

2. THE SEEDLING NURSERY SURVEY IN LEYTE ISLAND AND NORTHERN MINDANAO, THE PHILIPPINES

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The operation of private and government nurseries in the Philippines is not delivering high quality planting materials of a wide species base for smallholder forestry, tree farming and reforestation programs in the country. A project supported by ACIAR has been implemented in the Philippines to improve the operational effectiveness of the forest nursery sector. Surveys in the form of personal interviews, observations of the nursery set-up and assessment of seedling quality were undertaken in Leyte and Mindanao to provide baseline information for designing possible interventions. The study revealed that the low operational effectiveness of the forest nursery industry is a result of a combination of social, economic, technical and political factors. The majority of private nurseries are managed by resource-constrained smallholders with little access to high quality seedling production technologies. Seedling production, both in private and government nurseries, is largely quantity-oriented and the pathway of high quality germplasm is not well developed. Currently there is no policy that regulates the quality of planting stock from the forest nursery sector. Government nurseries operate to provide free seedlings but this scheme resulted in crowding out the small-scale private nurseries, negatively affecting the operational effectiveness of the private nursery sector. It appears that improving the operational effectiveness of the forest nursery sector in the Philippines requires policy changes to re-organize the operation of private and government nurseries.

INTRODUCTION

Growing of seedlings in the nursery is the most common practice for raising planting stock and the use of plants produced from the nursery is generally the most efficient and effective way of establishing a forest plantation in the tropics (Evans and Turnbull 2004). In the Philippines, a variety of forest nurseries operate with different objectives, resources and production technologies (Gregorio 2006). Despite the existence of various nursery groups, the limited availability of seedlings has been regarded as a major impediment to the promotion of smallholder forestry in the country (Gunasena and Roshetko 2000; Herbohn *et al.* 2001; Mangaoang 2002).

Harrison *et al.* (2001) argued that the forest nursery industry in the Philippines is not well organized. Forest nurseries established by government agencies including the Department of Environment and Natural resources (DENR) exist to provide seedlings for smallholder tree farming activities. However, the majority of smallholders are producing seedlings for their own use and only a few have utilized the seedlings produced in government nurseries. This raises a question regarding the effectiveness of government nurseries in giving out support to smallholders especially on the aspect of provision of planting materials. Small-scale nurseries managed by community groups and private individuals flourished and serve as the main source of planting materials for the smallholder tree farmer community (Lawrence 1999; Emtage 2004; Cedamon *et al.* 2005).

With support from the Australian Centre for International Agricultural Research (ACIAR), the Visayas State University (VSU), in cooperation with the Department of Environment and Natural Resources (DENR) Regions 8 and 10 and the World Agroforestry Center (WAC, formerly ICRAF), is implementing a project, entitled *Enhancing tree seedling supply via economic and policy changes in the Philippine nursery sector* (referred to as the ACIAR Q-seedling project). The primary objective of the ACIAR Q-seedling project is to improve the operational effectiveness of the forest nursery industry in the Philippines. In order to have a comprehensive knowledge of the nursery industry systems which would be an important basis in formulating measures to improve the operational effectiveness of the forest nursery industry, it is necessary to obtain up-to-date information on the operation and problems of the forestry seedling nursery sector.

This paper reports the development of nursery sector surveys in Region 8 and 10 of the Philippines. The objectives of the survey, selection of the target population, development of the questionnaire, and results of descriptive statistics are reported. Comments are made on how the survey information will inform other activities of the seedling enhancement project.

RESEARCH QUESTIONS TO BE ADDRESSED

In general, the seedling enhancement project is concerned with the questions of how seedling quality can be improved, how supply of high quality seedlings can be sustained and how the financial sustainability of community and private nurseries can be improved. These questions raise both government policy and private nursery sector management issues. The nursery surveys are designed to provide information to assist in answering these questions.

The surveys address general questions such as 'What are the profiles of firms in the industry?', 'What production technology is used in the industry?' and 'What is the current financial status of the industry?' This is done by seeking details on the history, capital infrastructure, management practices, production volume and costs and sales revenue, financial performance and future intentions of active government, community and private nurseries, and also seeks details of nurseries not currently carrying out seedling production.

GENERAL RESEARCH APPROACH

The chosen research approach includes a literature review, interview surveys of forestry seedling nursery enterprises in Regions 8 and 10 of the Philippines, an analysis of the survey data, and subsequent focus group discussions to present and critically evaluate survey findings. The nursery survey repeats and extends that of Gregorio in 2006 [PhD thesis]. The same three groups of nursery types (government, community and private) were included. Both active and non-producing nurseries identified were included.

