



Agroforestry from Existing Timber Resources

on the Northern Tablelands

**A report for the RIRDC/LWRRDC/FWPRDC
Joint Venture Agroforestry Program**

**by David Thompson
Centre for Agricultural and Regional Economics**

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FOREWORD

Currently there are extensive areas of native forest on private land in the Northern Tablelands of NSW. This report examines the potential benefits to landowners of managing these privately owned native forests through financial assessments on four farms. The report also examines the potential benefits to landowners of more intensive forest management and marketing approaches.

RIRDC's involvement in this project and in the Joint Venture Agroforestry Program, is part of the Corporation's Agroforestry and Farm Forestry R&D Program which aims to foster integration of sustainable and productive agroforestry within Australian farming systems.

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Peter Core

Managing Director

Rural Industries Research and Development Corporation

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EXECUTIVE SUMMARY

In the Northern region of NSW there are large existing native timber resources on private property which are under-utilised. In terms of forest industry development, it makes little sense to focus all farm forestry activity on plantations and ignore the potential contribution from the existing resource.

In this study, whole-farm budgeting techniques were used to assess the financial effects of managing existing native timber on four case study farms. These farms are located on the Northern Tablelands of NSW, operate a variety of livestock enterprises and have quite different timber resources in terms of species, quality, growth potential and the scope for management and value adding.

Results show that where timber is managed and sold at stumpage prices, the improvement to farm financial performance is marginal. The analysis indicated that incurring timber management costs in the order of \$200/ha cannot be justified where stumpage prices of \$18-25/m³ are achieved. Under these conditions, most of the financial benefits were derived from increases in livestock carrying capacity after thinning.

However, with the exception of dense cypress stands, it is unlikely that the stem densities for eucalypts in the region would result in such high thinning expenditures. Under these conditions, managing existing timber is feasible from a financial viewpoint. On some sites, selective logging alone may be sufficient to improve timber yields.

In terms of using revenues from existing timber management to fund plantation establishment, in most case the revenues fell well short of covering establishment costs.

A key information gap for the Northern Tablelands region is the response of native timber species to thinning. Where thinning doubles sawlog yields, managing existing timber becomes a more attractive financial option.

The ability to value-add native farm timber greatly enhanced the financial performance of the enterprise. Selling both sawn and dried and dressed timber off farm converted a marginal operation into one which generated significant improvements in net farm income. However, these activities rely heavily on the ability of landholders to access markets.

The lack of markets for thinnings in the region is a major financial hurdle, particularly in terms of cash flow effects. The ability to reduce or negate thinnings costs with thinnings sales would greatly enhance the scope for managing existing timber on the Tablelands.

At a regional level, it is likely that an integrated approach to forest industry development will be required for farm forestry from all sources to become a form of land use which can compete with traditional enterprises. Issues such as timber

volume and quality, infrastructure, transport, processing capacity and silvicultural skills all need to be addressed on a regional basis. Some form of landholder networks will be required to cover these issues in a cost-effective manner.

In the absence of an integrated regional approach, the likely outcome is a small number of landholders operating in limited niche markets.

1. Introduction

The focus of this study is the potential financial contribution from the management and sustainable harvest of existing native timber on Northern Tablelands/North Coast farms. The general location of the study area is shown in Figure 1.1.

Figure 1.1 Northern Region Study Area

Figure 1.1



The timing of this work is pertinent to the current policy environment surrounding both the forestry and agricultural industries in Australia. The development of Regional Forest Agreements (RFAs) throughout Australia has led to an increased focus on private native forests as sources of sustainable timber and the provision of environmental benefits (FORTECH 1998).

Recent reductions in the harvest volumes of timber from SF NSW have prompted some timber processing operations to increase their attention on private sources of timber to maintain the level of mill throughput to maintain/improve business performance. Other processors have anticipated the changes in timber supplies from Crown sources and have modified their product mix to capitalise on timber species which provide a higher return as a method of off-setting any reduction in throughput.

The basis on which the royalties paid for State Forests' of NSW (SF NSW) timber are formulated are also under review. This is in line with a general perception that the future demand for timber on a global basis will outstrip supply and, as a result, timber prices are likely to rise to reflect the demand and supply situation (eg. see Wright 1996).

The changes reflect a move toward extracting maximum economic value from the timber resource, and directing higher quality timber species toward high value end uses (for example decorative and feature grade products as opposed to structural materials). There is also a perception amongst some commentators that native Australian hardwoods possess unique features and qualities and that current timber royalty levels do not reflect this.

At the same time, recent drought and low commodity prices have encouraged many farm managers to seek alternative sources of on and off-farm income. The sale of farm timber has been promoted as an opportunity in this regard. In addition, there is scope for using some timber products on-farm as a cost saving measure (eg. fencing material). To date however, the focus has been on plantation timber and the significant existing native timber resource on private property has been largely ignored.

In NSW any form of land clearing is subject to government regulation. Under the current State and Environmental Planning Policy No. 46 (SEPP 46, recently replaced by the Native Vegetation Conservation Act), there is an exemption¹ for private native forestry where native forest is being selectively logged on a sustainable basis or is currently being managed for forestry purposes/timber production (NSW Department of Land and Water Conservation 1997).

The current legislation therefore provides an avenue whereby private landholders can manage existing native forest for timber production. This procedure is subject to some guidelines which are discussed in more detail below. However, in terms of the management and retention of native vegetation, the policy may have far reaching ramifications.

Under existing legislation, landowners may clear up to two contiguous hectares per annum. For many landholders, this is perceived to be an economically attractive option as existing native vegetation may be deemed to have no economic value and therefore is gradually replaced with alternative income-generating land uses (grazing and cropping for example).

Attaching an economic value to native timber which provides scope for regular cash flows may generate the incentive required to manage and maintain tree cover. This could result in a shift in the way many landholders view the timbered portions of their properties. This issue will be explored specifically in this study.

¹ The forestry exemptions under SEPP 46 are expected to remain under the new legislation.

In addition to the existing timber situation, there has been a concerted effort by the Federal Government to increase the plantation forest estate in Australia. The Federal Government recently launched *Plantations for Australia - The 2020 Vision* (DPIE 1997) which enunciated the objective of attracting \$3 billion of private investment for plantation expansion over the next 23 years.

If private landholders, particularly those operating farm businesses are to be part of that investment, it is likely that the option to invest will be more attractive if it is revenue neutral - that is, initial cash outlays for plantation establishment are met (or partly met) by alternative sources of income other than those generated by existing farm enterprises.

The recent poor financial performance in many sectors of agriculture coupled with the long-term nature of plantation farm forestry investments and early negative cash flows are key obstacles to the wider adoption of private plantations on farms.

Revenue neutrality might be achieved through joint ventures with private investors or SF NSW where landholders provide land for forestry establishment in return for a share of timber proceeds. The joint venture partner would supply most or all of the initial cash outlays for the plantation.

An alternative approach and one which is addressed in this study is the scope for the revenues from existing timber harvest and sales to improve farm financial performance and perhaps fund plantation establishment and/or environmental tree plantings.

Anecdotal evidence from some landowners in the Northern Tablelands region suggests that there is considerable interest in the management of existing commercial timber to generate income. There is also some interest in planting additional commercial species for timber as well as non-commercial timber species for stock shelter and environmental/aesthetic purposes.

While some shelter/environmental plantings have been undertaken, there are a range of information gaps which are hindering the decision to pursue commercial timber activities - both the management of existing timber and plantation development. These include:

- Concern over, and a lack of understanding of, the environmental legislation which regulates the management of existing native timber for commercial purposes;
- A lack of information on the silvicultural requirements and related growth responses for native timber species in the region;
- Limited knowledge of the markets for existing timber species in the region; and
- Little information about the economic impacts on the farm business from existing timber management for commercial purposes.

It should also be recognised that despite these impediments, timber from private native forests has played a significant role in the NSW timber industry, as demonstrated in Table 1.1.

Table 1.1 Timber sourced from private native forests in NSW, 1995/96

Timber product	Proportion of logs sourced from private native forests
Hardwood sawlog	19%
Cypress pine	12%
Hardwood veneer log	6%
Poles, piles, girders	25%
Mining timber	42%
Pulpwood	3%
Sleepers	10%

Source: FORTECH 1998

The remainder of this study is set out as follows:

In section 2, an economic overview of forestry and agriculture for the study region has been constructed to provide an overall context for the case study evaluations at the farm level. There is also a summary of the current legislative requirements for the management of existing timber and a summary of some recent research on the silvicultural treatment of existing timber.

In section 3, the methods used to analyse the financial implications of existing timber management/harvest on case study properties is described. This includes a description of the economic model used and the assumptions made about silvicultural treatments, timber production, harvest levels and product sales. The options for using the revenues from existing timber for plantation establishment are also outlined. The results of the financial modelling work are presented in section 4 for each case study farm. In section 5, concluding comments and policy implications are made.

