Note: Filled circles (●) represent stands with above-median volume MAI; white circles (○) represent stands with below-median volume MAI. The lines represent height-growth curves for sites indexed as 10, 17 and 22 m.

Yield models for key species

A generic growth model for smallholder forests in the Philippines has been constructed using the equations outlined in Vanclay (2009). Although the equations (as presented in Table 1) are few, simple and robust, they can be made more accessible and useful by incorporating them in a spreadsheet-based decision-support system.

Table 1. Equations used for Gmelina robusta in the Leyte Smallholder model

Variable	Equation
Maximum dbh	Dmax = 10.89 H/Ln(N)
Mean dbh	Dmean = (1 - 0.01 sqrt(N)) Dmax
CV% of dbh	CV% = (1 - Dmean/Dmax)
Survival rate	S = (Dmeant/Dmeant+1) e-0.0006(BA-20)
Defect rate	D = 0.083/Age
Timber volume	V=0.1054 D2H

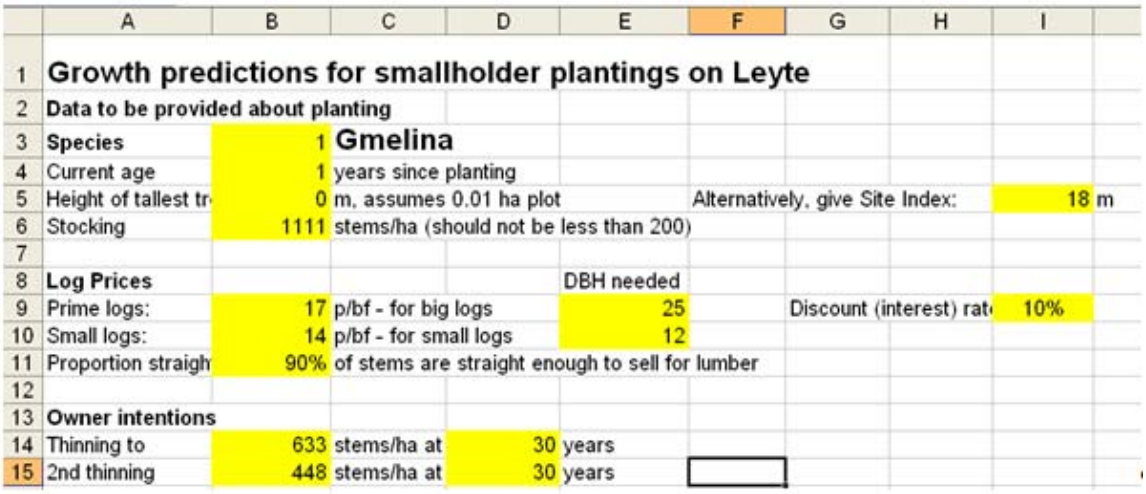
The model is implemented in a commonly-available spreadsheet package, and presents a series of columns showing the following predicted annual parameters over several decades:

- Stand height (m)
- Max Dbh (cm)
- Mean Dbh (cm)
- StdDev of Dbh (cm)
- Survival (%)
- Total stocking (stems/ha)
- Basal area (m2/ha)
- Total merchantable stems (stems/ha)
- Number of small stems (stems/ha, Dbh limits specified by user)
- Number of large stems (stems/ha, Dbh limits specified by user)
- Mean Dbh of small logs (cm)
- Mean Dbh of large logs (cm)
- Volume of small logs (board feet)
- Volume of large logs (board feet)
- Standing value (1000 Pesos)
- Value of thinnings (P.1000)
- Total value (P.1000)
- Discounted value (PhP.1000)

Despite the large number of variables predicted, users of the model need to supply minimal input data. Typically, a user will supply data of plantation species, age, stand

height (or site index), stocking rate and the proportion of stems that are straight enough to sell. An example of the spreadsheet input is provided in Figure 9. In addition, they should define the likely market for their products by indicating two merchantable size ranges and corresponding sizes. They may also indicate their thinning intentions, and the discount rate applicable. Figure 8 illustrates the user interface of the spreadsheet, with shading indicating the fields that may be altered by the user. Users are encouraged to experiment with the model, and to explore the consequences of alternative thinning regimes and types of log grades/classes produced (i.e. market possibilities).

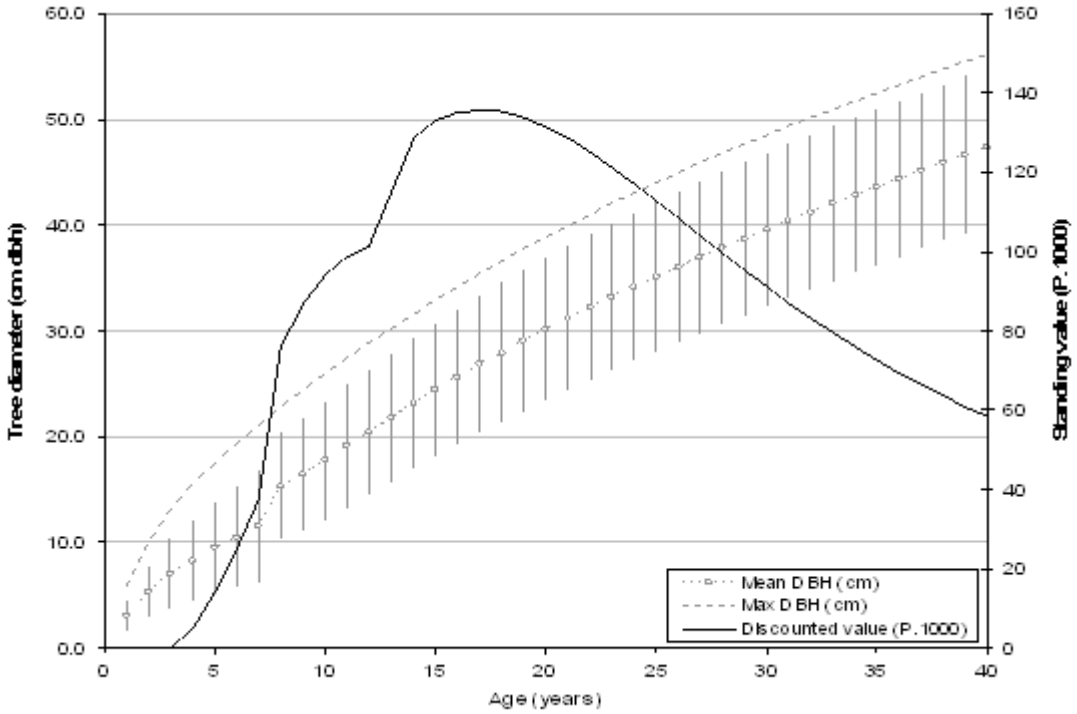
Figure 8. **User interface to the smallholder growth model**



	A	B	C	D	E	F	G	H	I
1	**Growth predictions for smallholder plantings on Leyte**								
2	**Data to be provided about planting**								
3	**Species**	1	**Gmelina**						
4	Current age	1	years since planting						
5	Height of tallest tr	0	m, assumes 0.01 ha plot			Alternatively, give Site Index:			18 m
6	Stocking	1111	stems/ha (should not be less than 200)						
7									
8	**Log Prices**				DBH needed				
9	Prime logs:	17	p/bf - for big logs		25		Discount (interest) rat		10%
10	Small logs:	14	p/bf - for small logs		12				
11	Proportion straigh	90%	of stems are straight enough to sell for lumber						
12									
13	**Owner intentions**								
14	Thinning to	633	stems/ha at	30	years				
15	2nd thinning	448	stems/ha at	30	years				

Although the model offers several columns of detailed output, the most useful output is the graphical summary as illustrated in Figure 9. This graph shows how diameters and discounted stumpage value change over time, allowing users to examine harvesting and thinning regimes that may be may be suited to their circumstances.

Figure 9. **Screen dump from the smallholder model showing the graphical output from the model**



In Figure 9, the dotted line with symbols (Θ) indicates the mean dbh. The vertical bars indicate the range of stem sizes, with two-thirds of the stems falling within the range indicated by the bars (one third above the mean, one-third below the mean), and one third lying beyond the bars (one-sixth above, and one-sixth below). The upper dashed line indicates the largest stem within the stand, and the solid line indicates the discounted financial value of harvests (indicated on the right axis).

In Figure 9, a jump in mean diameter is evident at age 8 following the first thinning, and a jump is evident in the discounted value at age 13 when stems reach a size that attracts a high market price. The case study illustrated in Figure 9 is indicative of one possible outcome and dependent on the assumptions shown in Figure 9, and may not apply in other scenarios.

The model can be used for any species, and is currently calibrated for three species planted in Leyte (Gmelina arborea, Swetienia macrophylla and Acacia mangium). Further enhancements are currently being made to the model. A ‘model calibrator’ is currently under construction, and will allow users to ‘cut and paste’ inventory data into a spreadsheet that automatically calibrates coefficients so that the smallholder model can easily be adapted for additional species.

To date, the smallholder tree farm growth model has been used for limited research and demonstration. While model outputs have been inspected and found reasonable, they have not been formally evaluated to establish the reliability of the model, a step that should be completed before the model is used more widely. Model outputs have been reported in units commonly encountered by the ACIAR project team (tree dbh in cm and height in metres, but sawn timber output in board feet). While these units seem

convenient to the project team, their use should be confirmed with stakeholders to ensure that the model is useful.

Obviously, the smallholder tree farm growth model gives is constrained by its reliance on only five parameters (listed in Table 1). To develop a more rigorous model, data are required that allow insights into tree plant competition. Such data are normally gathered from many plots over a long period of time – data which are not normally available an obstacle for new plantings and smallholder enterprises. The project has established efficient experiments that will allow these key inferences to be made from plantings within a few years. Computer simulations have been completed to verify the utility of these designs, which have also been published in refereed journals (Vanclay 2006b). Early results from these experiments are anticipated shortly from the plantings in Leyte Leyte.

7.2.2 Establishment and early results from field trials

A series of field trials have been established as part of the ACIAR Smallholder Tree Farmer Project. These trials are designed to have both research and demonstration functions. A field trial established at Leyte Leyte was designed to investigate the potential interaction between four species comprising a providing a combination of native and exotic species and nitrogen-fixing vs non-nitrogen-fixing species. Importantly, this design provides information about different mixture ratios using only one plot. This field trial will provide important information about the interactions of the four species when grown in varying mixture ratios. A clinal trial using the design of Vanclay (2006a) was established in Leyte Leyte in December 2007 using four species. This trial will provide important information on ideal spacing at which trees should be established and how initial planting density affects site capture and early growth, especially in respect to indigenous species. Field trials have also been established to investigate the effect of fertiliser and shade on the establishment and early growth of mayapis and to demonstrate the positive impact that the use of high quality germplasm and good early-age silviculture has on the growth of gmelina. The establishment of the field trials has been an important capacity-building exercise for the project team. Filipino collaborators have been intimately involved in the design, establishment and monitoring of the field trials and are now capable of establishing similar rigorous field experiments.

Further details of the rationale and key research questions addressed by the field trials can be found in Herbohn et al. (2009a) while further details on the establishment procedures including consultations with local communities can be found in Gregorio et al. (2009a).

Light response curves for 12 year old gmelina at the thinned and unthinned sites at Bato are presented in Figure 10. The light response curves at the thinned site are generally higher than those for trees at the unthinned site, with only a slight overlap. T-tests revealed that photosynthesis at light saturation (Amax) for leaves at the thinned site were significantly higher ($p<0.05$) than for leaves at the unthinned site. In addition, trees at the thinned site had an average DBH increment over the past 15 months of 5.6 cm compared with an average 3.5 cm DBH increment for trees at the unthinned site. It appears that the photosynthetic capacity of leaves of the trees at the thinned site has increased in response to an increase in resources made available to individual trees by the removal (thinning) of nearby competing trees. This response is probably due to the increased availability of a limiting resource – perhaps light, water, a macronutrient such as N or P or a combination of these. It is also interesting to note that this impact starts to become strong (i.e. statistically significant) at quite low levels of PPFD.