Since seedling nurseries do not need to be registered with the DENR, no comprehensive list of nurseries was available as a sampling frame. In Leyte, the starting point for identifying the target population was the list of nurseries visited by Gregorio in 2003. These nurseries were identified through the snowball approach. The method involved asking the nursery operator as to his/her knowledge of other existing nurseries within the vicinity. Some further nurseries were identified by DENR, DA and through random inquiries to local government units of some municipalities. However, it was once more necessary to adopt a snowball approach in identifying nurseries. In Mindanao, information about the existence of private nurseries was sought from DENR, DA, LGUs, ICRAF and random inquiries directed to various municipalities. A snowball approach was also used in this case.

All the nurseries identified were included in the survey (i.e. a census was conducted rather than studying a set of samples) since the overall population is relatively small (e.g. less than 100 nurseries on Leyte Island), and this will lead to collection of higher quality data. It is to

be noted that when all members of a population are surveyed, the data cannot be subjected to statistical analysis¹. Although a *census* is being conducted, the term *survey* is used in this paper, because this is the more widely understood term for data collection activities, and because *survey methods* are being employed in data collection.

RESEARCH METHOD

Structure of the Questionnaires

Three sets of semi-structured questionnaires, one for each type of nursery ownership, were developed for the survey interviews. It has been a principle to use the same questions as far as possible for the different nursery ownership groups and survey locations. Separate semi-structured questionnaires but with most questions in common, have been developed for government, community and smallholder nurseries.

The content of the questionnaires can be illustrated in terms of the various sections presented in Table 1. Details are first sought about the operators and their financial resources. It is followed by sections eliciting information on germplasm pathway, species preference and seedling marketing, nursery profile and details of seedling culture. A section was also created for nursery stock quality assessment.

Table 1. List of topics included in the questionnaire

A. Demographic profile
B. Financial capacity and resources
C. Knowledge of and decisions on site-species matching
D. Technical skills in nursery seedling production
E. Flow/pathway of germplasm and planting stock
F. Familiarity about and attitudes towards tree species
G. Seedling marketing and pricing
H. Profile of the nursery, infrastructure and capital outlay
I. Nursery seedling culture and cost structure
J. Nursery stock quality assessment
K. Other relevant observations

Questionnaire Testing

Prior to using the questionnaire for the actual interviews, the questionnaires were tested to determine if the questions were structured correctly and clear enough to be understood by the respondents. Also, testing was performed as a means of practice for the interviewers in carrying out the interviewing process. Testing was done by selecting three nursery operators with similar conditions to the target respondents and interviewing them using the questionnaires that were developed. Whenever necessary, questions were rephrased or deleted, or new questions were added. It was only after the testing process and making the necessary changes to the questions that final copies of the questionnaires were produced.

¹ Statistical inference techniques such as t and chi-squared tests and analysis of variance are designed to test hypotheses and thereby make inferences from a sample to a population, and rely on a measure of sampling error. Obviously, this framework does not apply when data have been collected from an entire population. Statistical tests typically assume an infinite reference population, so that when the sample represents a high proportion of the population unreliable results can be obtained unless finite population modifiers are used.

Gatekeepers and Protocols Conducted before Nursery Visits

Prior to the face-to-face interviews, arrangements with regard to the mechanics of the interviews and the time schedules for the interviews were made. Letters expressing the interest of the project to carry out the interviews and the reasons for conducting the interviews were sent to all nursery operators. Consent of the nursery operators to the proposed interviews was obtained either through phone calls or personal visits.

After obtaining consent from the respondents, permission to conduct the survey was sought from gatekeepers including the municipal mayors and barangay captains, through personal meetings and discussions with the principal researcher and the interviewers. It was only after the approval of the gatekeepers was obtained that the survey interviews started.

Interviewer Selection and Training

Three teams of enumerators were formed to carry out the fieldwork with each team comprising of three members. The enumerators included staff of the ACIAR project who had previous experience in carrying out socio-economic surveys. The ability to converse in local dialects (Cebuano and Waray) was an essential criteria in the selection process.

Prior to the fieldwork, a one-day orientation and training was conducted to discuss with the enumerators the protocols in carrying out the survey, to expose them to the questions and to practice conducting the interviews. The enumerators also participated in pre-testing the questionnaires and in identifying the required revisions.

Conducting the Fieldwork

Personal interviews were carried out. For the private nursery category, the head of the household was interviewed. The person in charge of each nursery together with the organization president answered the questions in the communal nursery category. For government nurseries, the staff members designated to manage the nurseries were the respondents.

In addition to personal interviews, the interviewers made observations of the standard of design and operation of the nurseries, drew sketches of the nurseries and determined the nursery location using the global positioning system. Destructive testing of seedlings was also performed to measure seedling quality parameters, including sturdiness (Jaenicke 1999), basal diameter, total height, root-shoot ratio and root morphology. Signs and symptoms associated with any disease were recorded. Further, important secondary data about the nursery groups and information pertaining to the programs of the government in support to small-scale forestry were taken from files.

