THE POTENTIAL ROLE OF NURSERIES IN IMPROVING ACCESS TO HIGH QUALITY PLANTING STOCK AND PROMOTING APPROPRIATE SILVICULTURAL SYSTEMS TO IMPROVE THE PRODUCTIVITY OF SMALLHOLDER TREE FARMS IN LEYTE, THE PHILIPPINES

Nestor O. Gregorio, John L. Herbohn and Steve R. Harrison

Constraints on availability of high-quality planting stock, improper matching of the species to the planting site and low level of silviculture hamper the success of smallholder tree plantings in Leyte. In spite of the available technologies in nursery and plantation management, smallholders still lack the necessary technical skills. This suggests that insufficient efforts are exerted by concerned agencies in extending the knowledge to the level of smallholders and it is indeed imperative to design means by which this pool of information can be disseminated. Inasmuch as most tree planting activities involve the establishment of nurseries, use of the nursery sector as a focal point of extension warrants investigation. Potential intervention measures including establishment of model smallholder nurseries to showcase the nursery cultural practices, creating a farmer-based seed distribution network to facilitate the distribution of germplasm and widen the species base, and accrediting the nurseries to improve sales, are suggested. These measures are designed to solve the previously identified problems ultimately promoting a wider adoption of smallholder forestry in the province and eventually in other regions of the country.

INTRODUCTION

Small-scale forestry (community-managed or individually-owned) has emerged as an important activity in the Philippines over the last decade (Harrison *et al*. 2001a, Aggangan, 2001). Private small-scale plantings for multiple objectives (e.g. for timber production, fuelwood, food, fodder, windbreaks, soil stabilisation and property demarcation) and with multiple designs (pure stand, mixed with agricultural crops, planted in blocks or scattered along homesteads, roadsides, streambanks and canals) are sporadically established and reflect the major paradigm shift of forest management by the forestry department (Mangaoang 2002). Dart *et al*. (2001) argued, however, that the majority of these smallholder plantings have limited success due to lack of integrated package of tree management practices. Harrison *et al*. (2001b) stated that the standard of silviculture in smallholder farm forestry in the Philippines is low. Planting materials are generally of low quality and species planted are not matched with the ecological conditions of the planting site (Lapis *et al*. 2001, Herbohn *et al*. 2001). Gregorio *et al*. (2004) revealed that nursery operators' lack of knowledge on appropriate nursery cultural practices and their limited access to sources of high-quality germplasm have led to the production of low-quality planting stock in most tree nurseries in Leyte. Moreover, lack of information on site and species combination and narrow species base have resulted in the planting of most species in unsuitable sites resulting in poor growth performance of planted trees.

Silviculture is the manipulation of forest growth through careful design and management (Reid and Stephen 2001). Essentially, it embraces a wide assortment of treatments to include not only those management systems conducted when the seedlings are already planted but also those practices that are carried out while the seedlings are raised in the nursery. Substantial information regarding silviculture has long been available. Textbooks discussing the principles in nursery and plantation management and various publications including symposia proceedings, journals and technology transfer brochures reporting the results of nursery and silviculture-related research activities and experiences are widely published. Nonetheless, smallholders in the Philippines rarely have access to forestry offices or academic and research institution libraries where these references are kept. Further, insufficient effort has been made by relevant agencies to extend the available information to reach the level of smallholders. Consequently, there is a need to look for ways to convey the information to the smallholders and one of the potential means is by using the forest nursery as the focal point of extension.

Seedling production is an integral part in most tree growing programs. Nurseries are established in order to produce seedlings, and are often a major part of most community forestry projects (Shanks and Carter 1994). Extending silvicultural advice from the nursery level is important for three reasons: (1) Qualities of seedlings as they are raised in the nursery largely influence their subsequent growth. Hence, it is necessary that silvicultural interventions be provided as early as possible while the seedlings are in the nursery. (2) Smallholders frequently visit nurseries prior to any tree planting activity to obtain planting materials. In fact, most nurseries and particularly those established by community organisations serve as multipurpose centres in which community organisation members convene or training by extension agents is conducted. Nurseries therefore could be used in extending silvicultural advice to a wider population before tree planting activity commences. (3) A nursery could showcase silvicutural technologies that smallholders could later adopt and apply in their respective seedling production and tree management ventures.