The thinning experiment, even at 18 months, has produced results with important implications for the management of smallholder gmelina tree farms. The thinning trial has provided evidence that late age silviculture (i.e. thinning) for gmelina results in a significant positive growth response. This indicates that even at 12 years of age, benefits can be obtained from thinning gmelina stands. Further analysis of the thinning trials being undertaken as part of a MPhil by a John Allwright Fellow at The University of Queensland will provide further insights into the potential impacts of late age thinning on improving financial returns to smallholder tree farmers in Leyte.

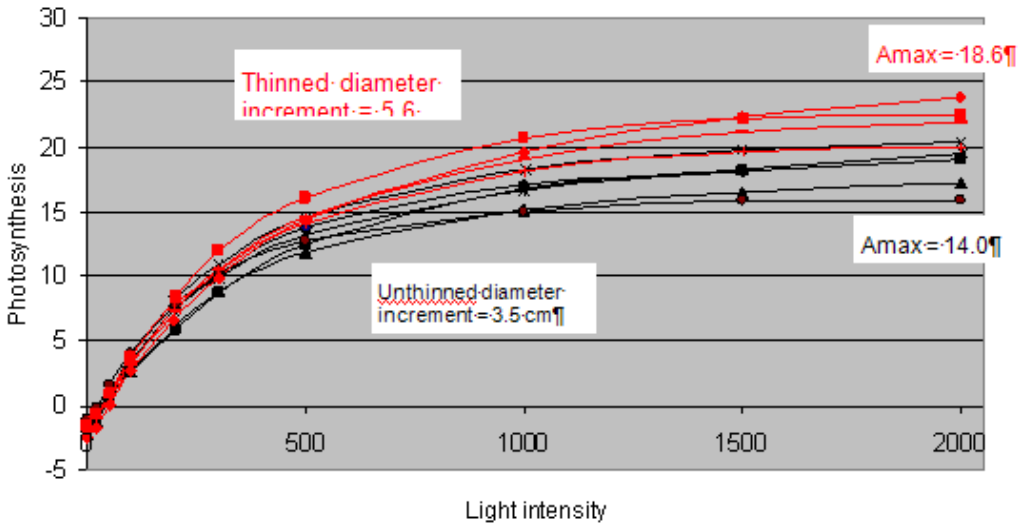


Figure 10. Light response curves for Gmelina trees at thinned and unthinned plots at Bato

The average light response curves for the four species used in the mixed species trial in Leyte Leyte are given in Figure 11. Amax follows the pattern of falcata>narra>mahogany>mayapis. This pattern is also reflected in the average height of each species but not in the pattern for average biomass (as measured by number of leaves) and dbh which followed the pattern of falcata>mahogany>narra>mayapis. The reversal of mahogany and narra suggests a different pattern of resource allocation between species. Narra has high rates of Amax with a smaller number of leaves compared with mahogany which has a lower rate of Amax but a much greater number of leaves and total leaf biomass. There is far greater variability in both the shape of the individual light response curves and Amax for mayapis compared with the faster growing falacta, mahogany and narra (Figure 12).

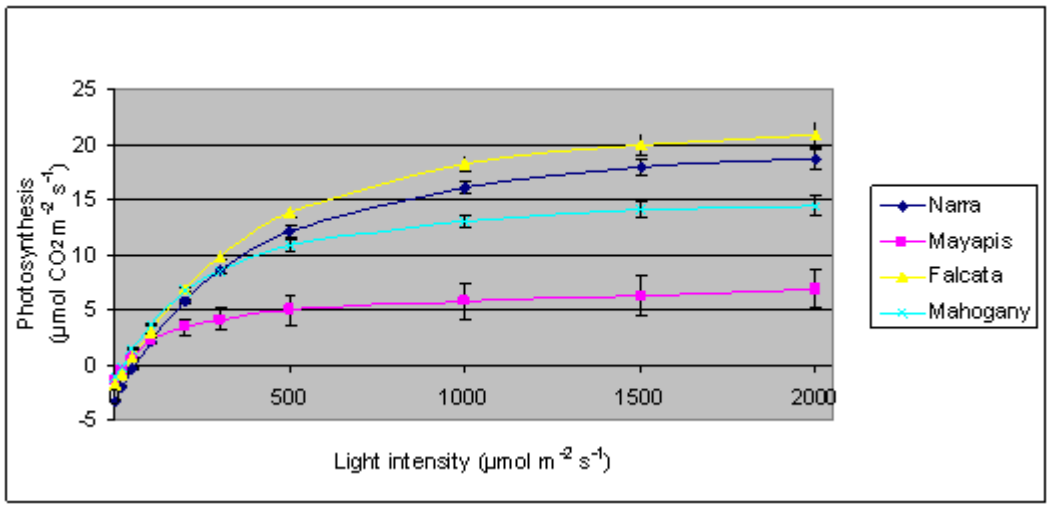
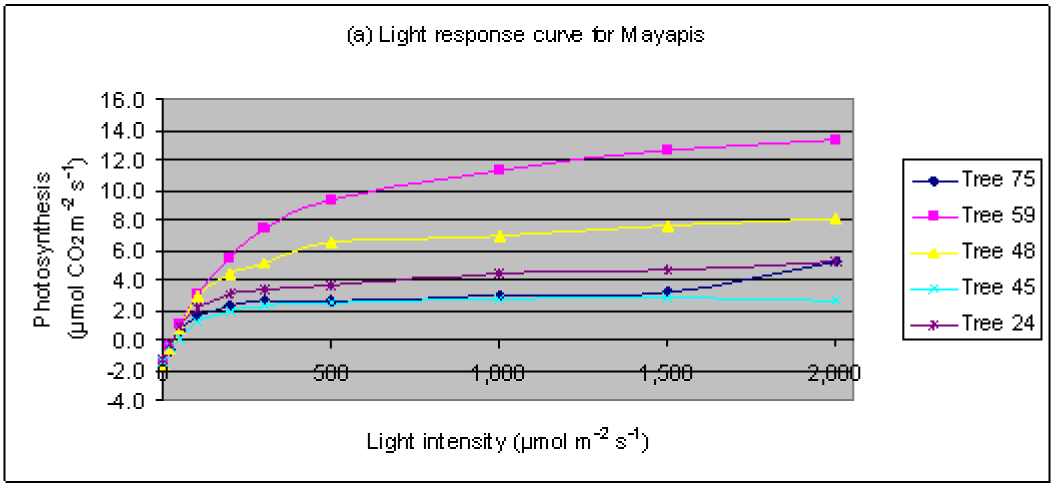
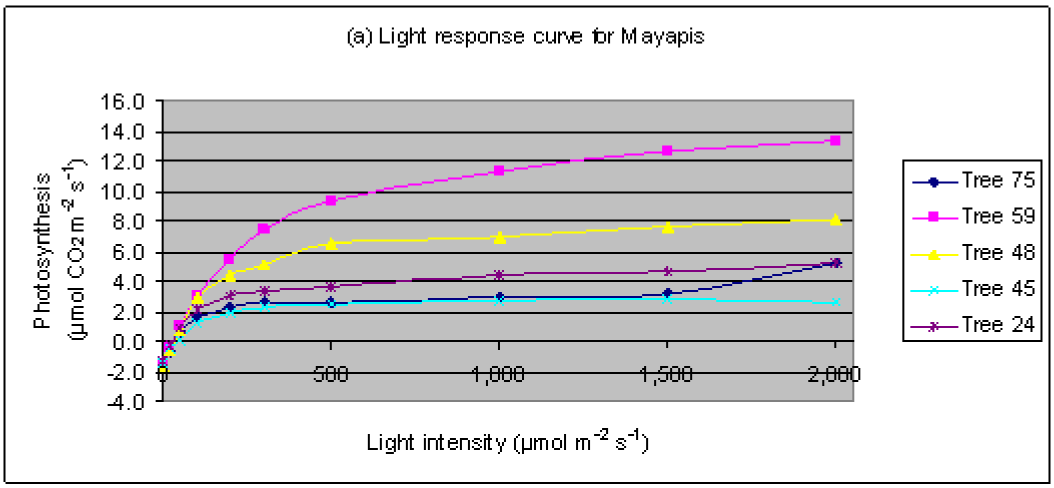
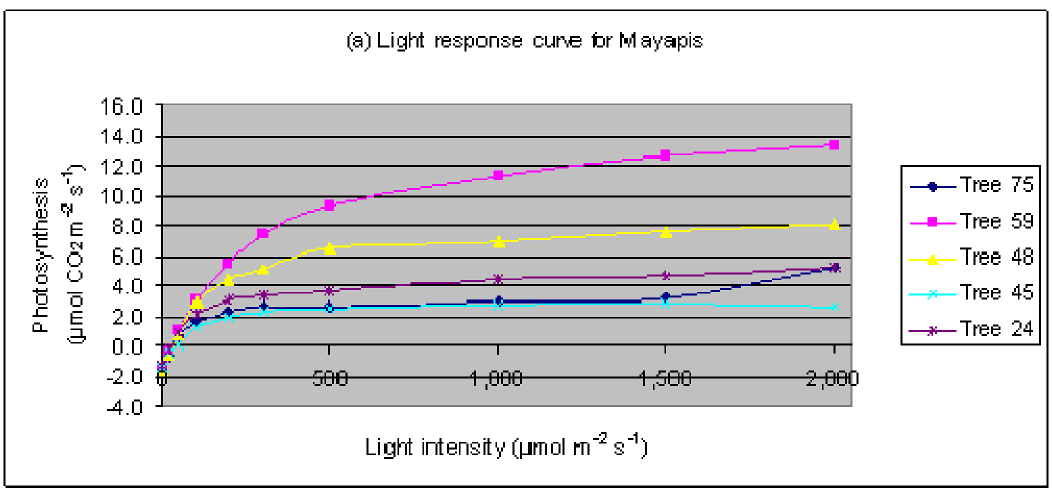


Figure 11. Average light curves for species used in mixed species trial


(a) Light response curve for Mayapis
Photosynthesis
(µmol CO2 m-2 s-1)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
0
500
1,000
1,500
2,000
Light intensity (µmol m-2 s-1)
Tree 75
Tree 59
Tree 48
Tree 45
Tree 24


(a) Light response curve for Mayapis
Photosynthesis
(µmol CO2 m-2 s-1)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
0
500
1,000
1,500
2,000
Light intensity (µmol m-2 s-1)
Tree 75
Tree 59
Tree 48
Tree 45
Tree 24


(a) Light response curve for Mayapis
Photosynthesis
(µmol CO2 m-2 s-1)
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
0
500
1,000
1,500
2,000
Light intensity (µmol m-2 s-1)
Tree 75
Tree 59
Tree 48
Tree 45
Tree 24

