10. ESTABLISHING FIELD TRIALS TO PROMOTE SMALLHOLDER FORESTRY IN LEYTE, THE PHILIPPINES

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The quality of planting material is one of the key factors that determine the success of tree farming and reforestation activities. In the Philippines, low quality seedlings are commonly used in smallholder plantings for reasons such as the limited supply of high quality seedlings and smallholders' lack of awareness of the benefits of using high quality planting stock. The ACIAR-funded seedling enhancement project has been carrying out training and extension activities to enhance the knowledge of tree farmers about the importance of high quality planting material and improve the capacity of nursery operators in the production of high quality seedlings. Various field trials were established to gain new knowledge on tree farming and to demonstrate to smallholders the result of adopting the best management practices.

INTRODUCTION

The application of appropriate silvicultural practices starting from seedling production up to the period when trees have reached maturity is a requisite for successful tree farming. Examples of these practices include the collection of germplasm from physically and genetically superior mother trees, production of healthy and robust seedlings without root deformities, pruning of trees to produce straight and long merchantable bole, and thinning to boost the growth of the best trees in the stand.

In Leyte Province in the Philippines, a number of small-scale tree plantings exist for various objectives. Trees are planted in small blocks as a future source of timber, lines for windbreaks and to mark property boundaries, small numbers of trees within homesteads to provide shade, and farm hedgerows to promote soil stabilization. Harrison and Herbohn (2001) argued that smallholders in the Philippines are not getting maximum returns from their plantations. Trees are growing slowly, with poor stem form and heavy branches. This observation could be attributed to the use of low quality planting material, mismatching of site and species, and the absence of appropriate silvicultural treatment particularly thinning and branch pruning. Surveys carried out as part of the ACIAR Smallholder Forestry Project revealed that more information regarding the best nursery cultural practices, plantation establishment and maintenance is required for smallholders to increase the economic returns from planted trees. While training classes have been held by support agencies – for example by the Department of Environment and Natural Resources (DENR) – to improve the tree growing practices of smallholders, research such as that of Gregorio (2006) showed that skills of smallholders have not improved and the majority have not adopted the technologies conveyed in training classes.

In general, smallholders are resource constrained. Every seedling they produce and plant corresponds to an investment (Thappa *et al*. 1991). Accordingly, smallholders are particularly selective in adopting technologies and will not readily subscribe to suggestions they are not sure will yield positive results. It is known that farmers will not readily adopt a given technology unless they can see how it works.

A field demonstration trial is one way of showcasing to smallholders the result of using sound tree farming technologies. Actual observation of the impact of the technology is envisaged to provide concrete learning and promote better technology adoption. For this purpose, a number of field trials have been established under the ACIAR-funded Smallholder Forestry Project in Leyte. This paper focuses on the purposes and processes of establishing the field trials. The objectives of each trial are presented, the methodology of establishing the field trials are outlined and the perceived impact of the trials on the promotion of smallholder forestry are discussed.

DECIDING ON FIELD TRIALS TO ESTABLISH

To gain new knowledge on tree farming and demonstrate to smallholders the result of adopting the best management practices, six trials were established as part of the implementation of the ACIAR Smallholder Forestry Project. These trials are:

- continuous variable spacing trial,
- mixed species trial,
- shade by fertilizer trial on dipterocarp,
- gmelina germplasm trial,
- the physical quality of gmelina and mahogany planting stock trial; and
- mahogany and gmelina thinning trial.

The field trials were established to investigate field growth performance of planted trees in response to treatments and replicates. They serve as an extension tool to support the technologies disseminated as part of the Information, Education and Communication (IEC) program of the ACIAR Smallholder Forestry Project, specifically the Seedling Enhancement (Q-seedling) Project which emphasizes the importance and benefits of using high quality seedlings, appropriate planting design, and effective silvicultural treatments such as thinning and pruning.

ESTABLISHING THE FIELD TRIALS

Since their function is not only that of physical research but also to serve as an extension tool, the trials were established on sites that are readily accessible to visitors. Establishing the field trials involved a series of activities including a reconnaissance survey, signing the Memorandum of Agreement with the owners of the land where the trials were established, meetings with leaders of the communities to inform them about the trial, field planting, placing of signboards to advertise the trials, and employing a local resident to oversee the experiments.

