

Seedling Production Systems for Smallholder Forestry Development: Local Practices versus National Policies in the Philippines

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The tree seedling nursery sector in the Philippines is influenced by a number of national level policies affecting the number and type of species produced. Policies favour high-volume production of a limited range of mostly exotic species, and research indicates that seedlings are often of low physical and genetic quality. Local knowledge on best species for sites is not being communicated to people planting. A project funded by the Australian Centre for International Agricultural Research is investigating measures to improve the performance and effectiveness of the forestry seedling production system in Leyte and Mindanao in the Philippines. Seedlings are produced by government agencies, in community forestry projects and by individual private operators; the main customers are smallholder tree farmers. Communities and private individuals quickly set up nurseries when there is a demand for seedlings, but these nurseries tend to be ephemeral and lack financial sustainability. While large nurseries offer opportunities for economies of scale, small nurseries operate on a low cost basis, and are more widely distributed, and their seedlings are more accessible to smallholders, who lack transport facilities. Small private nurseries, while having limited access to new technology, often produce seedlings of quality similar to government and community nurseries. However, they require assistance in access to high-quality germplasm and training in improved seed production technology, to play a greater role in expansion of plantation forestry. This paper reports survey findings on seedling production systems, and examines the link between national level policies and local level practices.

INTRODUCTION

As in other islands of the Philippines, a high rate of logging of natural forests and export of surplus timber has given way to a timber shortage on Leyte Island, met by imports and plantation development. As noted by Gregorio *et al.* (2004) from a survey of the Leyte seedling nurseries in 2003, nurseries play a critical role in the timber industry, and have a strong influence on what species are grown. Seedlings of forest tree species are produced in by government, community and private nurseries. Government nurseries – notably those of the Department of Environment and Natural Resources (DENR), Department of Agriculture (DA) and local government units (LGUs) – produce substantial numbers of tree seedlings, mostly for free distribution to smallholders, while community groups and private smallholders and households also produce seedlings for their own use and for sale (Gregorio 2006).

Community forestry has become a widely accepted practice internationally, frequently supported by domestic and international NGOs. The Philippines have had a succession of programs to encourage communities to develop projects, now mostly existing under the umbrella Community-based Forest Management (CBFM) program, e.g. see Harrison *et al.* (2004). These programs typically involve a community seedling nursery component. A study by Estoria *et al.* (2004) found that these nurseries tend to have a short life.

Government policies favour high-volume production of a limited range of mostly exotic species, and research indicates that seedlings are often of low physical and generic quality (Gregorio *et al.* 2005a,b). While industrial forestry is found in some areas in the Philippines,

in general smallholder forestry is favoured as a more socially acceptable land-use option (Harrison and Herbohn 2003).

Patindol (1998, p. 41) noted in relation to local knowledge in Philippines forestry that

conservation efforts of any resource can only be successful with the participation of the users of that particular resource. Knowledge about native species from local people serves as an essential element of this approach. This supports today's strong recognition that local knowledge systems are a vital tool towards attaining sustainable management of our remaining biological diversity.

Bernaldez and Mangaoang (in process) noted that in the Leyte uplands some farmers treat seeds in preparation for planting, using methods which differ from those recommended by extension agencies, but which are nevertheless highly effective.

Based on the findings of Gregorio (2006), a four-year research project supported by the Australian Centre for International Agricultural Research (ACIAR) – project ASEM/2006/091, *Enhancing tree seedling supply via economic and policy changes in the Philippines nursery sector* – was initiated in 2007. This 'Seedling Enhancement Project' is examining measures to improve seedling production in Regions 8 (Leyte and Southern Leyte provinces on Leyte Island) and Region 10 (Bukidnon and four other provinces in Northern Mindanao). The specific research objectives are to: examine the respective roles and effectiveness of the private and public sector in the tree nursery sector; develop a policy assessment model and identify policy intervention points at both the national and at the local level; and implement local level policy changes in conjunction with DENR and pilot test strategies to increase the economic viability of the nursery sector. This paper reports initial findings of the project, in particular with respect to community forestry.

RESEARCH METHOD

The main data source for this study arises from a survey of seedling nursery operators on Leyte Island. Visits were also made by project researchers to forestry agencies and nursery sites in Indonesia, Thailand and Vietnam, to study seedling policies and production systems in those countries. As well, a number of research papers on seedling production systems in developing countries were invited, as a special issue of the journal *Small-scale Forestry*.