Regional economic context and forestry industry overview

2.1 Forestry industry

2.1.1 Contribution to the Northern regional economy

In an economic context, the timber industry has played a small but significant role in the Northern region of NSW. On a regional basis in 1993-94, the forestry industry has the following characteristics (Margules 1995):

Northern Region (Incorporates the Northern Tablelands study area)

- Contributed 1.5 per cent (\$81.4m) of the value of regional output;
- Contributed 2.0 per cent (1 278 jobs) to regional employment; and
- In particular townships (eg. Walcha - the base for the Fennings Pty Ltd hardwood mill), has a large local impact and is a key employer in the town.

Mid-North Coast Region

- Contributed 3.57 per cent (\$193m) of the value of regional output; and
- Contributed 3.51 per cent (2 753 jobs) to regional employment.

Richmond-Tweed Region

- Contributed 2.7 per cent (\$104m) of the value of regional output; and
- Contributed 2.36 per cent (1 477 jobs) to regional employment.

2.1.2 The Northern Tablelands timber processing industry and timber markets

It is important to recognise that there have been significant changes in the structure of the timber industry in Northern NSW during 1996 as a result of deferrals/cessation of native hardwood timber harvest from SF NSW and the creation of new National Parks. As a result, the regional forestry industry impacts described above have changed significantly (in general, exhibiting a reduction in the economic activity relative to 1993-94 levels).

Three large mills in the immediate Northern Tablelands study region (mills in Armidale, Glen Innes and Tenterfield) closed during 1996/97 as a result of changes to SF NSW timber supply conditions. Some of the timber allocation is now processed by mills on the North Coast and at the Fennings mill in Walcha.

At present, one large mill (Fennings Pty Ltd at Walcha) remains, together with a number of much smaller mills and mobile mill/farm milling operations. Most of these small mills are processing existing timber from private land.

The majority process local hardwood species, with the exception of the mill at Bingara which exclusively processes Cypress pine (*C. glaucophylla*), a mill at Tamworth which processes both hardwoods and cypress, the pole treatment plant at Kootingal which uses Radiata pine (*P. radiata*) and the Nundle saw-mill which utilises both hardwoods and Radiata pine.

The Fennings Pty Ltd mill at Walcha (which is the largest hardwood mill in NSW) processes a range of higher value species which are sourced from SF NSW reserves in the eastern portion of the zone. These include Spotted gum (*C. maculata*) and Ribbon gum (*E. viminalis*) which are marketed as high value feature grade products under the trade name 'Satin Ash'.

Figure 2.1 provides an overview of regional timber industry resources and timber flows. This is based on information from O'Neill (1994), mill surveys undertaken by CARE Pty Ltd in 1997 and SF NSW (personal communication 1997).

O'Neill (1994) examined existing native timber resources in two zones - a 100 km radius of Grafton and a zone which was 100-250 km from Grafton. The estimated sustainable annual harvests divided into key product categories from this analysis have been shown in Figure 2.1.

Taking into account that the O'Neill (1994) analysis does not show potential timber yields west of the New England highway and that parts of the Northern Tablelands study area cover both zones, it can be conservatively estimated that around 250,000 m³ of existing timber could be harvested annually from the study area.

The information in Figure 2.1 can be distilled into an origin-destination table (Table 2.1) which shows where timber is harvested within the study region and where it is processed.

Figure 2.1 Regional Timber Resources and Uses

Figure 2.1

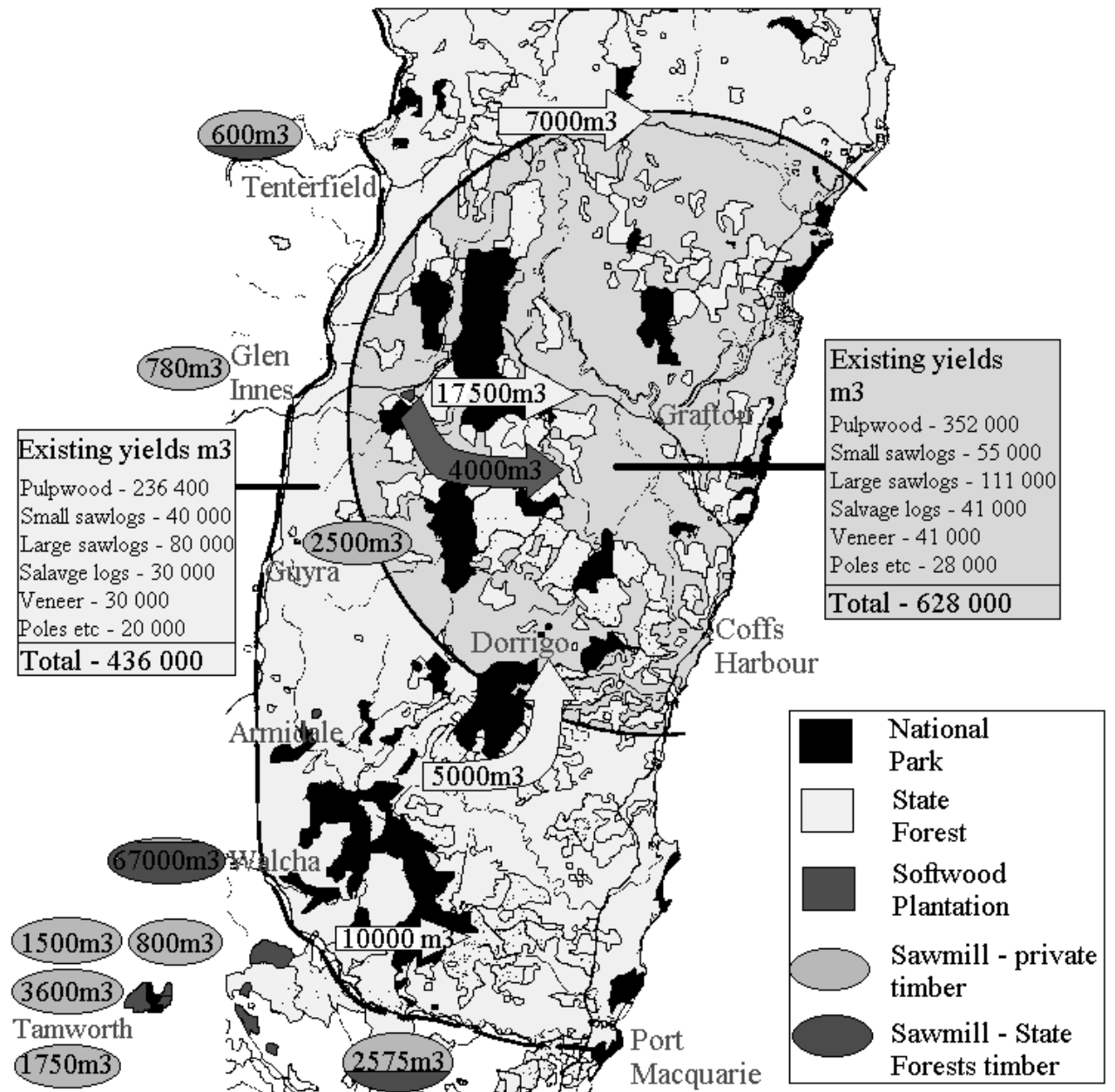


Table 2.1. Regional Wood Flows by Local Government Area 1997

New England Hardwood Flows (m³)

		Destination Mill LGA											
		Bellingen	Glen Innes	Grafton	Great Lakes	Kyogle	Nundle	Parry	Severn	Tamworth	Tenterfield	Walcha	TOTAL
Forest Source LGA	Dumaresq	5 000										15 000	20 000
	Nundle						775						775
	Parry							3 600		1 750			5 350
	Quirindi									1 500			1 500
	Severn		780	17 500					8 000				26 280
	Tenterfield					7 000					600		7 600
	Walcha				10 000							52 000	62 000
TOTAL		5 000	780	17 500	10 000	7 000	775	3 600	8 000	3 250	600	67 000	123 505

Figures in boxes = predominantly privately sourced timber

7000 m³ from private sources

New England Softwood Flows (m³)

		Destination Mill LGA											
		Bellingen	Glen Innes	Grafton	Great Lakes	Kyogle	Nundle	Parry	Severn	Tamworth	Tenterfield	Walcha	TOTAL
Forest Source LGA	Dumaresq						900						900
	Nundle												0
	Parry												0
	Quirindi												0
	Severn			4 000					8 000				12 000
	Tenterfield												0
	Walcha							800					800
TOTAL		0	0	4 000	0	0	900	800	8 000	0	0	0	13 700

Figures in boxes = predominantly privately sourced timber

Sources: SF NSW 1997, CARE Pty Ltd 1997

The bulk of the timber processed within the region is through the Fennings mill at Walcha and is largely derived from SF NSW. The remaining smaller mills in the region source timber almost exclusively from private property. Most of this is existing native hardwood timber. The exception is a small amount of *P. radiata* from private plantations processed at the pole treatment plant near Tamworth and Cypress pine from private land.

