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Estimated Financial Performance of Exotic and Indigenous Tree Species in Smallholder Plantations in Leyte Province

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ABSTRACT

This paper examines the need for estimates of financial performance of individual tree species for promoting smallholder forestry on Leyte Island in the Philippines, and presents some initial estimates of net present value and internal rate of return for smallholder plantings of indigenous and traditionally grown (exotic) tree species. Levels of profitability are found to be marginal for commercial production, particularly for native species. Data deficiencies are noted, and improved estimates of tree growth rates and rotation lengths in particular are needed to improve predictions of financial performance of smallholder forestry.

Keywords: Leyte smallholders, indigenous species, net present value

INTRODUCTION

Globally, there has in recent years been particular interest in smallholder forestry, and in the growing of indigenous species, in both developed and developing countries. In the past, indigenous species were available from native (natural) forests, but large areas have been converted to non-forest or conservation forest land uses, making them unavailable to timber industries. While some indigenous species have been recognized to have outstanding timber qualities, in general little information is available about their growth performance in smallholder plantations. Further, the established supply chain and generally more rapid growth rates of exotic species have led to them being favoured for plantation use.

In the Philippines, there has been a policy shift from industrial to smallholder and community forestry, as a more socially acceptable form of timber production (Harrison there is typically little experience in growing indigenous species in plantations, and hence a lack of information about site and silvicultural requirements and growth performance.

From a forest policy perspective in the Philippines, there are a number of arguments for growing indigenous species:

- Outstanding timber properties, suitable for high-value uses – an issue of wood price and perhaps export earnings.
- Better suited to the climate and soil types – which should influence growth rates.
- Biodiversity conservation, particularly where the timber species are rare and endangered – the case of the 'perceived important but endangered native tree species' (Mangaoang 1998, p. 60).
- Better for wildlife habitat because they are part of the natural environment.
- More suitable for mixed-species plantings – particularly where the species combinations exist in native forests.
- Smallholders are more interested in growing indigenous species than exotics, hence government smallholder forestry programs may be more readily promoted and more cost-effective. Evidence suggesting this is the case is reported by Mangaoang (1998), Emtage (2004) and Gregorio *et al*. (2005b).
- Greater attractiveness from a landscape aesthetics viewpoint.
- Perceived problems with exotics, e.g. prone to windthrow, allelopathy and dry up rivers.

While these advantages of growing indigenous species may be real, it could also be that the long rotation period, lower wood quality in plantations than natural forests, and lack of market recognition or processing capacity for indigenous species, will lead to lower financial returns. In this context, it is useful to have estimates of the financial performance of a range of indigenous and exotic species on smallholder tree farms.

METHOD OF ESTIMATION OF FINANCIAL PERFORMANCE

For investments which incur substantial costs up-front and for which returns are not realised for a number of years into the future, financial evaluation is typically in the form of discounted cash flow (DCF) analysis. In the Philippines context, the term 'cash flow' must be viewed to include not only financial return to the grower (cash inflows) but also the value of forest products used on-farm (cash outflows avoided). For example, farm-grown timber may be used on the farm for house construction or repairs, prunings and thinnings may be used for fuelwood or organic fertilizer, and edible materials from dual-purpose trees (particularly fruit) may be consumed by the farm family. Such plantation outputs substitute for purchased products and are in effect a cost saving to the grower.

DCF analysis can generate a number of financial performance criteria, the most useful with respect to smallholder forestry being net present value (NPV) – a measure of overall net payback – and internal rate of return (IRR) – a measure of the rate of profitability. The land expectation value (LEV) – an alternative to NPV calculated on the basis of an infinite sequence of rotations – allows comparison of financial performance of species with differing rotation lengths, although for smallholders the usefulness of this criterion is limited by short planning horizons. Benefit/cost ratios are not particularly relevant to private (as distinct from social) investment analysis, while the payback period is normally defined by the rotation length. The annual cash flow pattern and year of peak deficit can be useful supplementary information.

The Financial Model and Assumptions of the Analysis

The Philippines Smallholder Forestry Financial Model (PSFFM) (Venn *et al.*, 2000b; Venn and Harrison, 2000; Harrison *et al.*, 2004) has been adapted for this analysis. Tree farm products are limited to what is likely to be saleable at present in Leyte Province, including lumber, poles and fuelwood. No differentiation of cost and yield is made with regard to size or configuration of planting, though tree growth and production costs would probably vary between situations, e.g. between woodlots, fenceline plantings and undercropping situations. All financial estimates are made on a spatial unit of one hectare. In that smallholders face very high interest rates when borrowing money, even in real terms, a real discount rate of 15% has been adopted.