The Leyte Nursery Survey

Nursery operators were identified from the list compiled in 2003, as reported by Gregorio (2006), and a list compiled by the DENR for the Green Philippines or Trees for Life program which commenced in 2005. Neither list is complete, in that new nurseries set up, and nurseries cease operation, at frequent intervals. A 100% sample of identified nurseries (census rather than random sample) was employed.

Three variations of a questionnaire were developed for the Leyte survey – for government, community and private nurseries. Modifications of these questionnaires are being developed for Region 10. The questions were designed to be compatible as far as possible with the 2003 survey. Areas covered included: demographic profile, nursery history and business arrangements, operator training, species produced, nursery infrastructure and capital outlays, seedling culture and cost structure, seedling marketing and prices, perceptions on the seedling production industry opportunities and obstacles, local knowledge on seedling production practices, and seedling quality (through destructive testing).

Teams of three interviewers were trained for each of the three operator groups. A pilot survey was conducted, and minor wording changes made. The survey was conducted over January to March 2008. The survey data are being entered into a MicroSoft Access relational database, and preliminary summary tables have been extracted.

Other Research Activities

A trip to examine seedling production systems in Indonesia was made by three project members in December 2007, and two members visited Thailand and Vietnam in February 2008, each country trip being of about one week duration. Thirteen research papers on seedling production systems in the Philippines, Indonesia, Thailand, Vietnam, Nigeria and Bangladesh were prepared for *Small-scale Forestry*.

SELECTED RESEARCH FINDINGS ON COMMUNITY NURSERIES

The seedling nursery survey included interviews with managers of all 30 community nurseries which could be identified on Leyte Island. Some of the findings for this nursery group are summarized in Tables 1 and 2. Data entry is at an early stage for government and private nurseries; previous research suggests that the latter adopt similar practices to community nurseries.

Table 1. Selected statistics from Leyte community seedling nurseries

Characteristic	Response summary
Years since establishment	1 to 5 – 5; 6 to 10 – 8; 11 to 15 – 13; > 15 – 4
Purpose of establishment ^a	Sale of seedlings 5; communal use 6; free distribution to members 21
Reason for species choice	Dictated by funding agency 22; these were the species available 8
Species grown	Acacia, gmelina and mahogany included 9, two of these species included 6; mahogany 18; narra 11; red or white lauan; fruit species 7; molave 6
Duration of training	1 day 12; 2 days 2; 3 days 10; more than 3 days
Training agency ^a	DENR 13, GTZ ^b 6, PNOC 4
Seedling production capacity	Up to 2000 6; 3000 to 10,000 13; 11,000 to 20,000 4; > 20,000 7
Number of batches of seedlings produced per year	0 – 11; 1 – 8; 2 – 5; > 2 – 6
Currently sell seedlings	Yes 10, no 20
Seedling customers ^a	DENR 4; LGUs 3; PNOC 3; others (NGOs, ‘road passers’, universities) each < 3

a. Multiple responses possible.

b. GTZ is the Deutsche Gesellschaft Fur Technische Zusammenarbeit (German Agency for Technical Cooperation).

Seventeen of the 30 nurseries were established more than 10 years ago, and only five in the last five years. This indicates both that some of the nurseries have successfully continued operation, and that there has been little recent activity in community forestry projects in the last few years. Only a third of the nurseries had operated continuously, six of which are more

than 10 years old. Nineteen of the nurseries which had not operated continuously reported the reason was the end of a project or the lack of contracts from seedling buyers.

Only five of the nurseries reported raising seedlings for sale as a purpose of setting up (four of which had operated continuously), more than two-thirds producing seeds for free distribution to members. For most nurseries (73%), the species choice was dictated by the funding agency. Concerning choice of species, 18 included mahogany (*Swietenia mahogani* and *macrophylla*) in their list, and 13 included at least two of the three popular exotic species of mahogany, gmelina (*Gmelina arborea*) and mangium (*Acacia mangium*).

All respondents reported having undertaken some training relevant to nursery operation, though for 80% this training was of a duration of three days or less. The Department of Environment and Natural Resources (DENR), the German Agency for Technical Cooperation (GTZ) and the Philippines National Oil Corporation (PNOC, which manages watersheds for hydropower) were all active in training nursery operators, other contributors being universities and the World Agroforestry Centre (ICRAF). There was little NGO involvement in training activities.

Nearly two-thirds of the nurseries could produce no more than 10,000 seedlings at one time, and hence were unable to take advantage of economies of large-scale production. Nineteen nurseries currently produce zero or one batch of seedlings per year. One third of the nurseries currently sell seedlings, typically those in excess of the members needs. The main customers are the DENR, LGUs and PNOC.