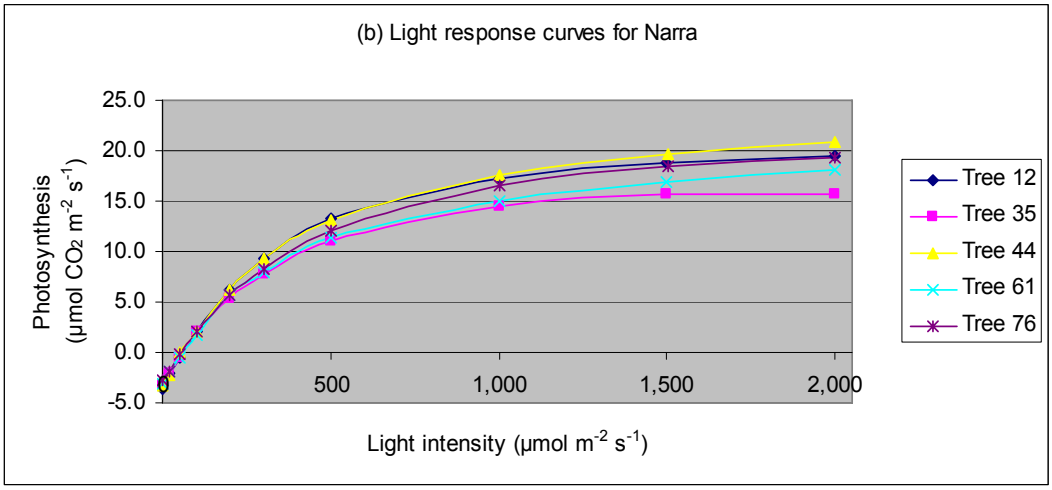
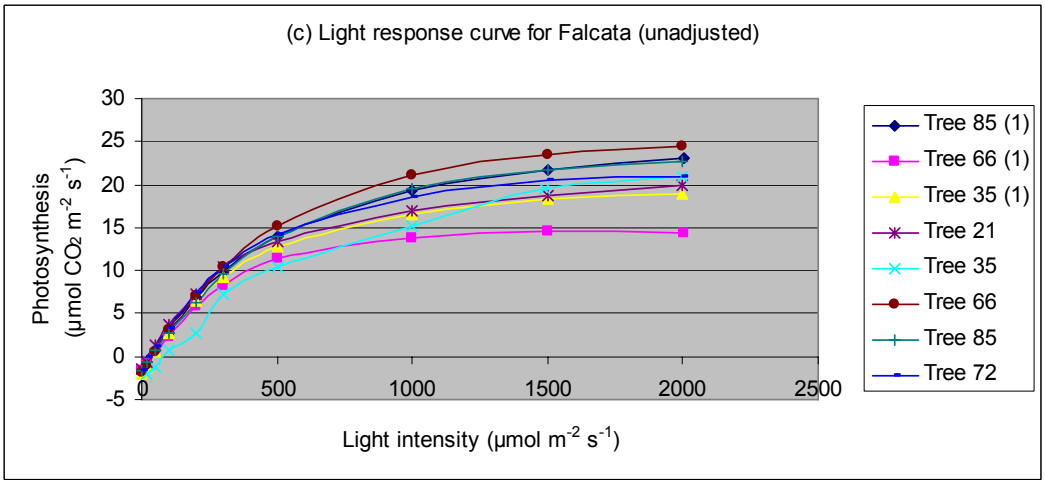


Figure 12. Individual light response curves for individual trees for each species used in the mixed species trial in Leyte Leyte



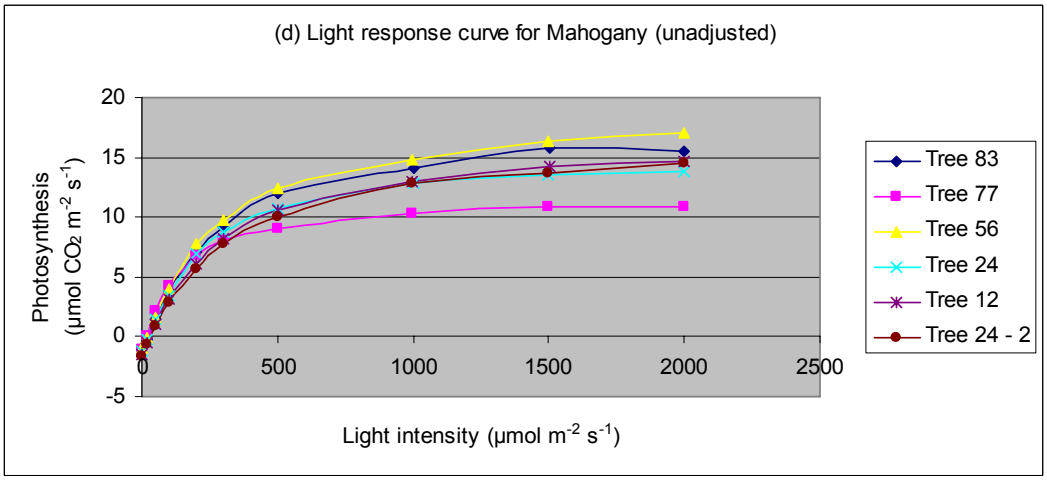


Figure 12 (Cont.). Individual light response curves for individual trees for each species used in the mixed species trial in Leyte Leyte

There was a substantial difference between the light curves for 11 month old gmelina trees in the three experiment plots with a 3 m x 3 m spacing compared with gmelina trees in the one experimental plot with a 4 m x 4 m spacing (Figure 13). The differences are statistically significant, as evidenced by the non-overlap of standard error bars. The preliminary interpretation of these results is that at even a very early age, resources within trees are becoming limiting for photosynthesis at a 3 m x 3 m spacing. This unexpected finding will be investigated further with a variable spacing trial.

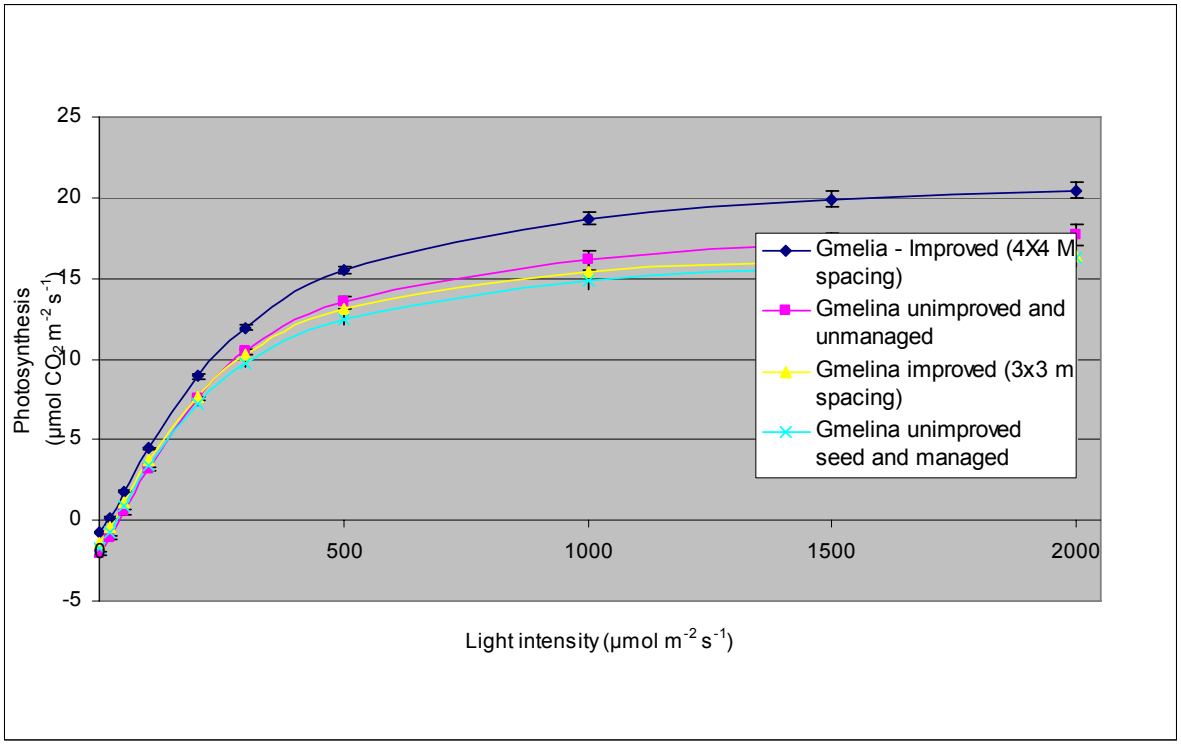


Figure 13. Light response curves for 11 month old gmelina treatments at Mahaplag

For each of the four experimental plots at Mahaplag a trend is apparent in increasing Amax from the lower Quadrant 1 to the upper Quadrant 4 (Figure 14). This is consistent with the greater proportion of older (and hence less photosynthetically active) leaves being located in the lower two quadrants and the upper quadrants containing a higher proportion of younger and highly photosynthetically active leaves. It is also notable that there is much greater variability in Amax across the quadrants in sites from sites 2 and 4 with unselected germplasm.

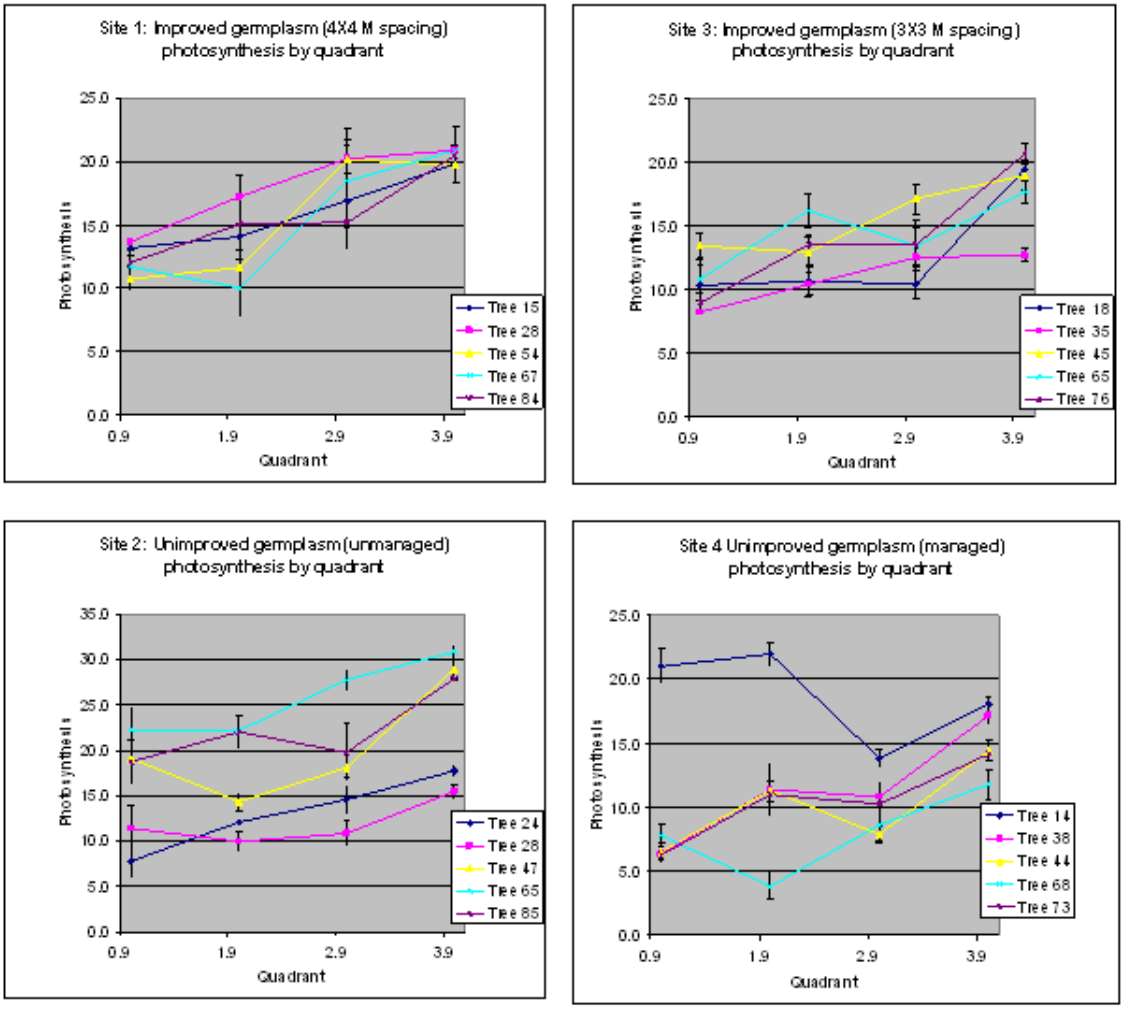


Figure 14. Amax by quadrant for 8 month old gmelina trees at Mahaplag

7.2.3 Survey of timber enterprises

A survey of timber entrepreneurs in Eastern Visayas and Metro Cebu was conducted in 2006 to investigate the use, attitudes and preferences of timber entrepreneurs for smallholder timber. Information gathered included: respondents' profile, overview of their business activities, timber procurement in volume and buying price, timber products sold (volume) and selling price received, entrepreneurs' views on smallholder tree farms as a source of timber resource, and their perceptions of future prospects for Philippine timber enterprises. The target population was those enterprises purchasing timber from tree farms. Enterprises were identified from the DENR registration list and by snowball sampling. Some of the larger Cebu-based enterprises were unwilling to cooperate in the survey.