The financial model (PSFFM):

- provides a set of default plantation or woodlot costs (excluding the price of land), the values of which can be modified by the user;
- allows for the discount rate to be entered by the user;
- accepts a number of yield and price parameters for up to three plantation products (e.g. fuelwood, poles, sawlogs);
- allows for sequential harvests of a given stand at nominated stand ages and adjusts subsequent yields according to the volume of timber removed;
- generates the performance indicators of NPV, LEV and IRR; and
- has provision for sensitivity analysis and breakeven analysis with respect to mean annual increment (MAI), rotation length and timber price.

Taxation implications have not been modelled; in most cases smallholders would pay little or no income tax.

Sources of Physical and Financial Data

Estimation of harvest age and yield for species which are not normally grown in plantations is a challenging task. This problem was faced in research into growth performance of rainforest timber species in North Queensland (e.g. Dayananda *et al.*, 2002), where a Delphi survey of foresters was used to obtain subjective opinions of growth parameters. It soon became apparent in the smallholder forestry research that there is a critical lack of data on stand growth for the less frequently grown species, and in some cases even a lack of information about suitable uses of the timber (e.g. whether well suited for furniture, construction, poles or fuelwood).

ERDS (1998) estimated high profitability for timber production for a range of native and exotic timber species. Carandang *et al.* (2000) concluded that smallholder forestry could be profitable with internal rates of return (IRRs) of between 18% and 45% for popular species including gmelina, mangium, bagras and mahogany. Further evidence of financial viability has been provided by Venn *et al.* (2000b) and Aggangan (2000). A considerable amount of physical and financial performance information is available in the 'grey literature'.

Harvest ages for indigenous species are based on various unpublished estimates, and are subject to high uncertainty. The harvest ages for exotic species is consistent with current industrial forestry practice in the Philippines for these species. Assumptions are made about the clearfall harvest composition, in terms of percentages of lumber and fuelwood. Stand growth rates have been based on ERDS (1998) and unpublished Philippine forestry data (particularly from reports and dissertations from the University of the Philippines at Los Baños). MAIs are used because lack of data has impeded the development of growth curve and yield models, and some existing yield models appear overly optimistic. Yields (MAIs) are based on those obtained in industrial forestry, and may not be achievable where poor silviculture is employed by smallholders.

Various data sources were drawn upon in the financial analysis. The cost data draw mainly on that reported by Venn *et al.* (2000b). It has not been possible to identify cost differences associated with growing different tree species in the Philippines, hence generic costs have been used. The opportunity cost for on-farm labour has been set at about 50% of the minimum award wage rate, on the assumption that tree farm maintenance can be conducted in slack times for other farm work. Timber prices reflect stumpage prices currently received by tree farmers in Leyte.

SPECIES AND SILVICULTUAL REGIMES EXAMINED

The species selected for financial modelling are listed in Table 2, together with some general information about the tree and timber uses. Three exotic species are included which are commonly grown in industrial and smallholder plantings in the Philippines. Four indigenous species have been selected on the basis of relatively rapid growth, high value timber, and interest of smallholders.

Table 2. Selected species and their timber uses

Common name	Brief description	Timber uses
Mangium[b] *Acacia mangium*	Maximum dbh of 90 cm and height 30 m (typically 15 m)	Light-duty building (framing and weather-boarding), posts, charcoal, firewood
Gmelina[b], Yemane *Gmelina arborea*	Maximum dbh of 50 cm and height 15-20 m. Very fast growing, can survive up to 30-40 years.	Carpentry, joinery, furniture and other household materials, posts, fixtures, musical instruments, boat decking, veneer, fuelwood
Mahogany[b] *Swietenia macrophylla*	Maximum dbh of 4.5 m and average height 30-40 m	Furniture
Bagras[a or b] *Eucalyptus deglupta*	Maximum dbh of 2 m and height of 60 m	Poles, construction wood, fuelwood, joists, studs, charcoal
Molave, Tugas[a] *Vitex parviflora*	Maximum dbh 1-1.5 m and height 25-30 m	Furniture-making, carvings and sculpture, carabao yokes, handles and novelties, railroad ties, ship building, wagon making, bridges, docks, firewood.
Narra[a] *Pterocarpus indicus*	A large tree 30 m tall or more; dbh of up to 2 m	Furniture, indoor construction, wood carvings.
White lauan[a] *Shorea contorta*	Maximum dbh of 1.8 m (typically 1 m) and height to 50 m (with clear trunk to 20 m)	General construction, mining timbers, boxes, crates, utensils, furniture, boat planking

a: indigenous species; b: exotic.