Everyday after conducting the survey, the survey teams convened and discussed their activities for the whole day. This was done to raise issues and constraints that would potentially hinder the survey process and thereby develop solutions to avoid experiencing a similar problem on succeeding days of the survey period.

Data Analysis

The data collected from the surveys in Leyte and Mindanao were organized using Microsoft Excel and Access programs, however, partial analyses was done using the Statistical Package for Social Sciences (SPSS). Encoding the data in the Access program was done for the purpose of further data organization and analyses, linking the survey data with other data from various research activities of the Seedling Enhancement Project. A financial analysis of the nursery enterprise is being carried out using the data from the surveys.

LINKS WITH OTHER PROJECT ACTIVITIES

Improving the Overall Understanding of the Nursery Sector in Regions 8 and 10

The survey is providing a wealth of information about the seedling nursery sector, which is highly useful for designing intervention measures to improve the industry operation. A number of different forms of analysis are being conducted, for example, the locations of nurseries (GPS reading) and their sizes will provide an indication of the accessibility of seedlings to smallholders. The approach adopted will follow that of Farrelly (2007), who used a GIS approach to map the spatial distribution of sawmills and boardmills in relation to private forests in Ireland, using a 20 mile radius. Concentric circles will be drawn on maps, to reveal the area serviced by nurseries in proximity to tree farmers in the survey areas.

Informing the Policy Modelling

A model of the nursery industry operational effectiveness was developed by Gregorio (2006). This will be used by the Seedling Enhancement Project for policy analysis to improve the operational effectiveness of the nursery industry. A key use of the survey findings is to provide information to update the model, making it a useful tool for policy simulation.

Informing the Financial Modelling

The questions relating to nursery capital outlays and operating costs (including unpriced resources such as the operators' labour) and revenue from seedling sales will be used in the development of financial models of seedling nursery operation. Financial modelling is being carried out for different scales of nursery operations to determine the extent of economies of scale, and the trade off between seedling production cost and accessibility of nurseries to smallholder localities. Some financial simulation work is planned to identify conditions under which nurseries will have long-term viability.

Identifying Practices in Relation to Formulation of BMP, Benchmarking, Certification and Branding

As the seedling enhancement project is designed to improve the standard of operation of nurseries, it is planned to develop some best management practice (BMP) guidelines to which nursery enterprises can aspire. These may relate, for example, to adopting systems which minimize root deformities, follow practices to produce sturdy seedlings, discarding of inferior seedlings, avoiding distribution of over-mature seedlings, and sun-hardening to prevent seedling damage on outplanting. To the extent that nurseries collect their own seed, guidelines can also be formulated on how best to do this.

RESULTS AND DISCUSSION

The survey was done on two islands – Leyte and Mindanao. The results of the survey research on each island are presented in two separate sections in this paper.

Nursery Survey on Leyte Island

The nursery survey on Leyte Island included 29 out of the 41 municipalities that comprise the island. The survey may not have included all nurseries on Leyte Island, however, the rigor of the census that was done to identify the nurseries is a strong basis to claim that almost all of the nurseries on the island were included in the study.

Nursery Type and Objective of Production

A total of 96 nurseries from 29 municipalities were included in the survey. Table 2 shows the distribution of respondents among the three nursery categories. The number of nurseries in each category did not differ much but the number of private individual nurseries topped the count of nurseries included in the survey.

Table 2. Types and counts of nursery groups included in the survey

Nursery category	Number of respondents
Individual	35
Communal	33
Government	28
Total	96

Individual nurseries are established and managed by individual farmers, usually with the help of their family members. These are usually established in response to the difficulty in obtaining planting stock from government nurseries. The nursery structure is usually temporary in nature, made of indigenous materials including tree branches or bamboo poles with coconut leaves as shade. This is generally established next to the house of the operator for ease of maintenance and security against pilfering and stray animals.

Communal nurseries are established by a group of people in the community. In most cases, the establishment is initiated through implementation of development projects. In this type of nursery, the seedling production schedule, quantity of planting stock and species raised are jointly decided upon by the organisation and the supporting agency. In most cases, the participating members are paid for raising the seedlings and a formal protocol exists for the sharing of benefits. The nursery is often located centrally within the community but in some cases, it is situated close to the communal planting site (which may be far from the barangay) for ease in transporting seedlings during field planting. The nursery structure is semi-permanent to permanent in nature.

Government-owned nurseries are usually situated in a major city or town. Seedlings are produced mainly for the purpose of free distribution to all interested parties. Experienced workers who are paid either on a contract or regular basis usually carry out the seedling production activities and the volume of seedlings produced is normally higher than in the individual and communal nurseries. With a well-established structure, this type of nursery is usually permanent in nature.