Representatives of 51 establishments were interviewed, located in Leyte Island, Samar and Metro Cebu. Six major activity areas were identified for timber entrepreneurs: 38 timber enterprises or 74% of the businesses were engaged in retailing sawn timber. Sawmills and re-sawmills are defined in this study based on the raw material sawn in the mill; sawmills use mainly logs as input while re-sawmills mainly use flitches that are cut

down to smaller dimensions. Accordingly, sawmills have large bandsaws while re-sawmills typically use mini-bandsaws.

Respondents identified a variety of timber sources, including 'local' timber from within the municipality, province or island, timber obtained within the region but outside the island where the timber enterprise is operating, timber obtained from other regions in the Philippines, and timber obtained from abroad. It was found that more than half (58%) of timber businesses in the study obtained some or all of their timber requirement locally.

Respondents' annual procurement volume of sawn timber for the year 2005-06 was 6.5 M board feet. In terms of species purchased, approximately 48% of sawn timber purchases were gmelina, 24% were mahogany, 8% lauan, and 6% Malaysian lumber. Forms of timber purchased included logs, flitches, sawn timber, standing trees, mouldings, timber from old houses, and s4s. Survey respondents were able to identify seven suppliers of timber. Over 60% of timber enterprises were supplied by timber merchants while only 33% obtained their timber directly from tree growers and 12% obtained their timber through a timber broker. Building contractors (constructing commercial and residential buildings and using large quantities of timber) and local consumers (mostly households using timber for small-scale repair and minor house construction or extension and furniture making) were the largest market. Other buyers include furniture makers, hardware and lumber retailers, government institutions, veneer plants and NGOs.

Just under half of the respondents agreed that smallholders produce timber suitable for their enterprises. They noted that: (1) there is demand by low-income households because timber and particularly gmelina is of lower retail price than lauan and imported lumber; (2) they are the only locally available timber species because of log ban; (3) the quality of smallholder timber is high; and (4) they only purchase small quantities of timber for their enterprise. These respondents identified the following problems with smallholder as timber source.

- many tree farms are inaccessible
- slow processing of approval papers for harvesting and transport
- most of smallholder trees are not registered with DENR
- some wood defects, e.g. centre rot
- expected shortage of future supply of smallholder timber
- some relatively well-off consumers are moving to use steel as alternative to timber in house construction

About a quarter of respondents said smallholder timber is not suitable for their enterprises. One reason is that timber produced by smallholders easily warps and twists and is prone to attack by insects. Another reason draws on their experience in difficulty of processing permits with the DENR for harvesting and transport. One of the respondent said that their company has a supply contract with a large-scale timber supplier who meets their timber needs. One respondent stated he prefers lauan (which is not available from smallholders) for making wood mouldings. A suggestion was made that smallholders should form an association or cooperative to minimize the time needed to conduct transactions; this would allow bulk orders to be filled with less time and effort, and with little intervention of middlemen.

About half the respondents said that they would like to obtain more gmelina and mahogany, while 42% would like to obtain lauan. Some of the respondents would like to obtain traditional premium native species, including narra, yakal and molave. Most respondents agreed that smallholders could provide gmelina and mahogany, while about half mentioned some issues that should be addressed to enable them to supply these species to the timber industry. The following is the synthesis of issues raised by respondents.

- farmers should be provided with technical support from the government
- problems arise in implementation of regulations and policies by law enforcement agencies, e.g. the DENR
- farmers should obtain complete papers, e.g. certificate of tree plantation ownership registration for their timber products
- farmers should properly manage their trees
- tree planting should be continuously done
- government should make intervention and provide technical and financial support to utilize idle tax declared lands for timber production

A few respondents said that smallholders could not provide gmelina and mahogany, noting that there are few gmelina and mahogany plantings to be seen on farms and most these plantations are young. Additionally, DENR policy on timber harvesting and transport is very strict which discourages tree planters from supplying wood to timber businesses. Lastly, Cebu respondents said that there are other places competing for timber supply from smallholders, which implies timber supply shortage in both the short and long run. Nearly half the respondents said they would like to obtain lauan timber for their enterprises, but were divided on whether smallholders could or would be willing to grow this species. It was commented that lauan is still being cut illegally by subsistence smallholders.

The majority of the respondents would like to obtain more timber with minimum thickness and width of 2 inches while about half of them may also accept timber with 1 in thickness. Most would like to obtain timber of 8 ft lengths. For Narra and Yakal, respondents would accept timber not smaller by 2 in x 2 in dimension.

Perceptions of future prospects for Leyte timber enterprises

One third of respondents were optimistic for a promising future of the timber industry, although some held conditional views. Their optimism is due to the (1) population increase and urban expansion; (2) gmelina and mahogany are already accepted in the market; and (3) there is a promising future for timber export. One quarter provided a ‘conditional yes’ answer and their conditions for a bright timber industry future are summarized as follows.

- government should strengthen information campaign to encourage farmers to plant trees
- tree planting should be continuously done to sustain timber supply
- there should be an association of lumber retailers to control illegally trade in timber.

A quarter of the respondents said that the timber industry does not have a bright future, commenting on declining timber supply, strict regulation on harvesting and transport, use

of steel as an alternative to timber in house construction, and current low sales or demand.

Most respondents believed the timber resource is becoming more difficult to obtain, including all Samar respondents. The majority from Cebu did not have any difficulty because of their access to imported timber. The reasons cited for supply shortage included:

- harvesting and marketing of planted trees is becoming difficult because of difficulty in obtaining necessary permits, e.g. for cutting and transport
- the log ban is limiting timber harvesting even for planted trees
- farmers are discouraged from replanting because of their negative experience in processing papers, and low demand and low market price of planted trees (particularly gmelina).

The survey information has implications for how to improve silviculture to obtain higher timber prices, particularly in terms of pruning and thinning to produce favoured timber quality (reduced incidence of branch defects) and dimensions (longer sawn boards).

The whiteboard pilot scheme for bringing timber buyers and sellers together

Two whiteboards were placed outside CENRO Maasin, one listing potential timber supply (details of tree farms in the CENRO) and the other listing timber demand-related information (timber prices being by species and dimensions of firms purchasing timber in the CENRO). An evaluation of the trial by Gerona et al. (2009) reveals it was highly useful for improving communications in timber marketing. The seller whiteboard helped timber processors locate sources of timber (for which tree registration had been secured) while the timber enterprise whiteboard made tree farmers aware of the going-rate prices for sawn timber according to board dimensions.

A limitation of the whiteboards as an information system is that they are extremely time consuming to update – especially writing neatly plantation details for a large number of tree farmers – hence no revision had been made since their initial establishment. Also, space limitations and perhaps oversight had led to the omission of planting date on the supply-side board, so potential buyers did not know if trees were of harvest age. Some respondents in the evaluation study stated that the whiteboards should be placed in a more conspicuous position, for easier and wider access.

While the whiteboards created considerable interest in timber marketing, it is probable that a more effective system at the present time is to post printed large-size paper lists, updated frequently (at least every few months), at least on the supply side of the timber market, and to extend this information system to other CENROs.

Development of a barangay-based timber inventory method

As part of a masters degree study at Visayas State University, Cedamon carried out a trial of enlisting barangay captains to carry out inventories of trees numbers by species and age on farms in selected Leyte municipalities. This greatly reduced data collection cost, and was found to provide acceptably reliable estimates of timber supply on sample tree farms, to be used in the transshipment modelling. This research was reported in Cedamon's thesis in 2006, and the application of the barangay-based inventory method to estimating timber supply is reported in Cedamon et al (2009a).

Modelling market supply, demand and financial benefits of improved timber quality

A detailed market modelling study of the timber sector on Leyte Island is being undertaken by Cedamon, preliminary findings of which are available in Cedamon et al. (2009, a-c). This market modelling study is investigating the optimal location for the processing and marketing of sawn timber from smallholder tree farms on the island. The economic impact of pruning and thinning on smallholder farms is also being assessed. The model is formulated as a transhipment model (Cedamon et al. 2009d), and specifies timber supply as one of the model constraints. In the transhipment model, available timber supply, particularly for relatively small tree farms, is being determined for each municipality.

It soon became clear that the information system for forestry, particularly at the individual producer level, is very limited; while many countries have regular monitoring of forestry production in Leyte it is necessary to conduct specific surveys to obtain enterprise level forestry statistics. In fact, no useful database of tree farmers is available, the tree registration database proving of little assistance in obtaining a sampling frame of tree farmers. Cedamon (2009a) carried out a trial of enlisting barangay captains to carry out inventories of trees on farms in selected Leyte municipalities. Further, he checked the reliability of these estimates. This greatly reduced data collection cost, and was found to provide acceptably reliable estimates of timber supply on sample tree farms.

Sawing recovery trials, milling cost estimation and validation of yield modelling

A trial was conducted in late 2008 and early 2009 to compare the sawing recovery rate from gmelina logs using chainsaws and mini-bandsaws in small-scale timber processing on Leyte Island (Cedamon 2009b). The sawing recovery rate for chainsawing was found to be 39% while that for the mini-bandsaw was 52%. The financial feasibility of using both saws in processing timber from smallholder tree farms on the island as well as its policy implications are evaluated in this paper. The net revenue of small-scale sawn timber processing is PhP873/m3 from chainsawing and PhP1895/m3 for bandsawing. Profitability of sawn timber processing was found to be highly sensitive to sawing recovery rate and therefore both the use of saws with a smaller kerf and training of the saw operators are recommended. Profitability was also found to be highly sensitive to haulage distance of sawn timber. Negative returns were predicted for a hauling distance of more than 2.25 km and 3 km for chainsawn timber processing and bandsaw milling, respectively. It is recommended that farmers, extension agents at local government units and Foresters of the Department of Environment and Natural Resources (DENR) should consider road access in forestry promotion if tree farming is oriented towards the sawn-timber market.

Demonstration sites, bus tours, and evaluation of extended extension assistance

Memoranda of understanding (MOAs) were signed with several farmers to periodically obtain data from their tree farms and to bring visitors to observe the sites. Two bus tours of these sites were conducted, where instruction was given to farmers on tree planting and management, and measurement of growth performance.

Baynes et al. (2009a) compared the effectiveness of extended on-farm assistance with more limited assistance in personalised forestry and agroforestry extension in four municipalities on Leyte Island. Farmers were found to respond positively to an extended program which helped them overcome problems in germinating and growing seedlings

and establishing trees on their land. A limited assistance program which sought to make use of farmers' familiarity with growing and raising plants was relatively unsuccessful, with poorer preparation of tree planting sites and a higher rate of abandonment. Allowing farmers freedom to select aspects of technical advice which suited their personal circumstances, encouraged a high degree of cooperation between extension staff and farmers, but some farmers employed poor tree establishment techniques and some sites were inappropriate for growing trees. In terms of attendance at tree management demonstrations, the number of farmers recruited through local government staff was low, but attendance by neighbours at locally held demonstrations was high, suggesting an avenue for further recruitment.