The Reconnaissance Survey

Finding areas at which to establish the trials was a great challenge. Private land that is readily accessible is mostly used for agriculture rather than forestry. There is open land available for tree planting but this is mostly in the hinterland, which was deemed inappropriate for establishing the trials due to inaccessibility. Information of potential plantation sites was gathered from the DENR, Local Government Units and communities. After obtaining the information about potential plantation sites, actual visits to the selected sites, accompanied by owners or administrators of the land, were carried out to assess if the proposed lots would be appropriate for the trials.

Formalizing a Contractual Agreement with the Owner of the Land

The field trials will continue for a number of years, on private land, so it was imperative to ensure security of right over the use of the land. Accordingly, Memorandums of Agreement (MOAs) were established between the owner of the land and the project. These are contracts that stipulate the rights and responsibilities of the owner of the land and the project researchers in respect of the field trials and the land where the trials are established. The contracts indicate the agreement of the owners to allow the project to utilize the land for the field trials for a specific period. The contracts also highlight the role of the project in the establishment and management of the field trial.

Informing the Local People

While the trials were established on private lots, trespassing on the trial sites by the locals in the communities as well as possible damage to the trees by domestic animals was anticipated. This is particularly true for sites which were used as pasture areas by the communities. To promote the protection of the field trial set-up by the local residents, community leaders were informed through a meeting where the purpose of the trials and the benefits the trial could provide were discussed. Among the benefits elucidated were the amelioration of the ecological condition of the locality, job opportunities in the maintenance of the plantation and the tree farming knowledge that the locals could gain from the plantation.

Site Preparation and Field Planting

Clear-brushing was done on each site to remove the existing vegetation cover and prepare the site for establishing the trial. Trees and patches of shrubs were cut and grasses were slashed. Cut biomass was hauled and piled on the side of the experiment plots.

Trial layouts were established using a compass, tape and laser hypsometer[1]. Blocks and plots were marked with pegs and stakes were placed at individual planting points. Holes with a dimension of 30 cm wide, 30 cm long and 30 cm deep were dug at each planting point. The holes were filled with the dug soil prior to planting. During backfilling, the topsoil was first placed into the hole followed by the subsoil to place the relatively fertile topsoil in contact with the root system. Fencing consisting of bamboo slats and barb wire was erected to protect the trial from straying animals.

Employing a Local to Oversee the Field Trial

A person from the community has been hired for the daily overseeing of each trial. This person patrols the site daily to inspect the plantation and report any observations that need immediate attention by the project management, for example any seedling mortality. The hired person also holds the log book for visitors to write down their names whenever a visit is made to the plantation. The logbook records information about visitors including their name, address, affiliation and comments about what they have observed or learned in the plantation.

Tagging Trees and Placing Signboards at the Trial Site

The trials were established so that tree farmers could readily decipher all they would observe during visits. Complete tagging of trees in the plantation was done to show the treatments

[1] Laser hypsometer is an instrument used to measure the height and diameter of trees, and distance between points. In preparing the site for the trials, this was used primarily in measuring the blocks.

and tree numbers. Signboards indicating the plot numbers and the treatments were placed in every plot. A signboard at each trial site indicates the title of the trial, the species planted, the experimental treatments, and date of establishing the plantation. Signboards were also placed along the national roads close the trials, to inform the people about the existence of the plantation and invite them to visit and learn from the trials.

OVERVIEW OF THE FIELD TRIALS

The field experiments were designed to answer research questions that would support the technologies that have been disseminated during training sessions and the extension material developed by the Seedling Enhancement Project. The following is a summary of each of the trials.

The Continuous Variable Spacing and Mixed Species Trial

A number of arguments have been raised against monoculture tree plantations particularly concerning the economic and environmental aspects. Mixed planting is encouraged to maximize the economic returns from plantations as well as for various ecological reasons. In mixed planting, the combination of various species and the spacing between trees are crucial considerations as these will profoundly affect the survival and growth performance of planted trees. Currently the optimum spacing between trees in a plantation remains uncertain to most tree farmers. Further, smallholders generally have very little knowledge of appropriate species combinations in mixed plantations. The lack of information on these important tree farming considerations led to the development of this study. This study aims to investigate the optimal spacing between trees to reduce the competition both below and above ground to a minimum but to maximize the use of the planting site. This study also investigates the complementarity effect of leguminous timber species when planted together with non-leguminous species in low fertility soil. If complementarity exists between legume and non-legume timber species, this study will determine the optimal spacing between planted trees to harness such complementarity.