FORTECH (1998) have reported that, for NSW:

- 15 per cent of all Tablelands hardwoods are on private land;
- 42 per cent of all stringybark species are on private land; and
- 35 per cent of all white cypress is on private land.

These represent the most commercially significant forest types on the Northern Tablelands.

Also, for NSW:

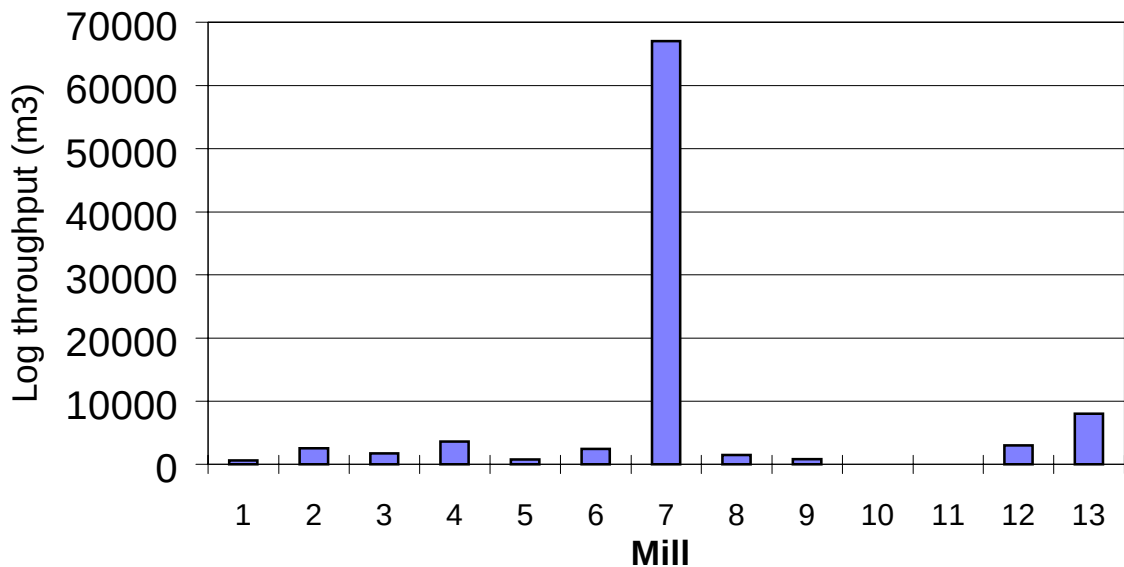
- 29 per cent of all coastal blackbutt is on private land; and
- 59 per cent of spotted gum is on private land.

These represent the most commercially significant forest types on the North Coast on NSW.

During 1997, CARE Pty Ltd surveyed the majority of the larger saw-mills in the region to gain an understanding of their requirements for timber in terms of species, quality, distances travelled to harvest, the products they produce and prices paid. The objective was to provide a basis upon which individual landholders could assess the marketability of existing timber on their properties. Several key findings from this survey are outlined below.

Figure 2.2 provides an overview of the throughput of regional saw-mills. The domination of the Fennings Pty Ltd mill in terms of the log volumes processed is clear. Fennings Pty Ltd is perhaps the only mill in the region which has made a concerted effort to target the high value end of the hardwood timber product range, and has shifted the product emphasis away from lower value structural materials toward higher value feature grade timbers (eg. wood panels, floor boards and mouldings).

Figure 2.2 Northern Tablelands Saw-mill Timber Throughput



Saw-millers were also asked about log dimension and species preferences. These findings are provided in Figures 2.3-2.5.

While there was considerable variation in the optimum length of logs required by Northern Tablelands mills, in general a 50-60 cm centre diameter was viewed as the optimum for hardwood logs. Although small logs (less than 30 cm centre diameter) were not suitable for sawing, very large logs were not a problem for most mills as they could be reduced with a chain-saw prior to running them through the breakdown saw.

In terms of species preference, most of the small hardwood mills expressed a preference for the native Northern Tablelands hardwood species with which they already had considerable experience. Two species stood out as being desirable but in short supply. These were *E. saligna* (Blue gum) and *C. maculata* (Spotted gum). Both were viewed as high value species suited to the production of flooring and decking type material. Unfortunately, for the majority of Northern Tablelands landholders, these species are restricted in their growth requirements to the higher rainfall eastern portions of the Northern Tablelands and are more prevalent in coastal areas.