Key Findings of the Survey on the Nursery Sector in Leyte Province

A survey was conducted in the nursery sector of Leyte province to investigate the causes of earlier-identified constraints of limited planting stock, use of low-quality planting materials and site-species incompatibility common in smallholder tree planting efforts. A total of 74 nursery operators from 24 municipalities were identified and interviewed. Of the total number of respondents, 37 were individual operators, 22 operated communal nurseries and 15 were in charge of nurseries established by government agencies, particularly the Department Environment and Natural Resources (DENR), Department of Agriculture (DA), the Philippine National Oil Company (PNOC) and Leyte State University (LSU). This section presents the salient findings of the survey, which provides benchmark information for designing potential alternative measures to solve the impediments to availability of planting stock and proper matching of the species to the planting site.

Species selection and preference

The availability of germplasm is the bottleneck in species selection. Although the growth performance and timber quality of the species are major considerations, germplasm availability is the key-determining factor why a particular species is raised in the nursery (Table 1). The table also shows that, aside from germplasm availability, individual operators place great emphasis on the end use of the species in deciding which species to raise. This indicates that farmers have preferences and select the species of trees that they want to raise such that, if given a wider option of available germplasm, it is likely that they will choose those species that fit with their interest and planting objectives. Being project initiated, species selection in communal nurseries is largely influenced by the recommendations, demand and the species supplied by supporting agencies. Least

emphasis was given to salability of timber of the species which suggests that farmers do not have a primary focus on selling the timbers from planted trees or, if they are planning to sell the timbers, they lack information on the market potential of the available species.

Table 1. Basis on deciding the species to raise

Basis for choice	Number of times mentioned			Total
	Individual	Communal	Government	
Availability of germplasm	27	11	14	52
Demand of planting stocks	13	8	9	30
End use of the tree	19	2	4	25
Growth quality of the species	14	5	5	24
Suitability to the planting site	7		2	9
Identified by the supporting agency		7	1	8
Salability of timber		1		1

Few of the nurseries have raised fruit trees, the majority of planting stocks raised being timber species. Although nursery operators are interested in fruit trees, the absence of germplasm and lack of knowledge on vegetative propagation techniques prevents them from raising the planting stock. The germplasm used in producing seedlings of fruit trees generally comes from consumed fruits that are sold in the market and from surrounding trees. Only one operator has taken germplasm of fruit trees from a certified source.

The three exotic species of *Swietenia macrophylla, Gmelina arborea* and *Acacia mangium* are the most commonly raised species in all nurseries groups (Table 2). These species were first introduced during the nationwide government-initiated reforestation projects, and are now commonly found planted on tree farms, along roads, in school grounds and municipal parks, and around homesteads, giving the operators easy access in germplasm collection. This shows that tree farmers will likely domesticate and multiply the germplasm of a particular species once it is introduced in the area, especially if the government promotes the species. Indigenous species including *Pterocarpus indicus, Shorea contorta* and *Vitex parviflora* are also commonly raised because of their premium wood quality and the high demand for planting stock.

Table 2. Most commonly raised species by nursery type

Scientific name[1]	Common name	Family name	Fraction of nurseries growing the species (%)		
			Individual	Communal	Government
Swietenia macrophylla)	Mahogany	Meliaceae	67.6	72.3	100.0
Acacia mangium	Mangium	Leguminosae	37.8	50.0	87.8
Gmelina arborea	Gmelina	Verbenaceae	78.4	31.8	86.7
Pterocarpus indicus	Narra	Leguminosae	24.3	45.6	73.3
Shorea contorta	White lauan	Dipterocarpaceae	8.1	40.9	20.0
Eucalyptus deglupta	Bagras	Myrtaceae	13.5	18.2	20.0
Vitex parviflora	Molave	Verbenaceae	10.8	22.7	13.3

However, these species were also identified as among the species desired by the operators (Table 3). The term ‘desired’ refers to species preferred by the operators but not raised because of various constraints, particularly the unavailability of germplasm and lack of

1 Sourced from Rojo, A. (1999)

technical knowledge on propagation. Most of the desired species are indigenous, an indication that many nursery operators are interested in raising native species but that the production of planting stock is hampered primarily by constraints on sources and availability of germplasm. Among the desired species, bagras ranks first followed by white lauan. Although mahogany has been widely grown, the difficulty in germinating seeds of this species and short seed viability constrained several nursery operators.