Two 60 m x 60 m plots were established in an area with acidic soil. Each plot was planted with legume timber species – namely falcata (*A. falcataria*) and narra (*P. indicus*) – together with the non-legume species mahogany (*S. macrophylla*) and mayapis (*S. palosapis*). The planting design was adopted from Vanclay (2004). In the first plot, seedlings of the four species were planted at a uniform spacing of 3 m x 3 m. In the second plot, the spacing of seedlings increased towards the edge of the plot so that seedlings at the middle of the plot were closer than seedlings on the edge of the plot. As with the first plot, the distribution of species followed the design presented by Vanclay (2004).

Data recording is carried out every three months. Three batches of data have been collected, and are now undergoing analyses. Variables measured include plant height, base diameter, plant health, maximum photosynthesis (Pmax) and light response of the sample plants. The last two parameters are measured using the portable Infrared Gas Analyser (IRGA). Initial observations after one year from planting suggest that seedlings planted at closer spacing (from 0.3 m to 2 m) have a higher growth response compared to those planted at wider spacing (3 m up to 10 m). Further investigation will be conducted on the factors contributing to this observation. Observations of the microclimatic conditions at various points within the plantation will be collected, including light intensity, relative humidity, minimum and maximum temperature and soil physical and chemical properties.

Shade by Fertilizer Trial

Anecdotal evidence suggests that shade is necessary when planting dipterocarp seedlings in open sites. Many of the sites used for tree planting are open land and the establishment of

shade, either artificial or natural (e.g. nurse trees), entails additional expense to smallholders. The study of Beer (1987) done in a coffee plantation revealed that direct exposure to the sun did not have an adverse effect on the growth of coffee planted on fertile soil. This suggested that high soil fertility could help prevent the adverse effects of direct solar exposure on the growth of some plants. This study aims to validate the notion that dipterocarps require shade. Further, this study will investigate the optimal fertility level of the soil for dipterocarp seedlings to grow better even without using shade.

The experiment is set up in an acidic soil using a randomized complete block design with 12 treatment combinations (4 shade levels and 3 fertilizer rates) and three replicates. Shading methods include nurse trees and thatch cages built using bamboo slats. Data gathering is carried out every three months. Variables observed include plant height, base diameter, plant health, maximum photosynthesis (Pmax) and light response (LR) of the sample plants.

Gmelina Germplasm Trial

Physical and genetic characteristics of mother trees have a profound influence on the subsequent growth of planted seedlings. It is common practice among smallholders in Leyte to collect seeds from unselected sources and with no consideration of the phenotypic and genotypic characteristics of the mother trees (Gregorio 2006). This is particularly true for widely planted exotics including gmelina (*Gmelina arborea*), mahogany (*Swietenia macrophylla*) and mangium (*Acacia mangium*). This research aims to compare the field growth performance of gmelina seedlings raised from various sources including trees of poor physical characteristics (crooked stem, unhealthy, heavily branched, short bole), trees with desirable stem form (healthy with straight and long bole) and trees with superior genetic quality from a seed orchard. The trial also aims to investigate the variation of photosynthesis from various layers of the plant canopy and to investigate the effect of pruning on the growth and photosynthesis of gmelina.

Three plots representing the three germplasm sources were established in relatively fertile soil. Each plot was planted with 100 seedlings of gmelina at a spacing of 3 m x 3 m. Only the inner 30 seedlings serve as experiment plants, with the outer two rows serving as border plants. Observations of various seedling parameters including basal diameter, height, health and stem for are made quarterly. Maximum photosynthesis rate (Pmax) and light response of planted seedlings were also collected using the portable Infrared Gas Analyser (IRGA).

Preliminary analysis of the data shows that there is a significant difference on the growth performance of gmelina seedlings depending on the germplasm source. The genetically superior seedlings and seedlings from selected sources outperformed the seedlings from the unselected mother trees both in terms of height and diameter growth. A follow-on experiment is designed to further investigate the initial findings of this trial.