Figure 2.3 Preferred Log Length - Northern Tablelands Mills

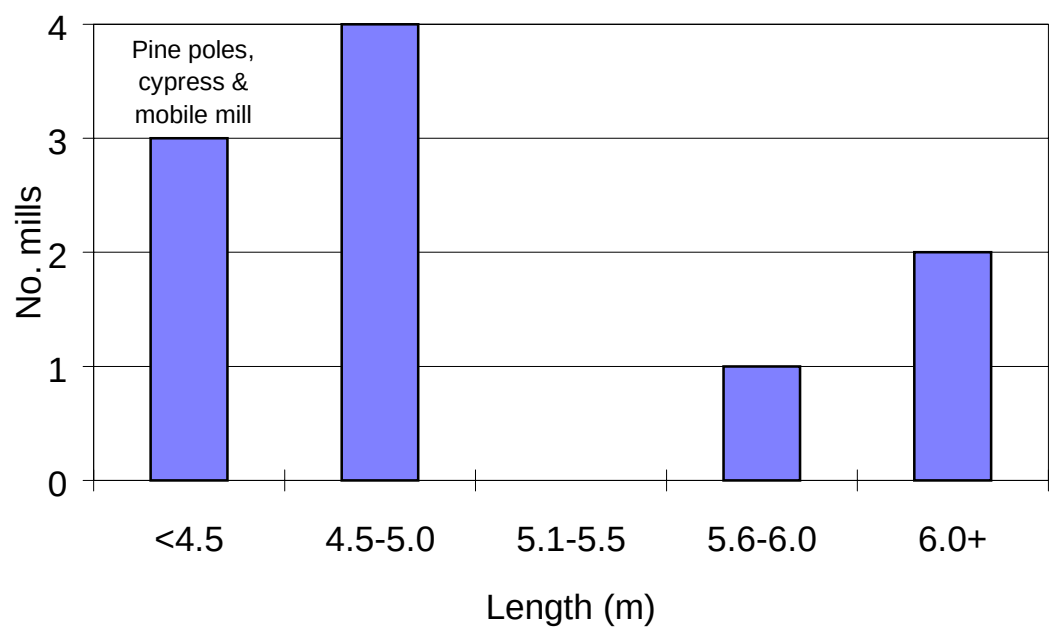


Figure 2.4 Preferred Log Centre Diameter - Northern Tablelands Mills

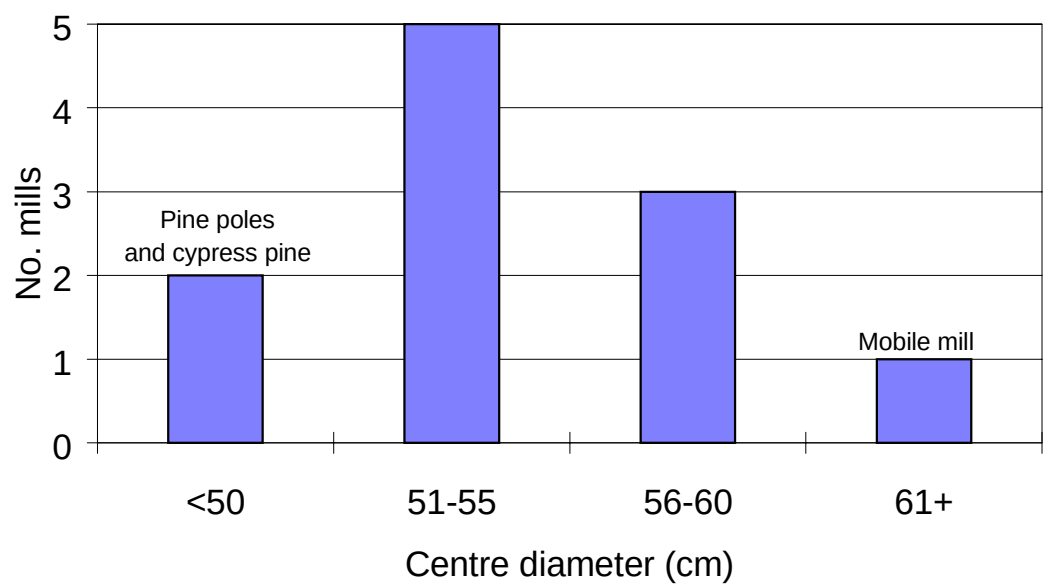
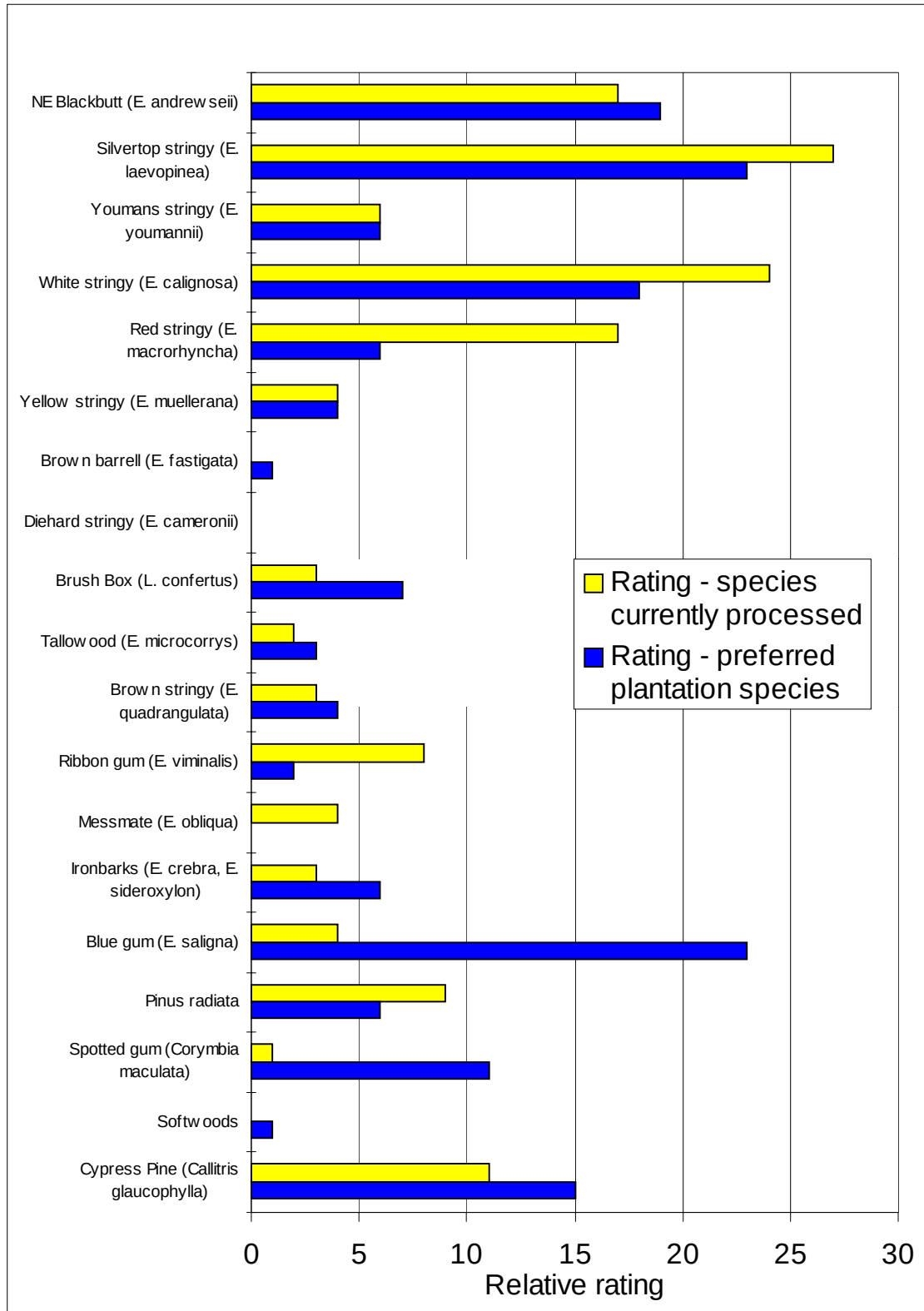


Figure 2.5 Timber Species Currently Processed and Preferred - Northern Tablelands Mills

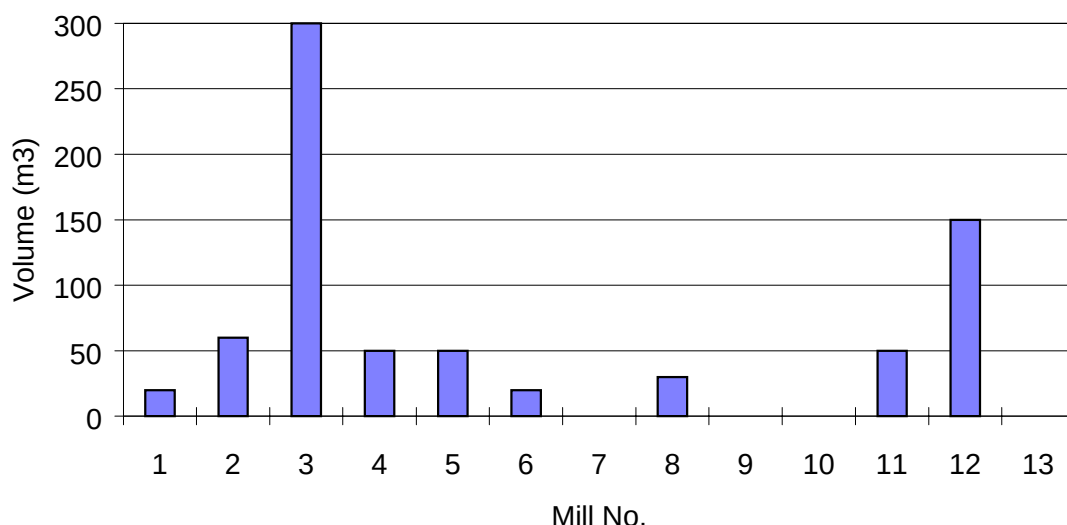


There was also some interest shown by mills processing hardwoods to move into Cypress pine milling. This may be a reflection of attitudes toward resource security, given the increasing pressure to restrict the harvest levels of native hardwoods. There is also a perception (shared by some saw-millers and pastoralists alike) that cypress is a ‘weed’ and that there would be less resistance to its removal for timber processing.

In addition, cypress responds well to silvicultural management, particularly thinning operations where density is high. The enhanced growth response from cypress is regarded as being more predictable than for existing stands of native hardwood species (SF NSW, personal communication 1997).

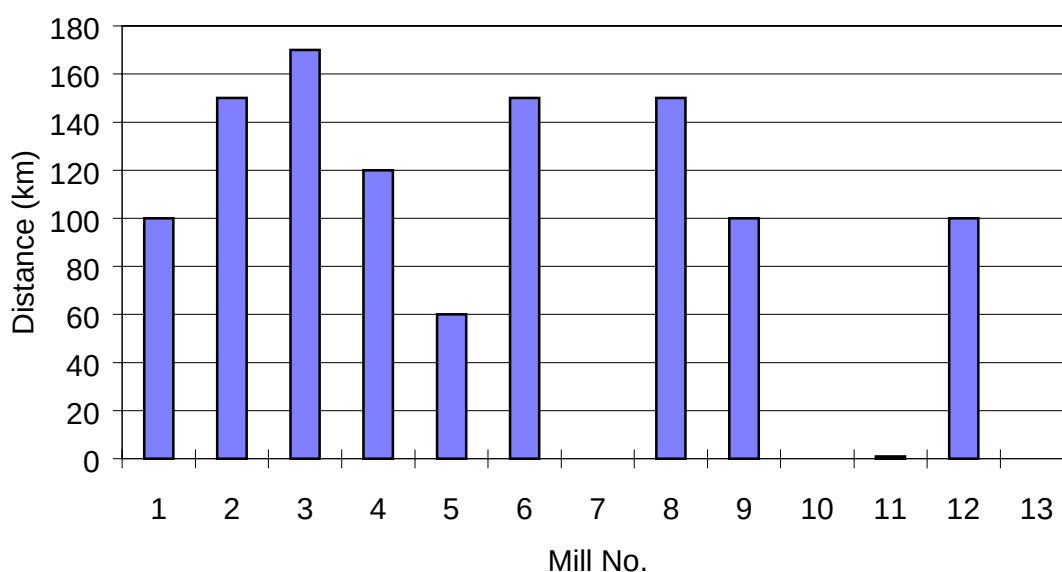
Any timber harvesting operation requires the mobilisation of equipment and there are economies of size and scale associated with this process. For this reason, saw-millers were asked about the minimum log volumes they would be willing to harvest and the distances over which they could economically haul logs. These responses are summarised in Figure 2.6 and Figure 2.7.

Figure 2.6 Minimum Log Volumes - Northern Tablelands Saw-mills



It is clear that while many saw-mills are willing to extract relatively small parcels of timber (around 50 m³) there is considerable variation in the distances they are willing to haul that timber. To some extent, haul distance is determined by the value mills are able to extract for their sawn products - higher value products warrant sourcing timber from more distant areas.