Table 3. Species most desired by the small-scale nursery operators and main reasons for not raising

Species	Reason for not raising
Bagras (*Eucalyptus deglupta)*	Unavailability of germplasm, difficulty in germinating seeds, high cost of seeds
White Lauan (*Shorea contorta*)	Unavailability of germplasm, lack of information on how to raise
Mahogany (*Swietenia macrophylla)*	Unavailability of germplasm, difficulty in germinating seeds, short viability of seeds
Molave (*Vitex parviflora*)	Unavailability of germplasm, difficulty in germinating seeds, takes a long time to germinate
Narra (*Pterocarpus indicus*)	Unavailability of germplasm
Bagalunga (*Melia dubia*)	Unavailability of germplasm, difficulty in germinating seeds
Fruit trees	Unavailability of planting materials, high cost of planting materials, lack of knowledge on vegetative propagation

When asked about their attitudes towards various reforestation species, the smallholders placed the highest preference on mahogany followed by dipterocarps and narra (Table 4). The high preference on mahogany is attributed to its fast growth and high wood quality. Dipterocarp species and narra are favoured because of their superior wood quality for structural and furniture purposes, respectively. Gmelina is not highly preferred but is commonly raised because of abundant seeds and wildlings. In fact, several farmers have developed apathy to this species because of the notions that it can rapidly deplete soil fertility, is toxic to livestock, and decreases water yield subsequently drying up rivers and streams. Eucalypts were identified as the most wanted species as shown in Table 3, but surprisingly in Table 4 they appear to be not highly preferred. Many farmers are interested in raising eucalypts but because of difficulty in seedling production, high cost of seeds and limited source of germplasm, they do not place high preference on this species. Less preference in this case does not mean that the smallholders do not want to plant eucalypts. They are very keen but because of low possibility of obtaining the planting stock due to the above-indicated constraints, they rated the species as less preferred. Teak has superior wood quality, but most of the farmers are unfamiliar with this species therefore ranking it as least preferred among the identified species.

The survey findings suggest that a farmer's preference for tree species is primarily based on two characteristics – wood quality and growth rate. These properties must go together in a species to make it attractive to smallholders. Mahogany is a highly preferred species because it possesses both characteristics. However, falcata, though fast growing is not favoured because of its inferior wood quality as structural material. Emtage (2004) found that farmers in Leyte are planting trees primarily for on-farm use of timber for construction, thus species selection is mostly attuned to this objective.

Table 4. Attitudes of the smallholder nursery operators towards various reforestation species promoted by the government

Species	Species preference (1-least prefer; 2-slightly prefer; 3-quite prefer; 4-moderately prefer; 5-highly prefer)			
	Individually owned nurseries		Communal nurseries	
	Mean	Mode	Mean	Mode
Mahogany	4.24	5	4.32	5
Dipterocarps	3.54	5	3.91	5
Narra	3.59	5	3.64	5
Mangium	3.57	5	2.77	1
Gmelina	3.08	3	2.22	1
Eucalyptus	3.11	1	2.00	1
Falcata	1.97	1	1.59	1
Teak	1.27	1	1.00	1

Germplasm type and collection method

The operators mainly use two types of germplasm: seeds and wildlings. While the majority of them prefer seeds, wildlings are commonly used because they are more available and easier to collect compared to seeds. Many timber species are fine-seeded making seed collection from the ground difficult. There is a lack of information on the phenology of various trees, particularly on indigenous species. As a result, operators are usually unable to judge the optimal time to collect seeds while these are still attached to the mother trees or when these have not fallen, germinated and anchored on the ground. A further reason for growing wildlings, especially for those who are selling seedlings, is the cost-effectiveness advantage due to a shorter management period in the nursery. While the use of wildlings offers these advantages, experience of the operators revealed that the use of this type of germplasm usually results to high mortality of potted seedlings and production of planting stock with deformed root systems.