Trial of Gmelina and Mahogany Planting Stock of Different Physical Quality

Seedling quality is expressed by physical characteristics and genetic make-up. High physical quality is crucial especially for the initial establishment of seedlings in the field. Training sessions and nursery and plantation manuals, for example those of Carter (1987), Wightmann (1999) and Evans and Turnbull (2004), have emphasized the importance of the physical quality of seedlings. To support the technologies demonstrated in training sessions and those indicated in the reading material, a field trial investigating the impact of low seedling physical quality on the growth of seedlings in the field was established.

Seedlings of gmelina and mahogany with varying physical qualities including bent stems, lanky shoots and damaged root systems due to being over-mature were obtained from private and government nurseries. Seedlings with J-roots and those with the ideal

characteristics (i.e. sturdy, straight stem and with straight taproot) were raised for this trial in the VSU nursery.

Seedlings of mahogany and gmelina were planted in two blocks. Each block consists of five plots corresponding to the five treatments (i.e. bent shoots, lanky shoots, over-mature, J-rooted, and with high physical quality). Twenty one trees are planted in each plot on a 3 m x 3 m spacing but only the inner five trees in each plot are the experiment samples. The performance of seedlings in terms of survival and increase in basal diameter and height is monitored every two months. The health condition of the seedlings is also assessed.

Mahogany and Gmelina Thinning Trial

Thinning or the removal of usually the inferior trees in the stand is one of the silvicultural activities that should be done to maximize financial returns of the plantation. While thinning has been advocated and demonstrated in training sessions on tree plantation management, farmers are generally reluctant to remove some of the trees in their plantations. Data have been shown to farmers to demonstrate the improvement of the stand after the thinning process but there is no actual demonstration site showing the positive impact of thinning. As a demonstration site, thinning trials were established in mahogany and gmelina plantations in Bato and Maasin.

Two 20 m x 20 m plots were established in each of the mahogany and gmelina plantations. One plot was subjected to thinning and the other plot was left unthinned. The diameter at breast height (dbh), merchantable height and crown diameter of trees within each plot were measured prior to the thinning operation. Inferior trees within plots to be thinned were identified, marked and felled. The bases for determining the inferior trees within the plots were stem form, height, health and dbh. Measurements of dbh, merchantable height and crown diameter of trees in the unthinned plots and trees left in the thinned plots were undertaken.

IMPLICATIONS OF THE TRIALS FOR PROMOTING SMALLHOLDER FORESTRY

The lack of information on tree farming technologies is an impediment in promoting smallholder forestry. IEC campaigns on nursery seedling production and plantation establishment and maintenance in the form of training and distribution of extension material have been undertaken by DENR and non-government organizations. In spite of these IEC activities, few smallholders have put these technologies into practice.

While the field trials will investigate the effects of various treatments on the growth performance of the planted trees, the trials are also designed to support the information conveyed during training sessions and the printed extension material. The trials will showcase the impacts of appropriate practices, thus providing actual learning experience on the benefits of following the appropriate tree farming technologies.

- The continuous variable spacing trial will demonstrate the appropriate spacing when planting trees on farms;
- the mixed species planting trial will show the complementarity effects of planting legumes with non-legume trees;
- the gmelina germplasm trial will showcase the importance of using superior germplasm from a selected source;
- the trial using seedlings with varying physical qualities will emphasize the importance of considering the physical quality of seedlings as they are produced in the nursery.
- The shading trial will validate the notion that dipterocarps will not grow well when planted in open sites.

- The thinning trial will demonstrate the importance of removing the inferior trees in the stand to bolster the growth of the remaining trees.

The billboard placed on the nearest major road will inform people of the existence of the trial and invite those interested to visit the trial. The labels of the plots will provide information about the treatments so that visitors can compare the effect of the treatments.

The direct observation by tree farmers of the difference in growth performance of trees among the different treatments together with a simple presentation of information generated from the analysis of the data are envisaged to provide useful and effective lessons for promoting smallholder forestry. It should be noted, however, that a demonstration planting is just one of the several tools used to improve the silvicultural knowledge of smallholders. While the trial provides visual learning, it should not be treated as a stand-alone extension method but rather as one coupled with other extension tools including the constant face-to-face contact with the extension agent.

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