Figure 2.7 Maximum Log Haul Distance - Northern Tablelands Saw-mills



The willingness of saw-millers to extract relatively small volumes of timber is closely linked to the availability of the resource or their need to fill orders.

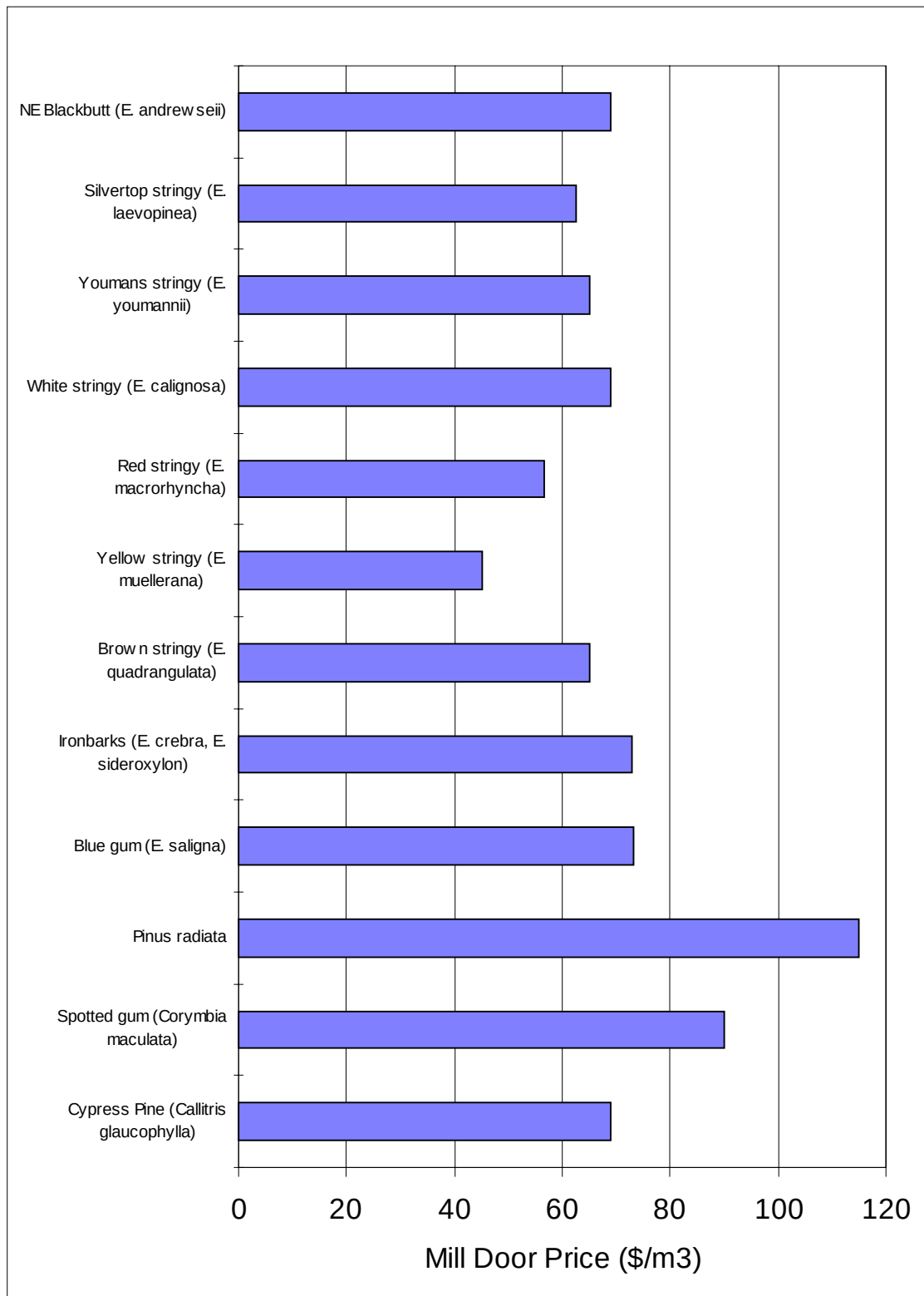
Information on mill door prices for logs of various species were also collected. These are summarised in Figure 2.8. Mill door prices include the costs of cutting, snigging and hauling and should not be confused with stumpages or royalties which are net of these costs.

Although the cut/snig/haul operation typically costs around \$35/m³ (SF NSW, personal communication 1997), this will vary with factors such as ease of site access and haul distance.

Where landholders perform some of the cutting and snigging operations themselves, the price they receive for their timber should be considerably higher as these costs do not need to be met by the processor.

Anecdotal evidence from Northern Tablelands landholders and saw-millers suggests that in most cases, the landholder will allow the saw-miller or their contractor to perform these operations and, therefore, will be paid a per cubic metre stumpage price for the timber.

Figure 2.8 Indicative Mill Door Log Prices - Northern Tablelands Saw-mills



Agricultural Sector

Agriculture in the study region is dominated by grazing activities, particularly wool and beef cattle production. In direct terms, agriculture represented approximately 19 per cent of the value of regional output and 18 per cent of employment in the Northern region in 1995-96 Northern Region input-output tables compiled by CARE Pty Ltd (1998).

Recent drought and low wool and beef prices will have altered this situation to some extent. These events have also prompted many landholders in the region to seek alternative sources of on and off-farm income.

Many properties in the region have existing forested areas which may be suitable for management and/or sustainable timber harvest.

The typical native timber species on Northern Tablelands properties changes markedly moving from east to west. Properties in the eastern portion of the region have a mix of coastal and New England species including Ribbon gum (*E. viminalis/nobilis*), New England blackbutt (*E. andrewseii*), Blue gum (*E. saligna*), Messmate (*E. obliqua*), Spotted gum (*C. maculata*) and Tallowood (*E. microcorrays*). These species tend to be the more desirable, higher value species which require higher rainfall to thrive.

The central portion of the region is dominated by the Stringy bark species including Silvertop stringy (*E. laevopinea*), New England stringy (*E. caliginosa*) and New England blackbutt (*E. andrewseii*).

The west of the region contains species such as Cypress pine (*C. glaucophylla*), Rough barked apple (*A. floribunda*) and various lower value stringy bark species including Red stringy (*E. macrorhyncha*), Brown barrel (*E. fastigata*), Diehard stringy (*E. cameronii*) and Brown stringy (*E. quadrangulata*).

2.3 Legislation governing the management of native forests for timber production

The SEPP 46 legislation sets out the guidelines for landclearing in NSW. In this legislation, private native forestry is defined as ‘the clearing of native vegetation in a native forest in the course of its being selectively logged on a sustainable basis or managed for forestry purposes (timber production)’. As noted above, SEPP 46 has been replaced by new native vegetation management legislation, though the mechanisms to operationalise this legislation were not in place at the time of writing.

Private native forestry is exempt from the general land clearing regulations under two conditions which are explained below. Native forests are defined as:

“A ... structure ... where the tallest vegetation is mainly woody, usually with a single stem, having a mature or potentially mature, height exceeding five metres, and with a foliage cover of overstorey trees about equal to or greater than 20% of the ground area” (NSW Department of Land and Water Conservation 1997).

Exemption 1 - A private native forest being selectively logged on a sustainable basis.

Under this option, clearing is allowed where there is an existing native forest which is being logged selectively on a sustainable basis. In this case, ‘sustainable basis’ means logging which, at a minimum, maintains:

- habitat value;
- an uneven age forest structure;
- more than 50% retention of trees greater than 40 cm diameter at breast height (dbh) on a broad area basis in each logging cycle; and
- the forest in a state from which it can recover to a similar structure before the next logging cycle.

To be eligible to claim this exemption “it would be reasonable to expect a private native forest owner to be able to furnish evidence of these sustainable land practices through some form of forest management plan or the like” (NSW Department of Land and Water Conservation 1997).

Exemption 2 - A private native forest being managed for forestry purposes (timber production).

Under this option, clearing is allowed where the forest is being managed for forestry purposes. The legislation refers to:

“managing native forest on a sustainable basis whilst allowing timber production. The exemption allows for normal silvicultural practices, including thinning, consistent with the forest being managed sustainably.”

In all circumstances, it would be appropriate for an owner of private native forest to satisfy himself/herself that the area of forest is in the course of being managed for forestry purposes (timber production). This means that there should be clear evidence of the continuous passage or progress through time of a succession of stages of forest management practices; i.e., there would be evidence of some positive action of control over the land use of the forest, or an accomplishment of reasonable forest management practices including a record of the practices.

The most appropriate evidence under these circumstances would be a forest management plan, silvicultural and/or harvesting plans” (NSW Department of Land and Water Conservation 1997).