Use of Local Knowledge in Seedling Production

Nursery operators were asked the question: ‘*Do you have any practices on the following seedling production activities which you learned from your ancestors or from actual experiences (as distinct from training from school or from training classes done by support agencies)?*’. Particular aspects probed concerned choice of mother trees as a seed source, germplasm collection procedures, potting mixtures and seed germination methods .

Table 2. Seedling production activities based on local knowledge in Leyte community seedling nurseries

Practice	Response summary
Mother tree identification ^a	No discrimination between tree 11; straight bole and no defects 15, other (healthy 8, large diameter 4, mature 3, tall 3, good crown formation 2)
Germplasm collection ^a	Climbing 5; collecting wildlings 17; packing wildlings in banana sheaths or anahaw (<i>Livistona rotundifolia</i>) leaves 9; use of recovery chamber 7
Potting medium	Topsoil or garden soil alone 11; soil and sand 9; soil and rice hulls 3; soil, rice hulls and compost 2; other augmented soil mixtures 2
Seed germination	No specific practice 10; sterilize soil 6; soak seeds in water 5

a. Multiple responses possible.

About two thirds of respondents reported making some mother tree selection criteria for seeds and wildlings. Half said they look for a straight bole with no defects and about a quarter mentioned tree health, with small numbers reporting other criteria.

In terms of germplasm collection practices, only five reported climbing trees for seed collection, most collecting seed while standing on the ground or picking up seed from the ground. Seventeen reported collecting wildlings. Mud puddling or use of mud press (from sugar mills) to pack the root system when transporting wildlings was mentioned by 12 respondents (nine of whom packed the leaves in vegetative matter for transport), and seven said they place wildlings in a recovery chamber after potting. Other practices reported including burning around the tree three days before seedling collection (presumably for acacias), packing wildlings in ice for transport, and soaking wildlings with algafer, a foliar fertilizer.

More than one third used soil alone as the potting medium, others adding various combinations of sand, rice hulls and compost. The soil was sometimes sieved or pulverized. Use of 6 cm x 4 cm polythene bags was mentioned by 15 respondents. Only two mentioned using fertilizer. Almost all said they watered seedlings twice daily.

Six mentioned sterilizing the soil used for seed germination, five noting that they used boiling water for this purpose. Other procedures including soaking seed in water (including for gmelina and mahogany), removing wings of winged seed, and applying a fungicide (benlate) to the germination medium. In general, large seed was sown directly into bags and small seed in seedboxes.

NATIONAL AND LOCAL SEEDLING PRODUCTION POLICY

The level of nursery activity and type of technology adopted are influenced by government policies. The Philippine government through the DENR is implementing a major forestry expansion. As noted by Mercado and Duque-Piñon (in press):

the Revised Master Plan for Forestry Development (2003) projected a deficit of more than 22 M m³ of logs by 2010. To address this, forest rehabilitation has been identified in the General Program of Actions (2005-2010) recently drafted by the DENR. In 2005, the Arroyo administration initiated the Green Philippine Program, which aims to plant 20 M trees across the country.

Only a small proportion of the seedlings will be produced in smallholder and community nurseries. While there is an elaborate system of regulations for 'tree farms' in the Philippines, there is little government control over private seedling production, Mercado and Duque-Piñon further noting that:

Little legislation related to seedling production exists in the Philippines, most of this being sections of major tree farming laws and polices. For example, Republic Act (RA) 7607 known as the *Magna Carta for Small Farmers*, notes 'the need of farmers for quality seeds and planting materials'. RA 7308 otherwise known as the *National Seed Industry Development Act 1992* mandates the National Seed Industry Council to 'promote among persons, groups, cooperatives, and corporations for genetic resources conservation, and grant incentives and other forms of assistance to seed or plant breeders'.

Seed certification has been implemented by the Department of Agriculture for agricultural crops and fruit trees in some areas of the Philippines, but not for timber trees.

At a local level, forest polices are implemented by the DENR Provincial and Community Environment and Natural Resource Offices (PENROs and CENROs) and the Municipal Environment and Natural Resources Officers (MENROs).

Forestry in the Philippines perhaps suffers from the fact that the Forest Management Services is part of essentially a government department of environment, cf. in Thailand where forestry is administered by the Royal Forest Department and in Vietnam where the Forestry Department is an agency within the Ministry of Agriculture and Rural Development.