Baynes et al. (2009b) evaluated the success of an agroforestry extension program in Leyte the Philippines. During the program, variables which are intrinsic to farmers' socio-economic and farming systems were found to have influenced the uptake and acceptance of extension advice. Evaluation of the program therefore depended on identifying the variables and their interdependencies and assessing their relative influence on program outputs. Using both empirical data collected during program activities and input from stakeholders, Bayesian Belief Network (BBN) modelling was undertaken to predict critical success factors for the four main extension activities, namely recruitment, the effectiveness of written extension materials, development of farmers' self-efficacy in nursery and silvicultural management and attrition of participating farmers. A key predicted constraint to program recruitment is farmers' perception of harvest security and whereas this variable could be partly addressed through dissemination of information on harvesting legislation, title security cannot. Differing levels of farmers' education flow through to differences in predicted reading ability, comprehension of extension literature and possible misconstrual of information. The variable found most critical to the development of farmers' self-efficacy was extended problem-solving support.

7.3 Achievements with regard to Objective 3: Identify and promote livelihood systems and policy which incorporate forestry and which recognise the socio-economic circumstances of smallholders

Smallholders in the Philippines, as in other tropical developing countries, adopt complex mixtures of crops, coconuts, timber and fruit trees and vegetable and other crops on their land, supporting on-farm product use and cash-earning activities. Project activities were conducted to gain an improved understanding of these farming systems, and to explore options for improved systems.

7.3.1 Identification of tree farming systems – the socio-economic survey

A socio-economic survey was conducted using a parallel sample to the tree inventory survey. A sample of 81 farm ownerships (though a greater number of farms) was obtained, using the same sampling frame as the timber inventory survey. Notably, this sample is biased towards tree farmers, due to the tree area threshold of 0.1 ha. The survey obtained detailed information at the farm, land parcel and individual tree block levels (Harrison et al. 2009a, Sevare et al. 2007, Alvare 2009, Jesusco 2009).

The survey examined the intentions and aspirations of smallholders with regard to adopting tree farming on Leyte Island. It was found that most of the respondents relied

on their own knowledge and experience in nursery and plantation establishment and maintenance. More than half the respondents had harvested timber in the last three years. Gmelina and mahogany were the species most often harvested.

In seedling production, most smallholder tree farmers collected their own planting materials rather than purchasing seedlings. The techniques used in nursery and plantation establishments and maintenance are largely based on their own experiences and those gained from others (i.e. relatives, friends and seminars or training). The most common species harvested by smallholder tree farmers are gmelina (Gmelina arborea), mahogany (Swietenia mahogani), ipil-ipil (Leucaena leucocephala), and mangium (Acacia mangium).

It was noted that there are particular conditions required to support timber selling, such as a high market demand with reasonable price, easy access to buyers, and availability of buyers who buy bulk volumes of timber. In this regard, a special effort is needed to support smallholder tree farmers and to encourage them to plant more timber trees. Local government units and even private institutions could collaborate to formulate activities that would assist tree farmers.

The major problems for growing timber trees identified by respondents were unavailability of land for planting, damage to trees by grazing animals, risk of typhoon damage and budgetary constraints. Most of them expressed an interest in growing trees in the near future to provide a legacy for their children and grandchildren, and for economic and environmental reasons. Almost half had registered their trees, and those who had done so generally had not experienced major difficulties in the process.

About 46% of the respondents were found to have registered their planted trees with the DENR and they generally had not experienced any difficulties in carrying out tree registration. A significant relationship was found between interest to register trees and some socio-economic variables, including indicators of well-being and socio-demographic profile.

More than half of the survey respondents held positive opinions about the value of planting trees for both environmental and personal objectives. Respondents were more inclined to engage in tree farming if they had access to some form of credit to finance plantation establishment. This suggests that tree growing among smallholders would be enhanced if financial assistance from private or government institutions were available, as well as other forms of support required including technical advice and free seedlings.

Harrison et al. (2009b) identified the characteristics of land parcels of survey respondents, as a basis for exploring land-use options (Table 10).

Table 1. Characteristics of owners and land parcels

Characteristic of parcel	Frequency distribution
Tenure (n=249)	Owner 150, tax declaration 52, tenant 15, administration 8, communal 3, lease 2, titled tenant 1, other (mixed type, no answer) 18
How land obtained (n=247)	Inherited 105, purchased 94, only a tenant 15, CARP (land reform) 10, ancestral domain 5, other (mixed type, no answer) 18
Land slope (n=246)	Flat 93, gentle 10, moderate 118, steep 11, flat to gentle 2, flat to moderate 3, moderate to steep 2, other 7
Parcel size in ha (n=240)	0-5 ha 60, 0.51 to 1 ha 52, 1.01-2 ha 49, 2.01-4 ha 37, 4.01-6 ha 17, 6.01-10 ha 11, 10.01-20 ha 8, 20.01-100 ha 5, over 100 ha 1, mean area 4.71 ha
Distance to nearest town (n=238)	0 to 2.5 km 45, 2.51 to 5 km 53, 5.01 to 7.5 km 42,7.51 to 10 km 46, 10.01 to 15 km 43, 15.01 to 20 km 9
Road type to nearest town (n=239)	Concrete 130, mainly smooth unsealed 6, mainly rough unsealed 35, trail 10, concrete and trail 20, concrete and rough unsealed 34, smooth unsealed and concrete 1, rough and trail 3

The crop combinations on these land parcels were identified (Table 2). Overall, the parcel analysis indicates that there is a wide variety of cropping systems, based in particular on coconuts, timber trees, fruit and rice. However, apart from this broad typification, it is difficult to identify commonly adopted agroforestry systems. While coconuts and timber trees are both grown on more than 40% of land parcels, these are listed together as major crops on only 67 parcels (27.3%). Similarly, both coconuts and rice are listed as major crops on only six parcels, and timber trees and rice on only four parcels.

Table 2.Crop combination matrix (n=245) a

Main crop	Other crop			
	Timber (42)	Coconut (50)	Rice (4)	Bananas (31)
Timber (101)	0	43	0	16
Coconut (108)	24	0	3	18
Rice (37)	1	3	0	3
Bananas (5)	0	0	0	0

a. Numbers in parentheses are frequencies of mentions as main and other crops.

In terms of planting systems, gmelina, mahogany and mangium are most frequently planted in compact blocks within land parcels, and there is only a small proportion of border plantings (mainly of gmelina) (Table 3). Notably, only about 51% of the gmelina plantings are in compact blocks, whereas compact blocks were the rule for mahogany and mangium (73% and 100% of the sample, respectively).

Table 3. Contingency table of species versus planting layout, for main species (n=198)a

Planting layout	Species			Total	Relative frequency (%)
	Gmelina	Mahogany	Mangium		
Compact block	59 (51.3)	54 (73.0)	9 (100)	122	61.6
Intercropped	25 (21.7)	16 (21.6)	0 (0)	41	20.7
Fenceline planting	18 (15.7)	2 (2.7)	0 (0)	20	10.1
Other, not stated	13 (11.3)	2 (2.7)	0 (0)	15	7.6
Total	115	74	9 (0)	198	100.0

a. Numbers in parentheses are percentages.

For the year preceding the survey, 68 respondents (84.0% of the sample) produced copra, all selling their product (Table 4). Thirty five respondents (43.2%) reported growing rice, but only half sold palay (unhusked) rice, on average selling about three quarters of their harvest. Abaca generated the next highest level of revenue, all being sold. On average, about half of the mango and camote crop was sold, and about one third of the banana and cassava production.

Table 4. Production, disposition, and prices and revenue from main crops

Production or sales variable	Crop							
	Copra (kg)	Rice (palay)	Camote (60 kg bag)	Cassava (60 kg bag)	Banana (piece)	Abaca (kg)	Pineapple (piece)	Mango (piece)
Number producing crop	68	35	11	6	29	6	9	6
Number selling crop	68	17	7	4	20	6	4	4
Total quantity harvested	256,554	6673.5	72.5	129	233,495	2350	6805	2719
Average proportion sold per producer (%)	98.28	37.61	49.47	33.83	31.93	100	23.44	58.83
Average proportion sold per seller (%)	98.28	77.44	77.74	50.75	46.3	100	52.75	88.25
Average price (PhP)	13.22	501.91	308.57	85.00	0.68	13.33	14.63	22.00
Average revenue per seller (PhP)	49,877	197,029	3196	2741	7939	5221	24,889	14,955
Average revenue over all sample farms (PhP)	41,152	32,023	214.71	68.70	907.57	5106.20	648.35	651.72

Livestock were found to be important for some smallholders, but not in general integrated with cropping. Pigs and chickens were the most widely reported livestock species raised, and used for food on-farm (Table 5). Twenty farmers slaughtered a total of 140 pigs, and sold 449 head at an average price of 3079 PhP. Thirty three farmers (40.7% of the total sample) had a total of 163 pigs on hand, and three of these reported having a total of 26 piglets on hand. Pigs were the greatest livestock revenue earner, followed by cattle. The annual livestock income over the whole sample averaged 24,787 PhP, more than two-thirds of which was from sale of pigs. In regard to other livestock, five owners had a total of 168 ducks on hand, although no duck sales were reported. One respondent reported having sheep, and one reported having horses.

Table 5. Livestock numbers, sales, prices and revenue

Production or disposition variable	Livestock species				
	Cattle	Carabao	Pigs	Goats	Chickens
Number of current owners	16	8	33	7	35
Number slaughtering animalsa	7	na	20	2	32
Number slaughtered	12	na	140	4	525
Number of sellers	6	5	23	1	6
Number sold	42	11	449	2	268
Mean priceb	10,337	15,250	3079	650	82.5
Stock on hand	515	79	163	20	570
Mean income over sample	5359.93	2070.99	17,067.54	16.05	272.96

a. 'na' means not available because not asked, but number very small.

b. The mean price is an average over the prices obtained per seller, where some respondents sold more than one head of a particular species.

In summary, a wide variety of 'agroforestry systems' were observed. However, apart from the general practice of growing rice on flat lowland irrigable areas, food crops on foothills, mixed timber, fruit and food crops on steeper land, and coconuts on any land type, no particular agroforestry systems dominated. The crops grown (food, timber, fibre) appeared to depend on individual choice, land type and established markets. Surprising little abaca was grown (perhaps affected by the current bunchy top virus problems). Livestock production and particularly pigs was only moderately prevalent, but with few cattle raised.

7.3.2 Identification of policy implications for agroforestry systems

The question arises as to whether traditional knowledge and farming experience have led to near optimal farming systems for the given resource endowments of Philippine smallholders, whether more profitable and sustainable farming systems could be devised with the given resource base, and whether interventions could be made with some assistance packages to improve the livelihoods of smallholders.

Survey information reveals that a narrow tree species base has been adopted (mostly of the two exotic species gmelina and mahogany), the rate of planting has declined in recent years (probably due to lack of increase in timber prices while copra prices have recovered strongly), and there has been a switch towards mahogany (the longer-rotation species, more popular with better-off farmers).

Farming systems in Leyte are closely linked to land type, with rice dominant on flat land where irrigation water is available, and coconuts and fruit and timber trees dominating sloping land. Further, self-sufficiency mixtures of coconuts, fruit trees, bananas, root crops and other vegetables are common, coconuts forming playing a central role due to their role as food, a cash income source and eventually a timber-substitute source. Within this general framework, a very wide variety of species mixtures are present, but no agroforestry systems appear to dominate.

There would appear to be considerable scope for trial and adoption of new agroforestry systems. In particular, wider growing of abaca (with a timber nurse crop such as Acacia mangium), alley cropping and growing or rubber agroforestry systems, and increase livestock production (particularly pigs and poultry).

There is currently considerable interest in the Philippines in tree planting for greater environmental benefits. In part due to the ACIAR project, Dr Eduardo Mangaoang has secured grant funding to examine the social and sustainability aspects of planting a combination of production, semi-production and conservation plantings of trees in Palompan Municipality in Leyte.

7.4 Extensions of project research

A number of research activities, which have not received funded support from the ACIAR project but do add value to the project research, are in currently in process.