While the prime reason for the establishment of private and communal nurseries is to grow seedlings either for own use or for sale (Table 3), the production in individual nurseries is highly flexible, for example private individual nurseries could readily shift their operation from a private use to commercial venture whenever there is a demand of seedlings. Communal nurseries are not as flexible as private nurseries because their operation is guided by the management plan of the project implementation.

Table 3. Primary purpose of planting stock production

Purpose	Proportion of responses in each nursery group (%)		
	Individual	Communal	Government
Internal/personal use	53	83	30
For sale	42	15	0
For free distribution	5	2	70

The seedling production in most communal nurseries is funded as part of the implementation of development projects, however, these nurseries are not able to readily sell their seedlings to other buyers. It is only after the culmination of the project that these nurseries could shift to a commercialized operation.

Private nurseries operated with all of their resources supplied by the nursery operator. Only about 27.6% received support in the form of seedling containers and seeds from supporting agencies. All communal nurseries received financial, technical and even market assistance from support agencies particularly during the time of the operation of the project. However, after the culmination of the project, communal nurseries were left to operate without the necessary support. The absence of continued support forced most of the community organizations to cease their operations.

Educational Background and Technical Skills in Seedling Production

In general, operators of private nurseries and members of community organizations have a low educational background, which could be an important factor to consider in designing support measures particularly with regard to information, education and communication. About 60.8% of private nursery operators and 64% of managers of communal nurseries only have a secondary education. While a small proportion of private and community nursery owners and managers have obtained some form of tertiary education, these are not related to forestry.

Operators possess the basic skills required for seedling production. Most of the individual operators have learned these skills through trial and error. About 73.3% of private nursery operators have had no exposure to seedling production in the form of training sessions while 87.1% of the communal nursery operators have gained their knowledge from attending formal training sessions. All managers of government nurseries have attended formal training and almost all have completed a four year degree mostly in agriculture and forestry. While a basic knowledge of seedling production is present in all nursery operators, it is apparent that they still need further knowledge and skills to become experts in nursery management. Constraints on the difficulty of germinating seeds, inappropriate germplasm collection methods and the production of seedlings of low physical quality are manifestations of the need for further knowledge of seedling production.

An assessment of seedling quality from the three nursery categories shows that the majority of the seedlings are of a low physical quality. Table 4 shows that 74% of seedlings from private nurseries, 69% from communal nurseries and 71% from government nurseries have a sturdiness quotient of higher than six. According to Jaenicke (1999), seedlings with a sturdiness quotient greater than six are considered lanky and unlikely to withstand the high temperatures and low soil moisture of the planting site. Most of the seedlings also have an imbalanced root-shoot ratio and about 41% of seedlings from private nurseries, 54% from communal and 32% from government nurseries have J-roots.

Table 4. Assessment of physical quality of sample seedlings from the nurseries

Nursery category	Sturdiness quotient above six (%)	Imbalanced root-shoot ratio (%)	Presence of J-roots
Individual	74	80	41
Communal	68	86	54
Government	70	73	32
Mean	71	80	42

All government nursery managers and owners of private nurseries, except one from the communal nursery category, claimed that they were satisfied with the quality of seedlings they have been producing. This perception contradicts with the result of seedling physical quality assessment.

Species Selection and Preference

The objective of production is the initial basis for the choice of species to produce. For example, those nurseries that are selling seedlings concentrate on the demand for the species while those who raise seedlings for their own plantings placed more emphasis on the growth and timber quality of the species. As communal nurseries are project-based, the recommendations by supporting agencies and the requirements indicated in the project implementation plan are also major considerations. Government nurseries normally have a specific list of species to produce for every growing season based on the demand by seedling users and directives from the office.

While nursery operators have a set preference of which species to produce, the supply of germplasm and difficulties in producing the planting stock are major deciding factors in choosing the species to raise. Most often nursery operators eventually resorted to the production of species including mahogany and gmelina, for which mother trees are readily available. These species are widely domesticated by smallholders and commonly planted in the reforestation projects of various government and non-government agencies. Table 5 presents the top five species that are commonly produced in the three nursery categories. Mahogany is the most widely propagated species followed by gmelina. The high timber quality, relatively fast growth and abundant supply of germplasm made mahogany the topmost raised species. Fast growth and abundant seeds are the main reasons for the abundance of gmelina in many nurseries. Narra, molave and lauan are also widely raised because of their premium wood quality.

Table 5. List and ranking of species commonly produced in the three nursery categories

Species	Percentage of nurseries in each category		
	Individual	Communal	Government
Mahogany	75	68	75
Gmelina	54	45	46
Mangium	29	55	25
White lauan	11	55	14
Narra	0	52	46

About 39% of private nursery operators placed a high preference on indigenous species. This suggests that smallholders are interested in planting native trees. However, the lack of access to mother trees prevented them from producing most of the native species. Unlike exotics such as gmelina and mahogany that are widely planted, native trees are less domesticated, thus germplasm are mostly sourced from mother trees in the native forest. Mother trees of native trees are scarce because they are preferred by timber poachers.