It was noted that collection of germplasm does not follow the standard procedure to ensure high quality. Operators ignored the quality of mother trees during the collection process. About 64.5% and 69.2% of individual and communal nursery operators respectively, did not consider the appearance of mother trees. Although nearly all (88.6%) of the operators know the benefit of collecting germplasm from phenotypically superior trees, most of them do not take serious concern on this aspect. It was pointed out that the scarcity of mother trees and limited availability of germplasm compel them to merely collect whatever is available. This could be true particularly for native species in which the supply of germplasm is often limited.

However, even if there is abundant supply of germplasm as in the case of most exotics, still the physical trait of the mother tree is not paid much attention. This is a crucial aspect in tree farming considering that the physical, physiological and genetic qualities of mother trees have direct impact on subsequent growth of planted seedlings. Mulawarman *et al.* (2003) stated that germplasm that is taken from healthy, mature and straight-stemmed trees would likely exhibit superior growth compared to that taken from defective trees. It is further known that the nursery operators mostly collected germplasm from few trees and the distance between the mother trees is not considered. This practice is likely to result in collection of seedlots with narrow genetic base. Dawson and Were (1997) pointed out that seeds should be collected from a minimum of 30 trees that are at least 50 m apart to ensure broad genetic base. Koffa and Rosethco (1997) argued that it is important for smallholders to collect

germplasm from a broad genetic base to prevent possible genetic erosion of the population of trees on the farm that will serve as future sources of germplasm.

Sources of germplasm

The quality of germplasm is largely associated with the selection of germplasm sources. Seed orchard and seed production areas offer the highest quality, but unfortunately smallholders do not have access to these. For most forest tree seedling production, germplasm is collected from unselected sources such as from planted or naturally growing trees on the farm, trees along the road, those on the school grounds, private or government tree plantations and sometimes the natural forest. These trees were not established for seed production purposes and cannot be guaranteed to produce germplasm with high physical, physiological and genetic quality. In a few cases, operators were able to receive certified seeds from supporting agencies basically as part of a research project. Some operators have also obtained germplasm from friends, neighbours, relatives, other nurseries and local seed dealers.

Technical skills in planting stock production

In general, the operators possess the basic skills needed to raise the seedlings. Most of the individual operators have learned these skills through trial and error while the majority of the group operators have gained the knowledge from attending formal training sessions. Nevertheless, it is apparent that the experience of the operators is limited and there is still a dearth of knowledge on proper seedling production techniques. It was observed that planting stock produced in the nurseries is not of high quality. Three sample seedlings for each species that were available during the nursery visit were taken for destructive sampling to assess the seedling quality using three parameters – root-shoot ratio, sturdiness quotient and root morphology – as defined by Jaenicke (1999). Among the 20 species taken for destructive sampling from all nurseries, only two had desirable sturdiness quotient values of less than six. This indicates that most of the seedlings raised were basically lanky, etiolated or not robust. With regards to root-shoot ratio, all of the seedlings tested had values of less than one, which means that shoot biomass is too high compared to root biomass[2]. These findings indicate that the seedlings raised both in small-scale and government nurseries are of sub-optimal quality and unlikely to withstand the adverse ecological conditions in most planting sites.