7.4.1 Tree planting trials

A number of forestry trials were established (with support from University of Queensland funds) to examine growth rates, thinning impacts, light interception and other variables, to provide improved information about silvicultural management. Data collection on these sites is continuing. In addition, a PhD student from the University of Queensland (Huong Thi Nguyen) has undertaken an evaluation of mixed species plantings established at the

Institute of Tropical Ecology sites in Leyte. A MPhil student from the University of Queensland (Eri Matsuma) has undertaken an assessment of the impact that tree farms have on bird biodiversity. In addition, Associate Professors John Herbohn funded from internal UQ sources a study into biodiversity impacts of treefarms. A John Allwright Fellow (Edwin Cedamon) is continuing market modelling work in Leyte, as required in his PhD thesis, with the support of a John Alright Fellowship. At this stage a preliminary mathematical program has been developed of timber supply, demand and transhipment logistics in Leyte. Further work will involve improving the estimates of Leyte timber supply over time and of apparent per capital timber consumption by region, and integrating the impact of improved silviculture on timber quantity and quality into the model, and deriving policy implications. A second John Allwright Fellow (Samuel Bernaldez) is investigating whether late-age remedial thinning of Gmelina and Mahogany plantations is viable.

7.4.2 Contributions of AVA and Work Experience students

Ms Melissa Gordon, Australian Volunteer Abroad, played an important coordinating role in much of the early work on development of the extension primer on tree registration and harvest and transport approval. As well, Melissa conducted a series of case studies of smallholders with respect to tree registration, reported as Gordon (2007b).

Ms Carol Neal – an industrial placement student – examined agroforestry systems through which crops, trees and small farm animals are produced and consumed, by three Leyte Island farming families, and the extent to which they contribute to the farmers' livelihoods and wellbeing. A survey using semi-structured personal interviews was carried out, and the farmers maintained diaries of on-farm product use. The research method and findings are summarized in Neal (2007).

In addition to crops grown as a source of income, portions of farm products were grown specifically for home consumption, and some non-consumable products were exchanged between households. The farmers had a basic understanding of the nutritional value and health benefits of all the food products they consumed for daily energy, health and medicinal purposes.

Fresh products were exchanged and bartered between neighbouring farmers and relatives, and bamboo was made available free of charge to local community members for construction if the purpose was for personal use. Coconut shells and husks were left at the land parcels where the product was harvested, i.e. there was no cost to the community for coconut shells for making charcoal if this was for home consumption. However, if these bamboo or coconut products were to be used for sale then a charge was imposed.

Prices of products used on-farm were estimated on the basis of market prices net of production cost. Cost savings were estimated to be the monetary difference between farmgate prices, and transportation costs and market retail prices. The food types that were used for home consumption from the main crops category were rice and coconuts. One farmer estimated a cost saving of 287.50 PhP/wk for rice. Coconut milk is used as a substitute for water. The farmer estimated that the net value of the coconuts that were consumed in the field would have been 8 PhP per fruit. Coconuts harvested as required by the household generated an overall weekly cost saving of 200 PhP. A cost saving of 70 PhP/wk was generated by the household for non-food products through use of fuelwood and leaf litter gathered from gmelina and acacia trees. Gmelina, which usually costs 14 PhP/board foot clean, was also used as lumber at Cebuana. Mahogany poles

and boards were used at Cebuana for house construction. Ipil-ipil used for fuel at the Mabagon farm saved 125 PhP/wk.

Compared to the current market price, the farmers generated weekly savings of 24 PhP for eggs and 25 PhP for poultry meat at the Anahawan farm, and 90 PhP for eggs and 150 PhP for poultry meat at the Cebuana farm.

Further analysis of the socio-economic survey data by Dr Mohammad Safa

It is also envisaged that further analysis of the socio-economic survey data will be undertaken by a Postdoctoral Research Fellow, Mohammad Safa, recently appointed to the UQ School of Integrative Systems, He will be integrating the socio-economic survey data with the tree farm inventory MicroSoft Access database, in order to carry out further analysis of the socio-economic data and to explore relationships between socio-economic variables and forest inventory variables.

Livelihood systems research by Mr Hai, PhD student

A new PhD student, Mr Hai Le Ding is commencing a project on forestry-related livelihood systems, in association with a new project commenced by Professor Eduardo Mangaoang in Palompon Municipality in Leyte. Some funding support will be provided by the School of Integrative Systems of The University of Queensland. While some conceptualization has been carried out, no reports have been produced on this work yet.

Farming systems research in Mindanao, including rubber agroforestry

The ACIAR team has been corresponding with World Agroforestry Centre (ICRAF) researchers in Mindanao concerning financial evaluation of rubber agroforestry systems. It is probable that a project with Sagittarius Mines Inc (SMI) in Tampakan Province will be commenced shortly, and this will involve collection of data concerning smallholder livelihood systems. Agroforestry systems, including alley cropping and rubber agroforestry, appear more advanced than in Leyte. There is an opportunity for the Mindanao research work to feed back into ACIAR project work.

7.5 Summary of Key Results

The Philippine government places strong priority on additional tree planting, for example through the Greening Philippines program which has led to large-scale seedling production and through the Highway Greening program, but a bottleneck still exists with regard to forestry impediments at the individual farm level. There are no industrial-scale plantings in Leyte. Greater localization of tree registration has been identified as a means to overcome much of the current disincentive effect of regulatory framework for tree registration and harvest and transport approvals.

A critical need for improved silviculture in smallholder tree farms has been identified, including more intensive pruning and thinning, and extension activities conducted and literature produced to encourage silviculture improvement.

The timber information whiteboards created strong interest in timber supplies and going-rate prices, but for practical reasons the posting of regularly updated printed information at CENROs have been identified as a more cost-effective information system.

A substantial amount of research has been performed which is closely related to but not specifically a part of the ACIAR project, and for which funding support has been made

available by The University of Queensland and by John Allright Fellowships. Work on timber market modelling, plantation thinning regimes, and further analysis of the socio-economic survey data are proceeding, and a new project has commenced on ensuring sustainable livelihoods in conservation and semi-production tree planting programs.

7.6 Capacity Building Achievements

A major contribution of the project was in capacity building for staff at Visayas State University, and to a lesser extent government agency staff. A skilled research team was developed at Visayas State University (which is now contributing to the seedling enhancement project). These team members have developed expertise in field research methods (tree inventory, use of specialized equipment (GPS, hypsometer, light meter), computer software (Excel, Powerpoint, Access, SPSS, GPS downloading software, GIS software), conducting surveys (socio-economic survey, timber enterprise survey), and report writing and conference presentations. The IUFRO Group 3.08 Small-scale Forestry conference in Leyte in June 2007 provided a valuable training event for team members, each of which was involved in preparing a paper.

Two DENR officers (Emma Germano and Dodong Tan) were loaned to the ACIAR project and took part in research activities, particularly with regard to tree registration studies, gaining experience in smallholder surveys, data processing and report writing.

7.7 Getting the Message Across to Government Policy Makers

It has become clear that regional DENR offices lack autonomy with regard to forest policy and regulations, and therefore research results must be conveyed to senior Forest Management Bureau officers in Manila if policy change is to be brought about. With this in mind, a Briefing Workshop was held and a Briefing Document distributed in Manila in February 2009. This was attended mainly be middle-level government officers. Subsequently, personal visits by Dr Mangaoang and distribution of project reports have been made to senior government officers to reinforce the messages of research findings.

8 Impacts

8.1 Scientific impacts – now and in 5 years

Scientific impacts now

The project has undertaken the first systematic assessment of growth of trees on smallholder woodlots in the Philippines. It is also possibly the most comprehensive assessment of its kind in any tropical developing country. The methodology has potential application in other tropical countries and the results are scientifically interesting. The growth models that have been developed as part of the project represent a significant advance on those that currently exist for key smallholder plantation species in the Philippines. The linking of social and economic data collected from tree farmers to the biophysical data collected from plots on their tree farms is unique and has yielded interesting results that have application to improving potential financial performance of the tree farms.

Impacts in 5 years

The field trials established for research and extension purposes are highly innovative and represent the state of the art of mixed species planting trials involving key species such as narra (Pterocarpus indicus), falacata (Paraserianthes falcataria), mahogany (Swietenia macrophylla) and mayapis (Shorea palosapis) As such they have the potential to make a major contribution to the fundamental understanding of mixed species plantations. Further monitoring will continue for the next five years.

8.2 Capacity impacts – now and in 5 years

Improved knowledge and skills have been gained by VSU forestry faculty members in conducting tree measurement and tree farm inventory, particularly the new techniques in establishing inventory plots and measuring trees using modern instruments. New knowledge has also been acquired by the faculty members in the use of GPS in mapping and inventory work. This new knowledge and skills has been adopted in teaching forestry courses such as forest mensuration and forest management. The new knowledge and techniques in conducting of tree measurements and stand inventory using the GPS and modern tree measurement instruments[1] have also heightened the interest of DENR staff on Leyte Island, particularly those at the community offices (CENROs) to adopt these techniques in their own inventory work. The tree measurement research has also opened new learning opportunities and interest among the members and research staff of the forestry faculty in the use of Excel and Microsoft Access programs for database development.

[1] *The next two sections have been prepared by the Philippines Project Leader, Dr Ed Mangaoang (Professor of Forest Management and Community Forestry, Visayas State University) who is in an ideal position to make an assessment of capacity impacts.*

The project has increased the capacity of the forestry faculty and DENR-8 and CENRO staff to develop socio-economic survey questionnaires and to conduct effective actual field surveys and interviews. There has been a significant increase in the capacity and confidence of VSU forestry faculty and affiliate staff members (from other VSU units), and DENR-8 personnel, in managing and conducting research, developing articles for publication, and delivering presentations of research outputs in local, national and international conferences.

The project has also provided the VSU forest faculty members with the knowledge and skills required to develop publication materials such as the 'Primer for Tree Registration, Harvesting, Transport and Marketing of Tree Products in Private Lands'. The acquisition of a broadband internet connection has provided the forestry faculty and affiliates from other VSU units much better access to the internet, which in turn, has led to an improvement in the way research, extension and instruction functions are conducted.

Modern instruments like the GPS and computers have proven highly useful in conducting teaching, research and extension activities of the College of Forestry. The modern tree measurement instruments were used as part of the VSU tree inventory program for tree registration purposes as required by the CENRO.

The large number of books and other publications acquired by the ACIAR Forestry Office has been invaluable to the instructional and research activities of the College.

Capacity Building Achievements

A major contribution of the project was in capacity building for staff at Visayas State University, and to a lesser extent government agency staff. A skilled research team was developed at Visayas State University (which is now contributing to the seedling enhancement project). These team members have developed expertise in field research methods (tree inventory, use of specialized equipment (GPS, hypsometer, IRGA light meter), computer software (Excel, Powerpoint, Access, SPSS, GPS downloading software, GIS software), conducting surveys (socio-economic survey, timber enterprise survey), and report writing and conference presentations. The IUFRO Group 3.08 Small-scale Forestry in Leyte in June 2007 provided a valuable training event for team members, each of which was involved in preparing a paper.

Two DENR officers (Emma Germano and Dodong Tan) were loaned to the ACIAR project and took part in research activities, particularly with regard to tree registration studies, gaining experience in smallholder surveys, data processing and report writing.

8.3 Community impacts – now and in 5 years

This section has been prepared by the Philippines Project Leader, Dr Ed Mangaoang (Professor of Forest Management and Community Forestry, Visayas State University) who is in an ideal position to make an assessment of community impacts.

8.3.1 Economic impacts

The project has heightened the awareness and interest of DENR 8 and CENR officers to emphasize among tree farmers the methods for proper tree farm establishment and management such as optimal tree spacing and the application of proper thinning and pruning methods to improve tree growth and realize high quality timber products that will attract high market prices.

Information about tree buyers and wood processors' demand for timber products has been disseminated to tree farmers, especially in the project-covered municipalities in Leyte and Southern Leyte, which kept them aware of the types and quality of tree products they have to produce, and encouraged them to apply appropriate silvicultural treatments including thinning and pruning. This has been perceived by the local project staff to lead to farmers receiving higher prices for their tree products from future harvests. Extension information on silviculture was distributed during discussion meetings with farmers and Local Government officials.