Harvest ages, clearfall harvest composition, timber price and mean annual increment (MAI) parameters are reported in Table 3. It is assumed that sawlogs are only harvested at clearfall, where trees will have diameters at breast height in excess of 30 to 40 cm, making them suitable for sawlogs and poles. Fuelwood and house construction poles are harvested in thinning operations earlier in the rotation, as well as at clearfell.

PLANTATION ESTABLISHMENT AND MANAGEMENT COSTS

A generic plantation cost model has been adopted, based on Venn *et al*. (2000a,b) but updated to 2004 prices[3]. Minor modifications are made for different species. As an illustration, the cost model for mangium is presented in Table 4[4].

Table 3. Yield and price parameters of selected species

Common name	Product	Harvest age (yrs)	Composition of clearfall harvest (%)	Timber price (peso/m^3)	Mean annual increment (m^3/ha/yr)
Mangium	Fuelwood	4,7,10	7	300	
	Poles	7,10	28	2000	20
	Sawlogs	10	65	2600	
Gmelina	Fuelwood	4, 7, 10	20	300	
	Poles	–	0	–	25
	Sawlogs	10	80	2500	
Mahogany	Fuelwood	4,15,25	7	300	
	Poles	15,25	28	2000	10
	Sawlogs	25	65	4000	
Bagras	Fuelwood	4,12,20	7	300	
	Poles	12,20	28	2000	18
	Sawlogs	20	65	3000	
Molave	Fuelwood	7,21,35	7	300	
	Poles	21,35	28	2000	6
	Sawlogs	35	65	4000	
Narra	Fuelwood	7,21,35	7	300	
	Poles	21,35	28	2000	7
	Sawlogs	35	65	5000	
White lauan	Fuelwood	7,21,35	7	300	
	Poles	21,35	28	2000	10
	Sawlogs	35	65	4500	

FINANCIAL PERFORMANCE ESTIMATES AND SENSITIVITY ANALYSIS

Based on a mean annual increment of 20 m^3/year, the stumpage prices indicated in Table 3, and real discount rate of 15%, the NPV for mangium is PhP12,641/ha. A sensitivity analysis is presented in Table 5 for a range of sawlog stumpage prices and

[3] $US 1 = 50 Philippines pesos (PhP) approximately.

[4] Costs are assumed to be incurred at the beginning of each year. Costs at the beginning of the first year (establishment costs) are not discounted.

MAIs. This suggests that at prices of less than PhP2000/m^3 or yields of less than 20 m^3/ha/year, the growing of mangium is unlikely to be financially viable.

Table 4. Plantation costs by year for mangium

Irregular management costs		
Expense	Year	Cost (PhP/ha)
Survey and mapping	1	0
Seedling production (many get for free, others might pay 3P/tree)	1	2240
Land preparation - brushing (burning)	1	1400
Land preparation - hole digging	1	1470
Planting	1	2310
Fertilisation 1	1	2170
Fertilisation 2	2	0
Weeding by hand	1	0
Weeding by hand	2	2625
Blanking	2	700
Form prune	2	0
Second prune	3	504
Thin 1	4	14000
Thin 2	7	42000
Cartage for 2nd thinning	7	25200
Roading and skid formation for 2nd thinning	7	16800
Sales commission and management for 2nd thinning	7	25200
Final clearfall logging and loading	10	54840
Cartage for clearfall volume	10	41130
Roading and skid formation for clearfall	10	4030
Sales commission and management for clearfall	10	12100
Annual management costs		
Supervision, management and administration overheads		200
Protection and maintenance of infrastructure		250

Table 5. NPV for mangium at various growth rates and stumpage prices

Stumpage price (PhP/m^3)	MAI (m^3/ha/yr)				
	10	15	20	25	30
1500	-91,902	-69,970	-48,038	-26,106	-4,174
2000	-77,281	-48,038	-18,795	10,448	39,690
2500	-62,660	-26,106	10,448	47,001	83,555
3000	-48,038	-4,174	39,690	83,555	127,419
3500	-33,417	17,758	68,933	120,108	171,283

The standing volume time path – with assumed thinnings in years 4 and 7 and final clearfell harvest in year 10 – is presented as Figure 1.