The seedling sales and demand situation

The nursery survey revealed that about 54% of the individual nurseries sell seedlings while only 13.6% of the communal nurseries accept seedling orders. This implies that individual nurseries are more commercial in nature, hence their operation is largely determined by the demand situation for planting stock. No clear information on seedling sales was obtained because the majority of the operators do not maintain records of their sales. Nevertheless, it was emphasised that low sales have caused most of the commercial nurseries to cease their operation. Low sales could be attributed to two factors, namely the incorrect choice of the species and the lack of public information about what seedlings they can supply or lack of advertising. Notably, most of the nursery operators, especially in the individual nurseries, choose species for which to raise seedlings not only because the species is in demand but also due to the direct availability of germplasm. In fact, there is little if any demand by landholders for some of the seedling species being grown. In addition, there is a lack of advertising about the existence of the nurseries and the types of species raised. The DENR holds no record of the nursery operators, thus the existence of most nurseries and the species that they can offer is unknown to many buyers.

[2] Jaenicke (1999) argued that a physically high quality seedling should have a root-shoot ratio between one and two and sturdiness quotient value of less than six

Knowledge and awareness on site-species matching information

Most small-scale nursery operators have no knowledge of site-species matching. About 77.3% of communal nursery managers admitted that they lack information on proper site and species combinations. Conversely, 62.2% of individual nursery operators claimed that they have some information on this aspect, although their knowledge is largely based on observations of the growth performance of planted and naturally growing trees. Few of them have attended formal training or received formal advice about this subject. Contrary to expectations, several managers of government nurseries were also found to be uninformed about appropriate site and species matching. Even managers in DENR nurseries who are mostly foresters admitted their lack of knowledge on this subject. The level of site-species matching knowledge was even lower in other government nurseries including those managed by the DA. Most of the managers in these nurseries are agriculturists, and therefore have limited knowledge about forest trees.

Suggested Potential Alternative Measures

The survey has revealed that constraints on low quality planting stock, unavailability of planting materials of a wide variety of species and improper matching of the species to planting sites are largely created by technical and extension factors interacting with the socio-economic status of the smallholders. Nursery operators lack the necessary technical skills in nursery management and proper site-species combination. Difficulties in germinating seeds and management of seedlings of various species constrained most nursery operators. Concerned agencies have the technologies but less effort is exerted to bring the information to the level of smallholders. Selection of species to propagate is primarily based on the availability of germplasm, which is usually collected from unselected sources. The importance of using high-quality germplasm is commonly appreciated, but nursery operators pay less consideration to this aspect. Low sales hamper the sustainability of nursery operation and high-cost of germplasm prevents the smallholders from raising their preferred species. The nurseries are not accredited by concerned agencies so that interested buyers mostly do not have information regarding their existence.

A number of intervention schemes could potentially be used to solve the previously identified problems, improving the quality of planting stock available to the smallholders, widening the option of smallholders on what species to raise, and promoting better selection of species to match the ecological conditions of the planting site.

Setting up smallholder-based model nurseries

In conjunction with the research that is being undertaken by the primary author, model nurseries managed by people's organisations will be established at four communities in Leyte. The communities will be selected purposively to approximately represent the entire province. Preferably, these organisations should have an existing nursery in order to avoid the cost of nursery construction. Further, they should be actively involved in tree planting and have established close linkage with ACIAR Smallholder Forestry project or any LSU-based projects such as those of World Agroforestry Center. This is important in order to save time and resources in establishing rapport with local people. Seedlings will be raised in these nurseries. Species will be selected based on the demand of the smallholders and appropriateness to the ecological conditions of the area. Farmers will be taught about low-cost but sound nursery cultural practices. The model nurseries will not raise vast quantities of seedlings; rather, they are to be used to demonstrate the techniques required to ensure the production of high-quality planting stock particularly germplasm collection and propagation. This should also disseminate information about the set of species that are suitable in the area, produce difficult-to-grow species and demonstrate vegetative

propagation of desired fruit trees. The seedlings raised could be used for establishing a demonstration plot adjacent to the nursery showing the most suitable way of planting trees either as a single crop or mixed with agricultural crops. Once trees have been established and are growing, silvicultural practices including thinning, pruning, fertiliser application, and control of pests and diseases, are to be demonstrated. The fruit trees planted could also be used as a future source of planting materials for vegetative propagation.

Apart from the hands-on involvement of smallholders in seedling production and nursery management, the nurseries will distribute manuals regarding nursery cultural practices and site-species matching for quick and permanent reference of the smallholders. The extension materials are to be written in the local vernacular so that they are easy for the smallholders to understand.