Germplasm Used in Seedling Production and Collection Methods

Seeds and wildlings are the common germplasm used by nursery operators for seedling production. Seeds are often used for exotic species including mahogany, mangium and gmelina, and wildlings for producing the native species. The location of mother trees in native forests makes it difficult for nursery operators to determine the fruiting season and the appropriate period to collect seeds. With germplasm collection carried out late, wildlings are usually available instead of seeds. Inappropriate potting of wildlings often result in the

production of seedlings of low physical quality – with an imbalanced root-shoot ratio and defective root form including J-rooting and coiling. If not allowed to stay in the nursery to fully recover from stress during the collection process, wildlings will exhibit a high mortality in the plantation. Sy (1998) argued that the use of low quality planting materials produced from wildlings is one of the reasons for the failure of tree farming and reforestation projects in the country.

Of the nursery operators who collected seeds, 68% indicated that seeds were usually collected from the ground instead of from the mother trees. The collection is also normally done from individual seed trees regardless of their physical characteristics. The 'collect what is available' practice is commonly adopted. According to Mulawarman *et al.* (2003), this scheme is detrimental to the genetic quality of the resulting seedlings. Ideally, germplasm should be collected from selected mother trees that are growing far from each other to ensure high genetic quality and to promote a high genetic diversity of seedlings.

Sustainability of Operation

The majority of the private (69%) and communal (65%) nurseries had ceased their seedling production at the time of the survey. The lack of financial resources was the major reason these nurseries stopped operating. The absence of financial support after the termination of the development project prevented most of the communal nurseries from continuing their operation. However, three communal nurseries have successfully shifted their operation to a commercialized venture. Sales from seedlings motivated members of these communal nurseries to sustain their operation. Regular annual funding has enabled all government nurseries to sustain their operation.

Although the majority of private nurseries have ceased their seedling production, more than half (58%) of operators have emphasized that they are willing to continue their operation if there is a demand for planting stock. Unlike private nurseries, communal nurseries are more difficult to revive when the community organization disbanded.

Constraints in Nursery Operation

A number of constraints have influenced the operation of the three nursery categories. The top five most important constraints are presented in Table 6. Lack of access to sources of germplasm is considered as the primary constraint experienced by individual and communal nursery operators. Inadequate funds are also experienced, which could be linked to the constraint on low sales. Lack of labour and pilfering are constraints in government nurseries but are not major problems in private and communal nurseries. Unlike private nurseries which are mostly situated within the homestead of the nursery owner, and communal nurseries strategically constructed within the community to facilitate protection and maintenance, government nurseries are mostly situated next to the office of the agency, with no staff to oversee especially during weekends and holidays.

The constraint on low sales in private nurseries could be affected by the free seedlings from the government nurseries. Although there is no definite data showing the decline of seedling sales in private nurseries as a result of the free distribution program, it is expected that free seedlings from government nurseries will prevent potential customers from buying seedlings in private nurseries. Without free transport and given the distant location of government nurseries from villages, the free seedling distribution in government nurseries favours those who have the resources to transport the seedlings from the nursery to their respective sites. Unfortunately, these are also the categories of tree farmers who are potential customers of the private nurseries.

Table 6. Topmost constraints in seedling production experienced by nursery operators

Nursery category	Constraint
Individual	Access to seed sources Inadequate funds Low sales Difficulty in germinating seeds Unclaimed orders
Communal	Access to seed sources Inadequate funds Low sales Uncooperative members Seedling mortality
Government	Inadequate funds Access to high quality seeds Low seed germination Lack of labour to work in the nursery Pilfering and damage by stray domestic animals

The size of the nurseries had not increased since the start of the operation. However, 69% of the private nurseries decreased the volume of seedlings produced before they totally ceased the nursery operation. The majority of the individual (87.9%) and communal (83.9%) nurseries have no business associations or networks with other nurseries. Having connections with other nurseries could have improved the germplasm pathway and seedling sales.

Nursery operators have strongly suggested hands-on training and visits to demonstration nurseries as methods to improve their knowledge and skills in forest nursery management.

The Nursery Survey in Northern Mindanao

Nursery Types and Background Information of Operators

There were three types of nurseries identified based on management, namely private, communal and government. A total of 90 nurseries were interviewed during the survey, 36 of them were private, 25 communal, and 29 government managed nurseries covering 16 municipalities and four cities in Northern Mindanao (Table 7).