The project's research and advocacy work on tree registration policy has been an awakening point for the DENR 8 and CENRO staff to realize the importance of promoting tree registration among smallholder tree farmers. This has led to more farmers registering their trees thus enabling them to legally harvest trees and transport their timber for sale. This awareness about and better understanding of tree registration policy that the project has managed to relay effectively to the policy implementers and tree farmers has had an even wider influence and has consequently helped other farmers outside the project site coverage to register and confidently harvest and transport their tree products for various purposes.

8.3.2 Social impacts

There exists a heightened awareness about the importance and advantage of tree registration among farmers and local officials in other communities, not only in Leyte but also in the province of Northern Samar where partner PENRO Ranulfo Arbiol disseminated project extension information and conducted advocacy activities among local officials at the provincial, municipal and barangay levels. Proof of interests among LGU officials is their requests for a training workshop on tree registration and tree inventory presented by the ACIAR Project staff.

The project has encouraged the support of DENR 8 officials and CENROs to consider tree registration as one of their major programs or supported activities. CENRO Baybay City included tree registration as one of the main highlights of its Environmental Caravan (campaign) in May 2008 which took place across the six covered municipalities it covered, comprising about 250 barangays. The project provided posters and copies of the Primer on Tree Registration booklet to CENRO Baybay for distribution during this campaign.

Considerable awareness and interest in project activities have been created, especially tree registration, even among the police and timber buyers and dealers. New tree farms have been established in the municipality of Hilongos in Leyte by 24 smallholder farmers. The registration of these farms has been facilitated by CENRO Baybay. Copies of the Primer booklets were issued to them by CENRO Baybay.

8.3.3 Environmental impacts

The fact that the tree farmer project action research activities have effectively created such interest among LGU officials, DENR staff and farmers, in particular, to promote tree farming and plantation establishment, is expected to decrease the occurrence of illegal logging in existing natural forests in Leyte and the nearby province of Samar.

8.4 Communication and dissemination activities

The project has actively sort to communicate with key stakeholders and to disseminate project results to the both stakeholders and policy makers. The project has produced a number of key extension materials, which have been designed and tested as part of the project activities. In particular we have produced a series of primers on tree registration, log transport and tree harvest approvals, in English, Waray and Cebuano. We have distributed large numbers of these extension materials to key stakeholders and government agencies (See Table 6). A year by year summary of key communication and dissemination activities is provided below. We have also conducted a large number of training activities with smallholders and communities. These are also summarised in Table 6.

Table 6. **Summary of Project Materials Distributed in Calendar Years 2006-2009**

Title of Material	**Number of copies of materials distributed to stakeholders**										
	Farmers	**Lumber Dealers**	**7Local Gov't Units**	**Academia/Research Organizations**				**10DENR**		**Total**	
				8LSU		**9Others**					
	Book	**Book**	**Book**	**Book**	**CD**	**Book**	**CD**	**Book**	**CD**	**Book**	**CD**
Redevelopment of Timer Industry Following Extensive Land Clearing (ASEM 2000/088) End-of-Project Workshop Proceedings				12	14	2	1	1	2	15	17
Improving Financial Returns to Smallholder Tree Farmers in the Philippines (ASEM 2003/053) Project Planning Workshop Proceedings						1	1			1	1
1. Smallholder Forestry Research Paper Series No. 1				12		13				25	
2. Smallholder Forestry Research Paper Series No. 2				8		13				21	
3. Socio and Economic Factors Affecting Small-scale Forestry				1						1	
4. Annals of Tropical Research Vol. 27				103		16		2		121	
5. Smallholder Forestry Info Kit No. 1	78		7	2		3				90	
6. Primer – English version	51	12	80	3		36		52		234	
6.Primer – Cebuano version	138	16	90	14		29		4		291	
6. Primer – Waray version	87	12	14	10		2		112		237	
Growing and Managing Trees	25									25	

1 Estimating Carbon Storage and Sequestration of Philippine Forestry Ecosystems – Rodel D. Lasco and Renezita F. Sales

2 The Role of Indigenous Peoples in Rehabilitating the Philippine Forests: A Review of the Implementation of Indigenous Peoples Rights Act – Arlyn C. Aquino

3 Thesis Manuscript of a PhD. Nick Emtage

4 Special Issue on Socio-Economic Research in Smallholder Forestry

5 Nursery Establishment and Practices for Smallholder Tree Farmers

6 Primer on Tree Registration, Harvesting, Transport and Marketing Policies in Private Lands

7 Office of the Municipal Mayor, Municipal Agricultural Office, Barangay Council through the Barangay Captain or his representative/s

8 CFNR, ISRDS, OP, ICRAF, Department of Economics, University Library, NARC, ODREX, DASS

9 PAFERN, IAF, ICRAF Visayas, ICRAF Philippines, UPLB College Library, CATP, ACIAR Australia (c/o Ken Menz), Germany (Prof. Holscher), Philippine National Library

10 Region 8 and CENRO

2008–2009

A comprehensive briefing document on Key Outputs for ACIAR Smallholder Forest Research in Leyte and Mindanao, was published for the Department of Environment and Natural Resources meeting held in Manila, 10 February 2009 (eds) John Herbohn, Steve Harrison, Nestor Gregorio, Jerry Vanclay, Carl Smith, Paul Dargusch.

Project staff were involved in a large number of communication and dissemination activities during 2007 and up to May 2008. During this period, a large number of publicatiosn on project activities were prepared, including the end of project workshop proceedings.

2007–June 2008

Improving the Triple Bottom line Returns from Small-scale Forestry, IUFRO 3.08 Conference, Ormoc City, Leyte, the Philippines, June 17−21 2007

Most significantly, staff were involved in hosting the 2007 conference of the IUFRO Small-scale Forestry group. This conference attracted about 90 delegates from some 20 countries. The conference provided an excellent opportunity to showcase the research being undertaken as part of the project and to obtain critical and constructive feedback from many highly respected international scientists. Project researchers and staff presented 21 papers, of which 15 involved at least one Australian and one Filipino author. Filipino collaborators presented 13 of the 21 papers. The conference was also a de facto end of project workshop which resulted in a large proportion of the research that has been undertaken being written up into formal conference papers.

8.4.1 Other activities

A large number of other activities were also undertaken, which are summarised below:

- School-on-air Radio Program on Tree Farming Policies.
- Presentation of project-related research outputs (eg. tree registration) in National Agroforestry Congress and National Forestry Education Conference; dissemination of Primer on tree registration extension booklet.
- Presentation of project-related research outputs in IUFRO conference
- Coordination and discussion meetings with LGU officials, DENR-CENRO staff and handing-over of project-related information materials (Primer) for their own consumption and dissemination.
- Presentation of project-related output (tree registration policy, tree farming) in the Training on Environmental Governance for barangay captains of Isabel, Leyte, participated by 24 barangay officials, 16 others from LGU Municipal Isabel, Private Industries, NGO, and media personalities.
- Presentation and dissemination of project extention booklets on tree registration, nursery and tree growing during VSU anniversary and farmers' field day.
- Dissemination of Primer booklet in all project covered municipalities and CENROs in Leyte and Southern Leyte.
- Provision of 50 booklets of Primer to PENRO Northern Samar which had been distributed in municipal LGUs.
- Presentation and provision of project extension materials (Primer, tree growing and management, nursery establishment booklet) during series of trainings in Claveria, Misamis Oriental through the ACIAR CATP Program, with about 80 recipient farmers.

2006

Conducting the School-on-the-Air (SOA) Radio Program on Tree Farming Policies with the participation of DENR personnel at the Regional and CENRO levels, municipal mayors, councillors and municipal agriculture officers in Isabel, Hindang and Bato, Leyte, and also a well-known private company (PASAR Corporation in Isabel municipality, Leyte). Arrangements have also been made with the station manager of a popular radio station DYSL Radio Bayan in Sogod, Southern Leyte (Ms Helen Bandala) for the airing of the project's School-on-the-Air Radio Program on Tree Farming Policies in areas not serviced by LSU's Radio Station DYAC. A number of planning and discussion meetings, and visits to the DENR Regional office and DYSL Sogod, Southern Leyte were made for the SOA program.

The Initial Policy Workshop and Action Research Workshop were held, attended by the Regional Executive Director of DENR 8, Regional Technical Director for Research, Regional Technical Director for Forestry, Provincial Environment and Natural Resources Officer (PENRO) Leyte, and Community Environment and Natural Resources Officers (CENROs) in Leyte, Southern Leyte and Biliran Provinces. Also present during the workshops were representatives from other government line agencies including the Department of Agriculture Region 8 and Department of Land Reform Region 8, and representatives from the Local Government Unit of Matalom, Leyte, and the Philippine National Police (PNP) in Southern Leyte. Each CENRO representative made a presentation of their tree registration policy implementation in their respective district coverage. A workshop was conducted on how the policy on tree registration can be improved, including its implementation. In the same way, the action research workshop paved the way for the development of extension material to improve the flow of information about tree farming policies for smallholder farmers and other stakeholders.

The second action-research workshop in Ormoc City was held and provided the opportunity to share ideas and discuss in more detail the project activities for improving information flow on tree registration policy. The event was attended by the Regional Director of DENR 8, together with his two Regional Technical Directors, CENR officers in Leyte and Southern Leyte, other DENR support staff, the officials and administrators of the Leyte State University and its faculty researchers, and the partner research scientists from Australia.

The development of the 'Primer on Tree Registration, Harvesting, Transport and Marketing in Private Lands' continued with a series of workshops and meetings with DENR Region 8 staff, key personalities at the CENR offices all over Leyte Island, the Director and technical staff from the Forest Management Bureau in Manila, Director of the Environmental Research and Development Bureau based at UP Los Banos, Laguna, and technical staff from various Local Government Units in Leyte. The final draft that was approved for piloting by a panel of experts and authorities at the DENR 8 office, composed of the RED, RTDs, PENR Officers and CENR officers covering Leyte and Southern Leyte. The Primer was produced in English and the Cebuano and Waray-waray local dialects. Initially, about 500 'best' copies were reproduced through a publishing firm, for which the World Agroforestry Centre (ICRAF) also contributed some financial assistance. ICRAF acknowledged the importance of the reproduction and dissemination of the Primer to ensure the appropriate implementation of the tree farming policy, in support of DENR and also to increase the smallholders' awareness and understanding of the policy. As part of the research activities of the project, the 500 best copies had been distributed in the projects' sampling municipalities and were consequently monitored and evaluated as to effectiveness in relaying information on tree farming policies.

During 2006 copies of the Primer were also distributed to several smallholder farmers and other stakeholders. Seventy-two copies of the English version were disseminated, 174 of the Cebuano version, and 94 of the Waray Waray version. Recipients of the Primer were farmers, lumber dealers, and Local Government Units at the municipal and barangay levels. The copies of the Primer were distributed to individual farmer-respondents and

other stakeholders during field survey and site visits, the farmers' field day of the LSU anniversary celebration, by ACIAR staff members at conferences and meetings outside LSU, and to visitors to the ACIAR Smallholder Forestry Project Office.

Discussion meetings took place with all CENR officers and technical staff involved in tree registration in Leyte and Southern Leyte provinces and Biliran Island as part of the study on Assessment of Tree Registration Rates in CENROs.