Creating a seed distribution centre in partnership with the smallholders

The survey of the nursery sector of Leyte revealed that smallholders have limited information on germplasm sources and that there is no free flow of propagation stock. Germplasm for some species was found abundant in one location but scarce in other areas. In view of this, a farmer-based seed collection and distribution system will be established. Farmers from selected communities will collect seeds of identified species. It is envisaged that farmers would be equipped with the necessary information and skills in proper germplasm collection through their hands-on participation in running the model nurseries. The ACIAR Smallholder Forestry Project will purchase the seeds from the farmers. These will be processed, packed together with propagation instructions and distributed to farmers for their own seedling production. The project will also procure seeds of highly demanded but expensive species from certified sources to link the smallholders with the pathway where high-quality germplasm operates. The packed seeds will also reflect information printed on the packet about the appropriate planting sites for such species. This will determine whether farmers will be able to produce seedlings given the propagation instructions and whether they will plant the seedlings in accordance with their site requirements. In addition, this will establish whether the farmers will choose the species suited to their farms if they are given a wider option of available species. The species of germplasm taken by the smallholders will be recorded and visits will be done to planting sites to assess whether the smallholder has chosen and planted the species suited for the area as indicated on the seed packs.

To improve the access of smallholders on germplasm, the seed distribution centre will develop a database of germplasm sources. The location of mother trees, seed stands and seed production areas of various species will be important inputs of the database. Further, the database will indicate the time when the seeds or wildlings will be available and ready for collection. Extension materials such as brochures or flyers pertaining to the information stored in the database will be developed and disseminated to the farmers.

Accreditation of the nurseries to improve market access

The existence of most nurseries is unknown to many landholders. Most landholders are unaware of even the nurseries located closest to them. Concerned agencies including the forestry department, do not hold a list of the nursery operators and the species that they produce. This could be one of the causes for low sales experienced in most nurseries that prompted a considerable number of them to cease their operation. Informing the buyers about the presence of the nurseries might improve the current sales situation and ultimately promote the sustainability of nursery operation.

The seed distribution centre will assist in advertising the nurseries (e.g. through radio or through direct contact with prospective buyers). It will accredit the operating nurseries in the province and will construct a database storing information such as the location of nurseries,

name of operators, species currently raised or that could be raised and corresponding seedling prices. Printed materials concerning the information in the database will be disseminated directly to prospective buyers.

CONCLUDING COMMENTS

The nursery sector has great potential for providing extension services to landholders, particularly in providing access to high quality planting stock of a wide variety of species and information on proper site and species combination. Nursery establishment is feasible for smallholders and planting materials used in smallholder forestry systems are largely sourced from smallholder nurseries. However, with limited inputs both on financial and technical aspects, a package of support systems, as discussed above, is needed for the sustainability of these nurseries and to harness their potential for promoting the success of smallholder forestry in Leyte Province. With improved technical skills, nursery operators will eventually become valuable extension agents for disseminating knowledge on effective nursery management and matching of the species to the planting site. Further, improving access to high-quality germplasm and income derived from seedling production will help sustain the operation of smallholder nurseries, and continuously provide support services to a wider small-scale tree farmer community. This support includes the provision of seedling production and tree planting advice, and a timely and sufficient quantity of high quality planting stock of various species.

REFERENCES

Aggangan, R.T. (2001), 'Tree farming in the Philippines: Some issues and recommendations', in *Socio-economic Evaluation of the Potential for Australian Tree Species in the Philippines*, S.R. Harrison and J.L. Herbohn (eds), ACIAR Monograph 75, ACIAR, Canberra, pp. 33-43.

Dart, P., Brown, S., Simpson, J., Harrison, S.R. and Venn, T. (2001), 'Experience from ACIAR trials of the sustainability and performance on Australian tree species', in *Socio-economic Evaluation of the Potential for Australian Tree Species in the Philippines*, S.R. Harrison and J.L. Herbohn (eds), ACIAR Monograph 75, ACIAR, Canberra, pp. 7-19.