Table 7. Nursery operator respondents in Northern Mindanao

Nursery Classification	Number of Nurseries
Private	36
Communal	25
Government	29
Total	90

The survey revealed that private nursery operators are mostly male (66.7%) and fall within the age range of 45–54 (38.9%). A considerable number of them (55.6%) have a family size of 4–6. Unlike the private nursery operators in Region 8, most nursery operators (44.4%) in Region 10 (Northern Mindanao) have completed their college education although in most cases not related to agriculture and forestry. With regard to their affiliation to organizations,

the majority of them (44.4%) do not have membership of any organization. However, 55% of those who have membership are members of agriculture related organizations.

Fifty percent of the nursery operators interviewed signified that the nursery business was their primary source of income while 27 percent stated being employed either in private, public or non-government organizations as their main source of income (Table 8). On the other hand, sixteen percent of nursery operators have their farms as their principal source of income and two other nursery operators rely on their retirement pension and fish vending while their nursery business is considered as only 'a sideline'.

The daily average income of private nursery operators based on their primary source of income ranged from 124 to 376 pesos per day. This denotes that most of the nurseries operated on a small scale basis. The nursery operator is usually assisted by family members. In this case, most nursery operators relying on the nursery business and farming were assisted by 2 to 4 members, respectively.

Table 8. Purpose of private, communal and government nurseries in raising planting stock

Purpose	Private N=36 Percent	Communal N=25 Percent	Government N=29 Percent
For sale	30.6	12	6.9
For internal/personal use	5.6	0	NA
For free distribution	0	88	34.5
For sale and personal/agency use	41.7	0	0
For personal and free distribution	2.8	0	34.5
For sale and free distribution	0	0	17.2
For sale, personal use and free distribution	19.4	0	6.9

Communal nurseries are established with the aid of support organizations same as that with Leyte. They are owned by a group of people usually composed of farmers and managed by the president of the organization. The majority (88%) of communal nurseries interviewed were composed of a group with less than 100 members who live in close proximity of each other. Results also revealed that the members are mostly female (54.3%) and that most members belong to the age group from 20 to 40 years old (39.8%). Worth noting is the considerable number of members who are above 60 years of age (one third of the total number of members) as well as the small number (1%) of young members (< 20 years of age).

Termed as 'pahina' in the local dialect, members share the various tasks in the day-to-day nursery activities from seeding to rearing and marketing. This labour system does not involve outright monetary equivalence. However, the efforts put in by the members are recorded and becomes the basis for profit sharing when the seedlings are sold.

Government nurseries on the other hand are forest nurseries established and managed by government institutions such as government schools, colleges and universities (SCU's) and different departments under the Department of Environment and Natural Resources (DENR). These are usually run by experienced nursery operators, foresters and agriculturists. Ninety percent of them have undergone nursery related training.

Nursery Location, Production Capacity and Objectives of Production

About 78% of private nurseries and 76% of government nurseries are situated near the main road at a distance ranging from 1 to 625 meters. This scenario is due to the goal of these nurseries to provide planting materials for sale and free distribution, respectively. Proximity to the main road means greater exposure to the buying public which is an effective mechanism in the promotion of seedlings to buyers' thereby increasing profitability. In the case of communal nurseries, 12 out of 25 nurseries or 48 %, which is a majority, are situated more than a kilometre away from the main road. This is due to being usually located near the tree farms of the organization and the houses of its members.

Almost all (90%) of government and communal nurseries are less than 1 hectare while few private nurseries are greater than two hectares (19.4%). The majority of nurseries in each category are producing less than 12,000 seedlings per year (Table 9). This is considerably lower than the 49,000 seedling mark which denotes the upper limit of a smallholder nursery production.

The government nurseries tend to produce more than they are mandated to distribute as free seedlings and the production target is usually high. Since communal nurseries are project supported initiatives, they are producing a smaller volume of seedlings than the private nurseries

Table 9. Number of seedlings produced annually by the three nursery types

Seedling volume	Private	Communal	Government
Can not estimate	0	8	3.4
< 12,500	55.6	64	41.4
12,501–25,000	8.3	12	13.8
25,001–37,500	13.9	0	6.9
37,501–50,000	8.3	4	13.8
> 50,000	13.9	12	20.7

* Nurseries producing more than 50,000 seedlings are not considered smallholder nurseries (Tolentino et al. 2002).

Tree Species Propagated

Seedlings of tree species commonly raised by nursery operators are presented in Table 10. On average, private nurseries are producing 13 species of timber and fruit trees, communal nurseries are producing 10, and government nurseries generally produce 24 species. Among the commonly raised exotic species were eucalyptus, acacias, gmelina, mahogany and the newly introduced muzizi. There were 12 indigenous species raised, and the most common species were lauan, molave and Bbagalnga. Most of indigenous species raised by operators are species that commonly grow in central Philippines (Visayas group of islands). This indicates that perhaps many, if not most, of the nursery operators' roots can be traced to central Philippines. Fruit tree seedlings were mainly raised by private and communal nursery operators with as many as 15 different species, the common species are durian, lanzones and jackfruit.