8.4.2 Training activities

The following postgraduate students were involved in project activities during 2006:

- Mr Nestor Gregorio. Enrolled in Doctor of Philosophy from 2002 and funded by a scholarship from the Australian Centre for International Agricultural Research, The University of Queensland. Community and small-holder forestry in the Philippines - the role of community-based nurseries and implications for policy development. Completed PhD in 2006 and returned to Philippines in August.
- Mr Jack Baynes. Enrolled in Doctor of Philosophy from 2004 and funded by The University of Queensland with supplemental support from ASEM/2003/052. Improving silviculture in smallholder tree farms in the Philippines through extension advice.
- Ms Eri Matsuura. Enrolled in Master of Philosophy from 2004 and funded by The University of Queensland with supplemental support from ASEM/2003/052. Impacts of smallholder tree farms on bird biodiversity at a landscape level in the Philippines.
- Ms Huong Nguyen. Enrolled in Doctor of Philosophy from 2005 and funded by The University of Queensland with supplementary support from ASEM/2003/052. Potential of native species in smallholder tree farms in the Philippines.
- Ms Sarah Forder, AYAD Scholar with supplemental support from ASEM/2003/052. Project looking at the ecosystem services provided by smallholder treefarms.
- Melissa Gordon AYAD Scholar with supplemental support from ASEM/2003/052.

Other training activities:

2006

During the year, the ACIAR project staff at LSU provided technical support to three field practice forestry students in the use of GPS in mapping during their respective case studies as a requirement for graduation. A mini-seminar on GPS which was attended by forestry students and faculty members was also conducted by the local staff.

Copies of the project publications were placed at the College of Forestry and Natural Resources Reading Room and LSU Main Library as reference material for both undergraduate and graduate students, e.g. the Special Issues of Annals of Tropical Research, Workshop Proceedings, Primer on Tree Registration, Harvesting, Transport and Marketing in Private Lands, ACIAR Smallholder Forestry Research Paper Series, and ACIAR Smallholder Forestry Info Kit.

2007–08

Farmers's Training on Tree Farm Establishment and Management, funded by Landcare Foundation attended by 40 farmers in Barangay Madaguing, Claveria, Misamis Oriental.

Farmers' Seminar-Training on Tree Registration Policy, funded by Landcare Foundation through the ACIAR-CATP Project attended by 45 farmers and LGU staff, Barangay Mat-I, Claveria, Misamis Oriental.

Training on Environmental Governance for the barangay captains of Isabel, Leyte held 23–25 July 2008 in Isabel, Leyte, funded by Tanggol kalikasan, PASAR Foundation, LIDE Management Corp, Isabel LGU, and VSU Institute of Environmental Governance, with

technical support from ACIAR Forestry Project. The major topics presented were Registration Policy and Tree Farm and Nursery.

9 Conclusions and recommendations

ACIAR Project ASEM/2003/052 – Improving Financial Returns to Smallholder Tree Farmers in the Philippines has been an extremely complex and many-faceted project. The project team has achieved not only the objectives set out in the original project document but has also undertaken additional research on issues that were identified in the implementation phases of the project. A highly competent research team has been developed through this and previous projects (as well as the ongoing seedling enhancement project). Various research activities are continuing, with alternative sources of funding. Because of the top-down decision-making structure of the DENR, further efforts are needed to communicate findings and recommendations of the tree farm research to senior DENR officers in Manila, and in particular those in the Forest Management Bureau.

9.1 Conclusions

ACIAR Project ASEM/2003/052 – Improving Financial Returns to Smallholder Tree Farmers in the Philippines has been an extremely complex and many-faceted project. The project team has achieved not only the objectives set out in the original project document but has also undertaken additional research on issues that were identified in the implementation phases of the project. A highly competent research team has been developed through this and previous projects (as well as the ongoing seedling enhancement project). Various research activities are continuing, with alternative sources of funding. Because of the top-down decision-making structure of the DENR, further efforts are needed to communicate findings and recommendations of the tree farm research to senior DENR officers in Manila, and in particular those in the Forest Management Bureau.

In the limited space, only some key items will be mentioned, under the three project objectives:

Objective 1

Tree registration and associated regulations create an impediment to tree farming. Increasing the role of local governments in implementation, together with steps to improve efficiency, and recognition of tree registration activities as a key responsibility of both the DENR and LGUs, are needed. Further efforts to promote this message to the Forest Management Bureau (FMB) in Manila are recommended.

Objective 2

Improved silviculture potentially will result in increased yield and timber quality of Leyte 'tree farms'. However, smallholders are loath to follow pruning and thinning practices which will maximize the net financial returns. The tree farm project has made substantial progress in identifying the yield and timber value sacrifice from following current practices. Further research (in process, with non-ACIAR funding) is needed to determine the timber production and income foregone from sub-optimal practices, and to determine for example when late thinning and pruning still generate positive payoffs. The DENR has shown strong interest in yield models developed in the timber inventory study, and guidebook on how to use these models is required (and partially developed). An improved understanding has been obtained of the timber supply chain and market requirements, and research into the financial aspects of timber selling by smallholders, improved silviculture, and efficient sawmilling techniques is continuing.

Objective 3

Beyond the basic constraints of availability of suitable land and water resources, agroforestry systems appear to be highly flexible and designed to meet the needs and resources of individual landholders. Evidence of outstanding performance of specific agroforestry systems elsewhere in the Philippines is similarly questionable, though alley cropping and rubber agroforestry appear successful. There is a need for field trials and predictive financial modelling of promising agroforestry systems in Leyte and elsewhere in the Philippines, including systems comprising a combination both production and conservation forestry.

9.2 Recommendations

PCARRD has identified two major focus areas for research in the forestry and environment sector, namely (a) environmental services and (b) wood fuels and biofuels (Aggangan and Baradas 2009). Reforestation of denuded catchments is a critical activity to provide for environmental services and much research is needed across a range of key areas including species selection, silviculture, planting designs and socio-economic and policy aspects. There is a growing recognition of the importance of the role that indigenous species have in providing environmental services. In particular there is a desire by smallholders and communities to grow mixtures of indigenous species, for a combination of financial and environmental benefits. Government agencies, particularly DENR, and aid agencies have also increasingly advocated the planting of indigenous species in mixtures as opposed to monocultures of exotic species. In part, the current lack of planting of indigenous species is due to a lack of planting material (i.e. seedlings). The lack of high quality planting material is currently being addressed in ACIAR project ASEM/2006/091. However, there is also a dearth of information about how to grow indigenous species and so even if planting material becomes available, there is unlikely to be successful establishment of large-scale plantings of indigenous species. Hence there is a desperate need for development of evidence-based guidelines for the growing of indigenous tree species. There is also little information about likely growth rates and how species will perform in mixtures. In addition, there is little information about the design of reforestation planting to achieve multiple benefits from watershed rehabilitation including ameliorating past inappropriate land clearing and biodiversity restoration, as well as providing economic and social benefits to communities including the alleviation of poverty particularly in upland areas, and the provision of woodfuels. The current project has provided some information but much more work is needed. Without this basic information, any attempt for large-scale reforestation for environmental services using indigenous and exotic species is likely to fail.

Most critically, current restoration projects are failing to adequately take into account the livelihood requirements of local communities, i.e. building into the project sustainable income streams that will allow communities to derive both financial and non-financial benefits from restoration plantings. Despite the rhetoric of government and aid agencies, there are few examples of successful reforestation projects that have become self-sustaining once financial support has been withdrawn. Most commonly, projects have been poorly designed from the perspective of recognising the importance of developing sustainable livelihoods for communities (rather than simply providing livelihood support for the duration of the project) as a core component of the projects. The result, once the project support is withdrawn, is almost invariably the collapse of local project enthusiasm and the collapse of people's organisations, as demonstrated in relation to community forestry in Leyte by Estoria (2004) and Estoria et al. (2004).

For ongoing environmental services to be provided from reforestation, the key messages and learnings from past experiences need to be captured and communicated to those designing and funding reforestation programs. A systems analysis is required to identify

the key drivers for success and failure of reforestation schemes and to then identify key changes to current practices and policy.

It is recommended that a new project be developed which is focused on forestry and environmental services, with particular emphasis on the socio-economic, policy and technical issues associated with using indigenous species in improved watershed restorations and in soil and water management in critical degraded catchments. It is recommended that any new project be predicated by a ‘pre-project’ systems analysis to identify the critical areas of research focus including the key policy leverage points. The primary focus of a new project should be on how to build sustainable livelihoods into reforestation activities that go beyond simply providing livelihood support for the duration of the tree planting stage.

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10.2 List of publications produced by project

10.2.1 Reports and Briefing documents

2005

Smallholder Forestry Research Paper Series No. 1

Smallholder Forestry Research Paper Series No. 2

Socio and Economic Factors Affecting Small-scale Forestry

Smallholder Forestry Info Kit No. 1

The Role of Indigenous Peoples in Rehabilitating the Philippine Forests: A Review of the Implementation of Indigenous Peoples Rights Act – Arlyn C. Aquino

Nursery Establishment and Practices for Smallholder Tree Farmers

SMALLHOLDER FORESTRY BULLETIN Vol 1 No. 1 August 2005

Primers:

Nursery Management for Smallholder Tree Farmers, Eduardo .O. Mangaoang and Edwin Cedamon

Growing and managing Trees on Your Farm, Jack Baynes

Primer on Tree Registration, Harvesting, Transport and Marketing Policies in Private Lands, (2005 Draft), Eduardo O. Mangaoang, Melissa J. Gordon, Edwin A. Balbarino, Rotacio S. Gravoso, John L. Herbohn, Steve R, Harrison, Edwin D. Cedamon

Poster Primer

Primer – English version

Primer – Cebuano version

Primer – Waray version

10.2.2 Training manuals

Financial and Economic Research Methods for Natural Resource Managers. Training Workshop held in Manila, 9–13 January 2007. Steve Harrison and John Herbohn (eds).

Financial and Economic Research Methods for Agricultural Resource Managers, Training Workshop, Manila, 24–29 September 2007, Steve Harrison and John Herbohn (eds).

10.2.3 Briefing Document

Key Outputs for ACIAR Smallholder Forest Research in Leyte and Mindanao, Briefing Document for the Department of Environment and Natural Resources meeting held in Manila, 10 February 2009. John Herbohn, Steve Harrison, Nestor Gregorio, Jerry Vanclay, Carl Smith, Paul Dargusch, Eduardo Mangaoang, Jun Mercado and Annerine Bosch (eds).

10.2.4 Journal Articles

2005

ANNALS OF TROPICAL RESEARCH 27(1)

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2006

Emtage, N., Suh, J., Cedamon, E., Harrison, S. and Herbohn, J. (2006), 'Promoting smallholder forestry as a poverty alleviation measure in the Philippines: a study focused on Leyte Province, Indian Development Review, 4(2): 385−405. (This same paper was published as a book section on a book edited by Clem Tisdell (ed.) (2007), Poverty, Poverty Alleviation and Social Disadvantage: Analysis, Case Studies and Policies. Serials Publications, New Delhi, pp. 904−905.)

Mangaoang, E.O., Russell. I., Gordon, M., Herbohn, J.L., Harrison, S.R. and Cedamon, E. (2006) Improving Information Flow on Tree Farming Policies for Smallholder Farmers in Leyte. Philippine Agroforestry Development MONITOR (2): 10 –11. ISSN 1908-4757.

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Baynes, J., (2007). Using FCD Mapper Software and Landsat images to assess forest canopy density in landscapes in Australia and the Philippines. Annals of Tropical Research 29(1): 9−20.

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Gordon, M. and Cedamon, E. (2007). Appropriate surveying methods in the Philippines: can modern GPS units help? Annals of Tropical Research 29(1): 33−38.

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Gravoso, R., Mangaoang, E., Gerona, A., Pasa A. and Harrison. S. (2009). Users' reactions to the Primer on Tree Registration Policies: lessons for designing extension materials and improving information flow. Small-scale Forestry (Published on line)

In preparation

Herbohn., J.L., Mangaoang, E., Gregorio, N. and Vanclay, J. Using bamboo scaffolding to access forest canopies: some lessons from their use in the Philippines

International Conference Papers

A. Improving the Triple Bottom Line Returns from Small-scale Forestry, (S. Harrison, A. Bosch and J. Herbohn, (eds). Proceedings of an international conference held in Ormoc, the Philippines, 18–21 June 2007

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