Anecdotal evidence from Department of Land and Water Conservation (DLWC) officers suggests that the interpretation of this legislation is somewhat vague in practice. For example, how is maintaining a minimum habitat value actually

measured? In addition, in the case of Cypress pine, very few trees would achieve 40 cm dbh and officers in the field are reducing this requirement to 30 cm dbh.

Moreover, there appear to be inconsistencies between advice provided by various state government departments. For example, recent guidelines from SF NSW (Nicholson 1997) on cypress management may run counter to the uneven age stand requirement by illustrating the removal of younger trees, leaving a predominance of older and larger trees.

Given this background, it is not surprising that the procedures followed by land owners and saw-millers/contractors in terms of logging existing timber range from the well planned and documented to virtually *ad hoc*. There is considerable confusion at present about what their responsibilities are.

Discussion with local saw-millers indicated that while some consulted extensively with DLWC and prepared harvesting plans for their activities on private land, others have not, and have relied on years of logging experience and common sense to 'do the right thing'.

There was also concern (from both saw-millers and land owners) that some saw-millers/contractors operated in a less than professional manner. This included incidences of taking more timber than they paid for, not paying at all, not following the landowner's instructions about where to log or leaving the logged area in a considerable mess.

In summary, the legislation and on-ground logging practices surrounding private native timber harvest are something of a 'grey area'. Having said that, local DLWC officers have indicated that in the near future, more attention is likely to be paid to these practices and there will be increasing pressure for landholders/contractors to prepare harvest and/or land management plans.

2.4 Managing regrowth forests

The first point to make is that little or no work/research has been carried out on techniques for, and growth responses from, managing native eucalypt forests on the Northern Tablelands. Some work has been performed on cypress management and the most up to date guidelines on cypress are provided in the publication by Nicholson (1997).

3.1.1 Rationale for and responses to silvicultural management of regrowth

In general terms, the rationale for managing native regrowth forests is to improve stand productivity and quality by modifying competition between individual trees for space, light, moisture and nutrients. In eucalypt species, up to 40 per cent of regrowth stand production can be lost due to competition (Kerruish 1997).

Unlike some plantation species where pruning of lower limbs is required to produce good log form, this is generally not necessary for the eucalypt and cypress species of commercial potential found on the Northern Tablelands. These species tend to be self-pruning, though this ability varies between species and with spacing.

In terms of silviculture, this leaves two main activities to be considered:

1. Non-commercial thinning (or spacing) which involves the removal of a high proportion of stems to allow the remaining 'crop' trees to reach a higher growth potential. This operation is non-commercial because culled trees are not of sufficient size to be sold for timber; and
2. Thinning (or commercial thinning), which occurs after spacing and involves the further removal of trees to allow accelerated growth and quality in the remaining final crop. This operation is commercial as the trees removed are large enough to be sold for timber (often pulpwood, but, depending on the location, also small sawlogs, poles or perhaps farm timber).

In Australia, the most detailed biological and economic investigations of managing re-growth timber have been performed in Victoria. Unfortunately, the results of these studies have little relevance to the Northern Tablelands area for two key reasons:

- Trials were conducted in Eucalypt species which have very dense regrowth rates eg. 6 000-27 000 stems per hectare (Kerruish *et al* 1993). The eucalypt stands in this study have maximum densities in the order of 300-500. However, cypress stands might reach a maximum density of around 20 000 stems (a spacing of around 0.7 m between stems).
- The Victorian studies are based on the premise that the costs of spacing are recouped through increased wood volumes harvested at subsequent thinnings for pulpwood sales and at final harvest. At present on the Northern Tablelands there are few if any markets for thinnings. Unless such markets can be developed, the costs of early spacing and later thinning (which in Victoria is usually commercial) must be recouped entirely from final harvest log sales.

Despite these anomalies, it is worthwhile briefly summarising the main aspects of the Victorian studies as they identify important elements for the future development of re-growth forestry in Northern NSW. In particular, the issue of spacing is discussed.

2.4.2 Spacing re-growth forests

Victorian studies have shown that early spacing of eucalypt re-growth is more profitable than commercial thinning alone because:

- Thinnings volume and quality are enhanced; and
- Harvesting costs for first thinnings are reduced.

Trials have suggested that in temperate eucalypt forests, reducing the basal area by some 50-60 per cent to around 1 800 stems/ha produces an effective growth response (Kerruish *et al* 1995).

In addition to traditional mechanical means of spacing using chainsaws or brush cutters, chemical thinning has been recognised as a cost effective option. The Tordon-Ax™ has been used in the past on the Northern Tablelands. Tordon is injected through a hatchet into incisions made around the tree. Dead trees may be left standing for future firewood use or pushed over and moved into piles (which are often burned).

More recently, trials have been conducted using a glyphosate stem injection technique (Kerruish 1995) which, it has been suggested, results in lower spacing costs and higher growth responses in dense stands of *E. sieberi* (average 15 900 stems/ha) than alternative methods such as clearing saws or the Hydro-Ax™.

Depending on the level of residual logs on the ground from previous logging activity, the costs of a combined Hydro-Ax™ - stem injection spacing ranged from \$683-1060/ha compared to \$362-739/ha for cutting corridors with the Hydro-Ax™ alone and \$1354-1731/ha for a combined Hydro-Ax™ - clearing saw technique (Kerruish *et al* 1995).

Rawlins (1991) has reported costs of \$490/ha using herbicide injection for spacing 15 year old *E. regnans* and \$780/ha using brushcutters on 5 year old *E. regnans*.

Stem injection techniques do not appear to have been adopted on the Northern Tablelands. Research indicates stem injection is most effective in young over-stocked stands, 5-15 years of age with a minimum size of 2 cm dbh (Kerruish 1997).

Advantages of stem injection include:

- A tool has been developed to combine tree notching and injection into a single function (Steminjector™) - this is significantly faster than the old 'notch and squirt' technique using two tools;
- Accurate dosages can be delivered to avoid 'flash-back' (herbicide being transferred to other trees via fused roots) and less chemical is used;
- Operator exposure to the chemical is reduced;
- Costs may be lower than other spacing methods - \$200-\$330/ha using contractors in favourable conditions (Bill Kerruish, personal communication, 1998); and
- Coppicing does not occur as it can with sawing where it is often necessary to delay spacing until canopy closure occurs.

In Victorian studies, the payoff from these expenditures is via increased future thinnings and sawlog sales. Rawlins (1991) reported NPVs of \$5800/ha in managed *E. regnans* stands compared to \$1800/ha in unthinned stands. However, keeping the Northern Tablelands situation in mind, it is interesting to note that where pulpwood

prices were relatively low (\$40/m³ delivered to mill), NPVs for unthinned stands were equivalent to those for three of the four managed stands. While stem densities and spacing costs are likely to be lower on the Northern Tablelands, this result does suggest that access to profitable thinnings markets is important.

The fact that the saw log harvest volumes required to produce these NPVs were in the range 357-765 m³/ha also requires stating. These volumes represent tree growth rates in the order of 11.7-18.2 m³/ha/year. In contrast, O'Neill (1994) has estimated growth rates in the Northern Tablelands to be in the order of 1-2 m³/ha/year (with many sites much lower than this). As set out below in the detailed description of the case study farms, millable timber yields are likely to be at best around 5 m³/ha on many Tablelands properties, due partly to a lack of management but also to relatively poor growing conditions.

Kerruish *et al* (1995) have noted that the economics of regrowth thinning is most attractive where:

- 3 Thinning is close to the processing industry and transport costs are low;
- 4 The areas of over-stocked regrowth are large;
- 5 Topography is gentle and ground debris is small; and
- 6 A gap exists in the wood supply that can be met by thinning.

On the Northern Tablelands, points 1 and 4 above represent key obstacles. Even so, on the case study farms examined in this report, the option of spacing to enhance wood production has been explored where it was deemed to be warranted.

3. Project methods

3.1 farm forestry models

There are a range of farm forestry models currently in use in Australia and New Zealand which aim to provide estimates of the economic impact of trees on farms.

These models differ significantly in complexity and scale. Some such as FARMTREE (Loane 1994) contain considerable detail on tree growth rates, product recoveries and stock shelter effects. The outputs from FARMTREE are calculated on a per hectare basis.

Others such as the Agroforestry Estate Model (Middlemiss and Knowles 1996) operate at the whole farm level, and estimates of timber yields are provided by the user (or calculated via other software) rather than being calculated internally by the model.

Models like Farmula (Kubicki *et al* 1991) provide a graphical interface for farm planning purposes and were originally designed as a tool for examining land management practices such as erosion amelioration effects as opposed to a specific farm forestry model.