Table 10. Tree species commonly raised in nurseries in Northern Mindanao

Species group	Common name	Scientific name
Exotic trees	Eucalyptus	<i>Eucalyptus spp. (E. deglupta, E. robusta, E. torelliana)</i>
	Acacia	<i>Acacia spp (A. mangium, A. lebbekoides)</i>
	Gmelina	<i>Gmelina arborea</i>
	Mahogany	<i>Swietenia macrophylla</i>
	Muzizi	<i>Mysopsis emini</i>
Indigenous trees	Lauan	<i>Shorea contorta</i>
	Molave	<i>Vitex parviflora</i>
	Bagalnga	<i>Melia dubia</i>
Fruit trees	Durian	<i>Durio zibethinus</i>
	Rambutan	<i>Nephelium lappaceum</i>
	Lanzones	<i>Lansium domesticum</i>
	Jackfruit	<i>Artocarpus heterophyllus</i>

Seedling Quality

The result of the assessment of the physical quality of seedlings produced by the different nursery categories is presented in Table 11. Generally, seedlings produced across the three nursery categories are of low quality. Only 10% of the seedlings in communal nurseries have an ideal sturdiness quotient of less than 6, and 14% and 38% for private and government, respectively. This indicates that most of these seedlings are lanky and unlikely to survive at high temperature and low soil moisture conditions when outplanted.

Table 11. Physical quality assessment of seedlings produced by different nurseries in Mindanao

	With ideal sturdiness quotient (<6)	Balance root-shoot ratio (1–2)	Absence of twisted and curled roots
Private	14	62	41
Communal	10	70	54
Government	38	50	33
Mean	21	61	43

Only 61% of the seedlings from all nursery types have a balanced root-shoot ratio. This means that about 40 % of the seedlings are having larger proportion of above ground than below ground biomass. Ideally, a more even biomass or those with greater root biomass are ideal as they are more able to survive field conditions due to better root formation which aids in the absorption of nutrients and water. In terms of root form, only 43 % showed acceptable form. Strictly speaking, only close to half of the seedlings sampled are ideal to be planted to the field with others needing to be rejected since they are expected to perform poorly at the field. Poor root form is equated to poor field performance because of poor root anchorage making them prone to wind throw in addition to hampered absorption of water and nutrients needed for growth.

Worth noting are the seedlings coming from government nurseries which showed that most of the seedlings produced are of low quality. These nurseries should have produced superior quality of planting materials because it is run by professionals in the field of forestry and agriculture as well as educators in the case of SCU's. The government nurseries should have been a model to other nurseries in the production of quality planting materials.

Even though the quality of their seedling was low, most nursery operators in private and communal nurseries expressed their satisfaction with the quality of the seedlings they had raised. This shows the need to educate nursery operators on how to correctly assess the quality of their seedlings. Also, there is a need to educate nursery operators on how to improve the quality of their planting materials and the use of appropriate nursery management practices.

Constraints on Nursery Operation Sustainability

The majority of private, communal and government nurseries in northern Mindanao have been operating continuously. However, the lack of funds is commonly stated as the reason for 'on and off' operation among private, communal and government nurseries (Table 12). Communal nurseries are, however, affected the most by the unavailability of funds because this type of nursery is usually closely dependent on the duration of the project which supports them. Other reasons such as that the members have already started to grow their own seedlings in their own backyards, the lack of management and the transfer of the nursery to another location were mentioned as reasons for the intermittent operations of communal nurseries.

Table 12. Reasons for private, communal and government nurseries' intermittent operation

Private Nurseries	Communal	Government
Lack of funds (2)	Support from funding agency stopped (5)	Unavailability of funds
	Members raised their own seedlings	Area used for another government project
	Transfer of location	Only when there is tree planting activity
	Lack of management	

Numbers in parenthesis are the number of nurseries sharing a common reason

Government nurseries argued that their intermittent operation, aside from the unavailability of funds, was due to a conflict in land use and that the nursery only operates when there is a scheduled tree planting activity. Government nurseries, similar to private nurseries, only showed a few cases with an inconsistency in their operation (Table 6). This is due to the fact that most of these nurseries have a stable form of support such as US government funding.

Networking between nurseries is a major factor in sustainability as this could promote better seedling sales. Most private nurseries (86.1%) and all of communal nurseries (100%), however, have not established a connection with other members of the nursery sector. Those remaining nurseries that have established connections limit their communication to exchanges in information on the market of seedlings only when their supply could not reach a certain quota or demand. Information on nursery management practices or strategies are not discussed. A network of nurseries is advantageous especially in pooling nurseries together in order to share a particular market at times when there is huge demand. Also, when nurseries belong to a network an open channel of communication will be established which may pave the way in promoting quality and price standardization.