POTENTIAL MEASURES TO IMPROVE SEEDLING PRODUCTION IN LEYTE

From the findings of the 2003 and 2008 surveys, plus investigation of seedling production in other developing countries in the region, a number of observations may be drawn.

Cooperation between government and private sector nurseries. Government, community and private nurseries in Leyte produce in particular seedlings of mahogany, gmelina and mangium. In that government agencies generally provide free seedlings, they tend to crowd out private nurseries in the seedling market. This is also the case in Thailand, but in Vietnam the government makes high quality seed and tissue culture materials available to private nurseries. The DENR in Leyte does purchase seedlings from private nurseries, though availability of contracts is somewhat unpredictable.

Economies of large-scale production and smallholder access to private nurseries. In that many Leyte nurseries have very small production volumes – particularly community and private nurseries – seedling production is relatively labour demanding or expensive. While there are more than 100 seedling nurseries in Leyte, evidence suggests that local smallholders are often unaware of sources of seedlings (Gregorio *et al.* 2005a, Mercado, in press).

Improved seed selection and seed pathways. Scope clearly exists from greater identification and use of superior or plus trees for collection of seed and wildlings, and also seed availability for a wider range of species (including native species). At present, Leyte does not have a well-developed seed pathway, unlike in Indonesia (Rothetko, in press) and Vietnam, and this is clearly one measure by which seedling quality could be increased.

Use of tissue culture. There are no tissue culture laboratories in Regions 8 and 10 in the Philippines, cf. their reasonably widespread use in Indonesia, Thailand and particularly Vietnam. However, these laboratories are costly to establish, and require high labour inputs and technical skills, and there is anecdotal evidence that many have a short operating life. This raises questions about currently appropriate technology and the transition strategy to more advanced technology. What technology is appropriate depends on the size of the market for seedlings, which is driven by the catchment area, farming systems adopted, and more especially government policy. If industrial or smallholder forestry is growing, then so will be the demand for seedlings. It is doubtful that tissue culture seedling production would be a financially viable technology in Leyte at present.

Training of nursery operators. It is clear that training courses have been available to Leyte community forestry nurseries, although the courses have generally been of short duration, and follow-up training events may be needed to encourage best practice, for example in terms of potting mix and fertilizer use.

Nursery financial sustainability and seedling certification. Both the 2003 and 2008 surveys identified a number of non-active nurseries. Some nurseries are set up for specific projects – particularly community-based forest management (CBFM) projects – and only a small proportion are able to develop into long-term commercial operations in the absence of government contracts. In that production of high quality and particularly certified seedlings (common in Vietnam) can both attract higher seedling prices from private buyers and allow access to government markets, a certification system may be necessary to improve nursery long-term survival.

DISCUSSION

Various types of forestry seedling nurseries can be recognized in the Philippines, including government nurseries mostly providing free seedlings to smallholders, nurseries of community groups typically associated with forestry projects, and private and usually small nurseries only some of which operate on a commercial basis.

A diversity of indigenous practices are adopted for seed collection and germination, wildling collection and potting mix composition. It is difficult to determine how successful these practices are, though in some cases they seem to be in conflict with research findings, e.g. in terms of most successful potting mixes.

Various measures may be identified to improve the quality of seedlings produced and the viability of small-scale nurseries. The implementation of these measures will require the commitment of government and the availability of funds.

Problems have been identified in seedling genetic and physical quality and variety of species available in Leyte. Large-scale seedling production systems operate in other developing countries in the south-east Asian region, including Vietnam, Thailand and Indonesia. There is a strong case for some of this technology to be adopted in Leyte, and ACIAR-supported research is exploring how this can be achieved. Development of improved technology required a realignment of the respective roles of government and private seedling nurseries. Government nurseries, with their greater resources, could provide clonal material and required technologies to private nurseries, which could use this to produce planting materials of high genetic quality.

Preliminary survey findings only are reported in this paper, because data analysis is continuing. Financial modeling on nursery systems is in progress, drawing on the survey data. This is designed to explore seedling production costs, operator net revenues, and conditions under which nurseries can financially sustain continued operation. This analysis will be carried out for nurseries of various production capacity levels, to explore the extent of economies of size. A spatial analysis of nursery locations and accessibility to smallholders is being carried out, with a view to examining the tradeoff between nursery size and accessibility to smallholders. Having a nursery sector with many small nurseries could provide greater accessibility, but higher seedling production costs and hence required prices.

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