For this study, an alternative modelling framework, AGROFARM was developed. This was based around the RISKFARM structure which was originally developed by Milham (Milham 1992), and has since been developed at CARE Pty Ltd. AGROFARM was used in preference to other models for the following reasons;

- The basic structure for Northern Tablelands properties was already in place and modules dealing with farm forestry were under construction as part of the Department of Primary Industries and Energy (DPIE) Farm Forestry Program;
- The model is whole-farm and has the capacity to capture the effects of existing timber management on existing farm enterprises and whole-farm financial performance;
- Detailed taxation modules are linked to the core model;
- The model caters for farm debt;
- The livestock shelter effects of plantations/windbreaks have been approximated; and
- Risk can be added to the model structure.

A comparison of AGROFARM with other farm forestry models is summarised in Table 3.1.

3.2 The AGROFARM model

The AGROFARM model framework was developed at CARE Pty Ltd during 1996-97 specifically to analyse the economic impacts of growing trees on Northern Tablelands farms. During the course of that work, it was recognised that existing native timber (both hardwood and cypress) might also contribute to farm financial performance. As a result, AGROFARM was modified to capture the costs and revenues associated with the management and sustainable harvest of existing timber on farms.

One important point to make with regard to existing timber management is that the model analysis covers a 60year time frame, however in the Northern Tablelands area, the logging cycle for many species is likely to be longer than 60 years. Even so, given that cash flow is a critical issue for most landholders in the region, the model will capture the cash flow effects associated with initial logging and management regimes. Previous work of this nature with landholders in the region indicated that their planning horizon is somewhere from 5-15 years and a 60 year analysis meets this criteria.

Many of the key features of the model are summarised in Table 3.1. The physical and financial flows in the model and important features/assumptions of/in the model are set out in Figure 3.1 and the discussion that follows.

3.2.1 Existing timber management

The costs of thinning, pruning and harvesting existing farm timber are catered for in the model. Recommendations on timber management and information on the effects of the management procedures on timber growth rates and yields were largely provided by SF NSW advisory foresters and Greening Australia field staff. This required visits to the case study sites.

It has been assumed that all existing timber management is on a sustainable basis and does not impact on stock shelter benefits (ie. sufficient cover is left for this purpose).

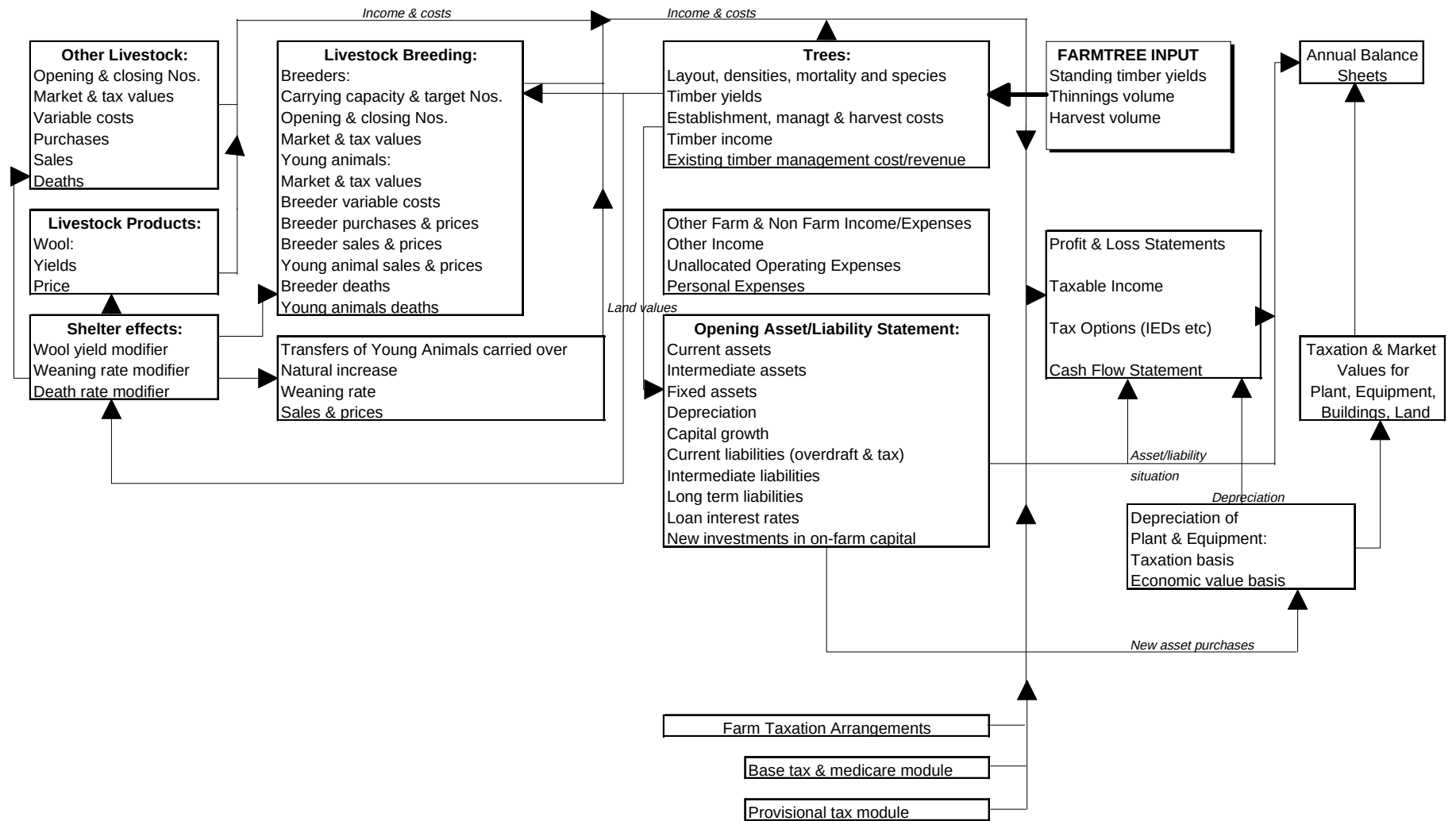
The model also caters for the costs associated with the on-farm milling of timber, or hiring the services of a portable mill if these are options a landholder wishes to pursue.

Timber revenues can be calculated either as direct sales of milled timber from the farm, or as a stumpage payment to the landholder from the contractor/saw-miller.

Table 3.1 Farm Forestry Model Comparison

	Farmula	Farmtree	Agroforestry Estate Model (AEM)	AGROFARM
Key purpose	Compare alternative farm plans (might include farm forestry)	Assess investments in farm forestry	Assess investments in farm forestry	Assess investments in farm forestry
Intended use	Farm management tool	Farm forestry assessment tool	Farm forestry assessment tool	Farm forestry assessment tool
Likely users	Farmers, farm advisers, researchers	Farmers, farm advisers, researchers	Farmers, farm advisers	Researchers, farm advisers
Whole-farm	yes	no	yes	yes
User-friendly menu-driven structure	yes	yes	yes	no
Accounts for:				
Stock shelter	no	yes	no	yes
Erosion	yes	no	no	no
Season type	yes	no	no	no
Taxation	no	no	no	yes
Risk	no	no	no	Risky variables can be added
Stochastic	no	no	no	yes
Iterative simulation capacity	no	no	no	yes
Geographic focus	Western Australia	Victoria	New Zealand	New South Wales
Farm plan graphics	yes	no	no	no
Optimising capacity	no	no	no	Can be modified to optimise
Time frame	20 years	Unlimited	Unlimited	60 years
Inputs	Electronic map of property	Default data for agricultural and forestry enterprises supplied but can be modified	Physical and financial data for agricultural and forestry enterprises entered by user.	Default physical and financial data for agricultural and forestry enterprises supplied but can be modified
	Defined management units (eg based on soil type)		Labour requirements	Farm taxation arrangements
	Crop plans		Cutting right options	Probability distributions if using in stochastic mode
	Stock plans		Joint venture options	Existing timber area and management options
	Financial plans			
Outputs	Cashflow Net Present Values Equivalent Annuity Values	Cashflow Net Present Values Internal Rates of Return	Cashflow Net Present Values Area planted	Cashflow Net Present Values Internal Rates of Return
	Breakeven analysis	Sensitivity analysis Annuity values	Enterprises displaced by trees Woodflows Labour requirements	Annuity values Taxable income Farm Equity <u>Profit & loss statement</u>

Figure 3.1 Structure of the AGROFARM model



3.2.2 Plantation timber

The original version of AGROFARM was constructed to assess the financial feasibility of developing commercial timber plantations on New England properties.

The plantation timber section of the model caters for:

- One-off or regular plantings;
- Block or windbreak configurations;
- The establishment and management costs associated with alternative tree species (default data from published sources is supplied, however this can be replaced with relevant local data if available);
- Planting densities, target harvest densities and the associated thinning regimes required to meet that target in the specified time frame;
- Tree mortality rates;
- Timber yields by product mix (these can be drawn from simulations using the FARMTREE software or simply calculated on the basis of an mean annual increment (MAI) figure). Yields are estimated for both thinnings (these may or may not be specified as saleable) and final harvest products;
- Estimates of tree height (used to predict stock shelter effects);
- Cutting, snagging and haulage costs with the capacity to alter haulage distances;
- Timber revenue across product types.
-

3.2.3 Livestock shelter benefits

The livestock module in AGROFARM caters for the fact that grazing area will be lost as trees are planted, yet there may be shelter induced production benefits in terms of reduced stock losses, increased weaning rates and wool production.