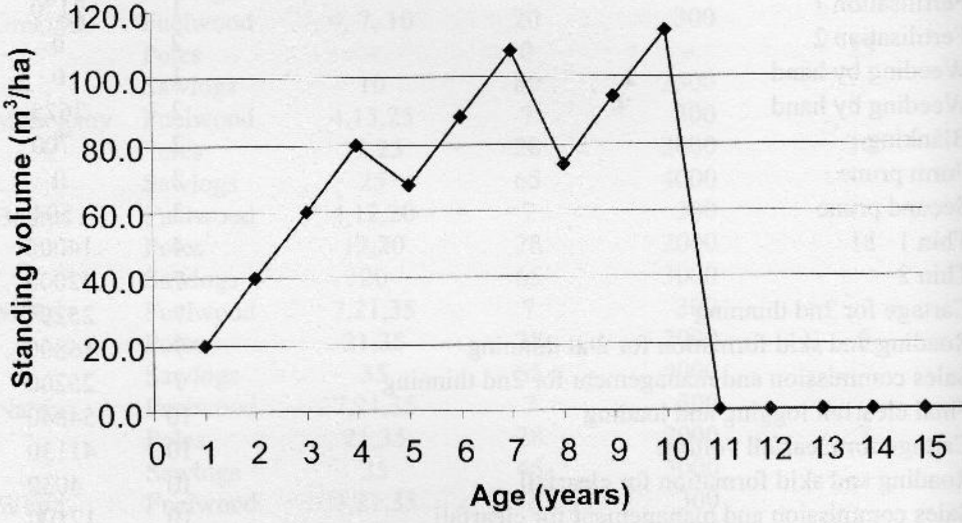

Figure 1. Standing volume versus age for mangium plantation

The estimated NPVs, LEVs and IRRs (single rotation) are presented for all species in Table 6. Gmelina is found to be the most profitable species, followed by bagras and mangium, with mahogany marginally unprofitable. The native species fail to achieve a 15% real return on investment.

Table 6. Financial performance criteria for the selected species

Species	NPV(PhP/ha)	LEV(PhP/ha)	IRR (%)
Mangium	12,641	14,602	17%
Gmelina	30,782	35,556	31%
Mahogany	-15,222	-13,651	12%
Bagras	13,723	12,709	18%
Molave	-41,764	-36,591	(Negative)
Narra	-36,674	-32,132	7%
White lauan	-32,930	-28,851	7%

LIMITATIONS OF THE ANALYSIS AND FURTHER INFORMATION NEEDS

The financial analysis is subject to a number of limitations, including:

- Future timber prices will depend on a number of domestic and international factors associated with timber production and trade, and are subject to high uncertainty.
- No allowance is made for non-timber forest products.
- The analysis has been conducted from the viewpoint of private profitability, rather than social desirability, without any allowance for environmental and social benefits.
- Species mixtures are not included.
- The timber yields adopted for exotics may be optimistic for smallholder forestry.
- Plantation production relies on estimated harvest age and MAI, whereas better estimates might be obtained through stand yield models.
- Tree growth performance is not differentiated by site conditions, an average site being assumed.
- The analysis does not allow for the practice of some smallholders of harvesting only a few of the larger trees at any time, for on-farm use.

Notably, estimated financial performance is somewhat lower than other reported estimates. Hopefully, in the near future, information will be obtained for a greater range of species, cost and revenue estimates will be refined, and improved stand yield functions based on tree farm experience will become available for at least a few key species[5]. In the longer term, it is hoped that reliable growth and yield data will become available for mixed-species and agroforestry plantings.

[5] Development of yield tables for the main commercial smallholder timber species on Leyte Island is currently being undertaken in ACIAR project ASEM/2003/052.

DISCUSSION

It would appear that in Leyte returns from growing indigenous species do not compare favourably with those from growing traditional exotics including gmelina, mahogany and mangium. The indigenous species in general have longer rotations than traditionally grown exotics and, given the high discount rate applicable in the Philippines, this leads to lower NPV and IRR levels even when timber prices are considerably higher.

The research reported here has been designed in part to promote critical discussion about financial performance of timber plantings, e.g. whether the available estimates are reasonable. The research has also identified information gaps which will help to prioritise future research. For example, it is clear that there is a lack of information about tree growth rates and harvest ages, particularly for indigenous species.

It may be that a situation exists where there is limited demand for high-quality native timbers for furniture production because the timber is in low supply and not available on a regular basis. Such a situation would reduce the price premium for very high quality native timbers relative to exotic species. An increase in production of high-quality native timber could lead to greater utilization and improved markets for tree growers. A further complication for Leyte tree farmers relates to small plantation areas and the need for buyers, particularly those from Cebu who are prepared to pay higher prices than local merchants, to assemble sufficiently large lots to justify transactions costs.

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