Dawson, I. and Were, J. (1997), 'Collecting germplasm for trees – some guidelines', *Agroforestry Today*, 9(2): 6-9.

Emtage, N.F. (2004), An Investigation on the Social and Economic Factors Affecting the Development of Small-scale Forestry in Leyte Province, the Philippines, PhD thesis submitted to the School of Natural and Rural Systems Management, The University of Queensland, Brisbane.

Gregorio N., Herbohn, J.L. and Harrison, S.R. (2004), 'Small-scale forestry development in Leyte, the Philippines: The central role of nurseries', *Small-scale Forest Economics, Management and Policy*, 3(3): 411-429.

Herbohn, J.L., Harrison, S.R. and Nixon, B.J. (2001), 'Social and economic factors affecting the use of Australian species in community based forest management in the Philippines uplands', in *Socio-economic Evaluation of the Potential for Australian Tree Species in the Philippines*, S.R. Harrison and J.L. Herbohn (eds), ACIAR Monograph 75, ACIAR, Canberra, pp. 125-132.

Harrison, S.R and Herbohn, J.L. (2001a), 'Forestry systems, policy and regulation in the Philippines', in *Socio-economic Evaluation of the Potential for Australian Tree Species in the Philippines*, S.R. Harrison and J.L. Herbohn (eds), ACIAR Monograph 75, ACIAR, Canberra, pp. 45-53.

Harrison, S.R. and Herbohn, J.L. (2001b), 'Socio-economic aspects of adoption of Australian tree species in the Philippines', in *Socio-economic Evaluation of the Potential for Australian Tree Species in the Philippines*, S.R. Harrison and J.L. Herbohn, (eds), ACIAR Monograph 75, ACIAR, Canberra, pp. 1-6.

Jaenicke, H. (1999), *Good tree nursery practices: practical guidelines for research nurseries*, ICRAF, Nairobi, pp. 8-15.

Koffa, S. and Rosethco, J. (1997), 'Farmer-managed germplasm production-diffusion pathways in Lantapan, Philippines', in J.M. Rosethco and D.O. Evans (eds), *Domestication of Agroforestry Trees in Southeast Asia,* Proceedings of a regional workshop, 4-7 November, Yogyakarta, Indonesia. *Forest, Farm and Community Tree Research Reports* (Special Issue), Taiwan Forestry research Institute and Council of Agriculture, Taiwan, Republic of China; Winrock International, Morrilton, Arkansas, USA and ICRAF, Nairobi, Kenya, pp. 142-150.

Lapis, A., Posadas, J. and Pablo, N. (2001), *Seedlings/Planting Materials: A Nationwide Supply and Demand Scenario*, Canopy International, March – April, Los Banos, pp. 3, 10-11.

Mangaoang, E.O. (2002), 'A forester's perspective of the socio-economic information requirements for forestry in Leyte', in *Socio-economic Research Methods in Forestry: A Training Manual,* S.R. Harrison, J.L. Herbohn, E. Mangaoang and J.K. Vanclay (eds), Cooperative Research Centre for Tropical Rainforest Ecology and Management, Rainforest CRC, Cairns, pp. 1-14.

Mulawarman, Rosethco, J.M., Sasongko, S.M. and D. Irianto (2003), *Tree Seed Management - Seed Sources, Seed Collection and Seed Handling: A Field Manual for Field Workers and Farmers*, International Centre for Research in Agroforestry (ICRAF) and Winrock International, Bogor, Indonesia.

Ried, R. and Stephen, P. 2001, *The Farmer's Forest – Multipurpose Forestry for Australian Farmers*, RIRCD Publication No.R01/33, Melbourne, Australia.

Rojo, J. (1999), *Revised Lexicon of Philippine Trees*, Forest Products Research and Development Institute, Department of Science and Technology, Laguna.

Shanks, E. and Carter, J. (1994), 'The organisation of small-scale nurseries', *Rural Development Forestry Study Guide 1*, Rural Development Forestry Network Overseas Development Institute, Stag Place, London, 144 pp.