CONCLUSION

There are three nursery types in northern Mindanao and Leyte based on management. These are private, communal and government nurseries. Each differs in management objectives as well as in other aspects including the operator handling the nursery, the capacity to produce seedlings, support and sustainability.

Private nurseries are managed mostly by a single individual with the help of household members. In some instances, as in the case of well established nurseries, nurseries are managed by licensed professionals in forestry and agriculture. Private nurseries are stable considering the high number of private nurseries that have continued their operation since they first started. In general, private nurseries in Northern Mindanao have better seedling market opportunity than those in Leyte with some nurseries engaged in large scale production of seedlings using best management practices. This is a result of greater demand for seedlings in Northern Mindanao region due to large reforestation programs and plantation farms. These nurseries also practices standard operating procedures in collecting planting materials of superior quality. The practices of some private nurseries in Northern Mindanao could serve as a model for Leyte nurseries in improving seedling quality and enhancing seedling supply.

Communal nurseries are mostly established with the aid of support institutions on which they still depend even up to the present time. Communal nurseries in Northern Mindanao and Leyte have a low sustainability since most have not broken away from their dependence on the agency that supported them from the beginning. In most cases their nurseries fail once support is stopped. Both Northern Mindanao and Leyte have communal nurseries that practices selection of superior mother trees for its planting materials, however only in Northern Mindanao that practices selling of seeds and branding. This could serve as an example for Leyte as well as to other communal nursery groups within N.Mindanao to make high quality seeds available to buyers and thereby providing a pathway for improved seedling quality.

Government nurseries in both regions are mostly managed by professionals. Sustainability is affected by the continuity of the government reforestation programs. Nursery existence is usually for a specific project and thus closes when project ends. These nurseries are potential showcase locations to showcase best management nursery practices for adoption by other nurseries.

Nursery operators from both regions believed that they are producing seedlings of superb quality while their seedlings, during quality assessment, showed to be of low quality. The need to educate nursery operators on how to assess seedlings in terms of quality is important as well as on how to produce quality seedling through following best management practices in nurseries.

POLICY IMPLICATIONS

In Northern Mindanao, some nursery operators are already producing quality tree seedlings. However, poor quality seedlings are still produced and used in tree plantations and reforestation projects. This constraint could be attributed to problems related to the nursery operators' lack of skills in producing high quality seedlings, the tree plantation owners' lack of awareness of the value of quality seedlings, and the fact that the poor quality seedlings are sold at a significantly lower price, making them more attractive to buy than the quality seedlings.

High quality seedlings are the key to successful private and communal tree plantations and government reforestation projects. Therefore, it is necessary that only quality seedlings are used. This can be made possible through enforcing a regulation that only quality seedlings be used in reforestation projects and encouraging private tree plantation owners to use only quality seedlings through accrediting nurseries that are growing quality seedlings.

Since the operation of the forest nursery industry in Leyte and Mindanao is not effective in delivering high quality planting materials of a wide species variety to tree farmers there is a need to educate seedling nursery operators on nursery best management practices.

Seedling buyers and reforestation project coordinators also need to be educated to only buy those seedlings of superior quality in order to create demand of quality seedlings. The aim of production should be changed from quantity-oriented to quality-oriented in order to promote quality seedling production.

With limited funds, low access to high quality germplasm and low quality of planting stock hampering seedling supply, interventions dealing with these aspects are apparent. Provision of financial support could aid in the establishment of quality producing nurseries. Identification of mother trees and enhancing the industry of quality seed marketing are important to ensure continued availability of seeds for nurseries. Also, widespread information dissemination on the advantages of quality seedling production could offer a solution to the problem on low seedling quality.

Coordination in the operations of the private, communal and government nurseries is important in order to prevent crowding out of the seedling market. The program of free seedling distribution of government nurseries crowds out the operation of private nurseries and communal nurseries engaged in selling. Most of the seedlings distributed from government nurseries duplicate the species sold in private nurseries. The continued operation of private nurseries is important because most of the seedlings used in smallholder tree farming in the Philippines come from private nurseries. Also, the fund allocation for government seedling production is declining, thus private nurseries will serve as an important source of planting materials for tree plantations.

There is a need to organize the nursery industry in the Philippines. The market of seedlings for industrial plantations, small-scale forestry and upland rehabilitation projects is evident but low sales remain a major constraint hampering the operation of most nurseries. There is a need to develop and institutionalize a policy that will regulate seedling quality and improve the financial viability of the private nursery. This intervention should be implemented parallel with an improved germplasm pathway and sufficient technical capacity of nursery operators.

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