Clearly, these benefits will vary from farm to farm depending on the existing levels of shelter. For this reason, there is the capacity in the model to alter the percentage change in these factors due to tree planting.

Depending on the planting area planted and the configuration (blocks versus belts), the model calculates the area of the farm under additional shelter. As is the case in FARMTREE (Loane 1994), it is assumed that shelter is provided to the leeward side of the plantings over a distance of 20 tree heights. For long narrow shelter belts, it is assumed that a hectare of trees is 10 meters wide by 1000 meters long. For blocks, a hectare of trees is assumed to be a 100 by 100 metre square.

The proportion of stock on the farm receiving these shelter benefits is then estimated according to the proportion of the farm under shelter.

3.2.4 Physical and financial flows for the remainder of the farm business

These are estimated in the same manner as for the RISKFARM model (Milham 1992). Opening and closing inventories for livestock, wool and financial parameters such as cash on hand and loans are calculated each year. The closing balance for one year becomes the opening balance for the next.

Livestock numbers are based on target levels to be maintained each year. An average stocking capacity for the farm on a per hectare basis is entered and this essentially sets the stocking rate for the farm. Stocking rates in total will change as land is taken out of grazing for trees or where existing timber is thinned to allow additional grazing.

Financial flows consist of the following measures:

- Annual net cash position (an annual measure of cash flow);
- Taxable income (gross income less allowable deductions);
- Net farm income - NFI (defined in this study as gross income less variable and overhead costs) ;
- Tax liabilities;
- Farm assets and liabilities;
- Estimates of standing timber values for plantations; and
- Farm equity level.

Whole-farm annual net cash position or NFI levels can be used as the basis for calculating net present values (NPV) and internal rates of return (IRR). In particular, it is possible to estimate the IRR on the additional investment in existing timber management and/or commercial plantations in a whole-farm context. Where trees have been planted, it is assumed that at the end of the analysis period, the marketable portion of plantation timber which has not yet been harvested is valued at market prices. This value is then added to the final year cash flow. Essentially, it represents a salvage value for the unrealised investment in timber.

3.3 The Case Study Properties

3.3.1 Background

Four case study properties were examined in the study. Two of these properties are located in the Kingstown area to the south west of Armidale, one is located in the Jeogla area east of Armidale and the fourth is situated in the Bingara area, north west of Armidale. The key features of each farm are listed in more detail below.

The geographical spread of these properties allowed the financial analysis to be performed for a range of native timber situations. The two properties in the Kingstown area are dominated by New England stringybark and blackbutt species although the quality of the timber on each property differed significantly. Rainfall in this region averages around 800-900mm per annum.

The property in the Jeogla area provides an example of native timber production in a higher rainfall zone. Here, annual rainfall is around 1500mm. Again, the focus on this farm was on Eucalypts, including red and messmate stringybark, white and blue gum and New England blackbutt, however this property is more typical of the North Coast rather than the Tablelands environment.

On the farm in the Bingara area, the focus was on native cypress pine management and this provided the opportunity to examine the scope for managing a timber species viewed by many landholders as a woody weed which encroaches on valuable grazing land. Average annual rainfall in the area is around 850mm.

For confidentiality reasons, the co-operating landholders have requested that the precise locations of their properties not be revealed.

3.3.2 Data collection

3.3.2.1 Farm business data

Each landholder completed a data template to provide a full specification of the financial and physical structure of their business. Information collected here included:

- Current and future target livestock numbers across each enterprise type (none of the case study farms undertook any significant cropping);
- Production parameters for livestock enterprises (turn-off rates for each class of stock, weaning rates, wool production, etc);
- Variable costs for each livestock enterprise;
- Expected sale prices for livestock and livestock products;
- Farm overhead costs (costs not directly attributable to a livestock enterprise) - these costs were to be specified in a manner which catered for any major future changes to farm structure;
- A full listing of their asset and liability situation;
- Legal and taxation arrangements; and
- Farm size, land value and estimates of current and future carrying capacity on both cleared and uncleared areas of the farm.

More specific information on each case study farm is set out below though clearly for confidentiality purposes, much of the financial detail is not included.

Because of the long-term nature of the analysis used in this study, it was necessary to build in some assumptions about future capital expenditures on farm. With the exception of case study farm C which is currently undergoing a substantial capital build-up, it was assumed that once existing debts were paid out, no future major debts would be incurred. Future capital expenditure was limited to that required to cover depreciation. Where cash surpluses were not sufficient to cover this cost, an overdraft facility is activated in the model.

The owners of farm C provided estimates of the capital required for their farm improvement program and this was factored into the analysis. They also provided information on how debt would be reduced in subsequent years.

3.3.2.2 Existing native timber data

The Department of Land and Water Conservation in Armidale provided relatively recent aerial photographs of each of the case study properties. These photographs were digitised, loaded into GIS software and the areas of the farm under different timber cover classes were mapped. For each farm, estimates were made of the total area where timber management might be feasible based on timber cover density (maps are provided below in the discussion of each farm structure).

This broad analysis of timber cover classes was subject to a ground-truthing exercise by visiting each farm with an advisory forester from of SF NSW. These foresters were able to provide information on:

- The relative timber site quality on different areas of each farm;
- The predominant timber species present;
- The commercial viability of those species in terms of their species characteristics, size and form;
- Advice on what (if any) silvicultural management might be employed to improve the quality of the native timber stands;
- Estimates of the amounts of harvestable timber which could be extracted now and in the future from each farm;
- Estimates of the length of logging cycle for each farm after allowing for sufficient recover time; and
- Estimates of the costs and returns for the proposed timber management options.

Within the scope of this project, it was not possible to perform a detailed timber inventory for each farm. Given that the growth and quality of native timber varies significantly within a relatively small area due to variations in the micro-environment, this would be a useful future step to enhance the information on timber values.

Even so, the experience of the foresters who assisted in the study and their familiarity with the region was such that ‘best guess’ estimates were obtained for the sustainable volumes of saleable timber which might be harvested. Their estimates of returns were reinforced by the information collected in the local saw-mill survey.

3.3.3 Case study farm A

This farm is located in the Bingara area of northern NSW and falls within the boundaries of the Bingara Local Government Area (LGA). It is a family operated business which is supported by a significant level of off-farm income.

Cypress pine is the dominant commercial timber species on this farm (see Figure 3.2) . There are two species of cypress present:

- White cypress pine (*Callitris glaucophylla*) which is currently regarded as the only commercially valuable species of cypress due to its durability and termite resistance; and
- Black cypress pine (*Callitris endlicheri*) which at present has no commercial value as a timber product as it lacks the termite resistance of white cypress.

The key operational features of the farm business are set out in Table 3.2 below and a map of the farm showing the timber cover classes is provided in Figure 3.3.

Figure 3.2 Typical cypress pine growth - case study farm A



A key issue on grazing properties where cypress of both species is present is its capacity to regenerate at very high densities and restrict pasture growth, a situation referred to as ‘stand lock up’. Where lock up occurs, usually at around 30-40 years of age in an unthinned stand, the lower limbs die and tree height and diameter growth become negligible (Nicholson 1997). For trees to have any commercial value, they need to reach a minimum centre diameter over bark of at least 18 cm.

In many instances, the response to lock up is to clear large areas of cypress to allow pasture regeneration. However, the potential to manage cypress in a manner that improves the quality and volume of commercial timber and opens up dense stands for grazing is being recognised by some landholders and this is a management opportunity that the owners of farm A were keen to investigate.

The recommended management procedure as specified by SF NSW is set out in Table 3.3. Taking into account these recommendations and the financial impacts on the farm business, the business owners viewed their preferred management timetable as follows:

- ➔ **Year 0** - log commercial trees from the entire 600 ha of cypress to be managed. The estimated volume of saleable logs is an average of $5\text{m}^3/\text{ha}$ at a royalty of $\$18/\text{m}^3$ (SF NSW advisory forester, personal communication 1998);
- ➔ **Year 1** - use the revenue from logging to perform non-commercial thinning on an area where that revenue will cover the costs of thinning (on this basis, an area of 270 ha can be thinned using brushcutters/chainsaws assuming a thinning cost of $\$200/\text{ha}$). Target stem density is around 280 stems/ha (ie. 6m spacings);
- ➔ **Years 2-15** - spend $\$5000/\text{annum}$ non-commercially thinning the remaining 320 ha. This would equate to thinning 25 ha per year (assumed it is possible to get contractors to thin an area of 25 ha);
- ➔ **Year 51** - commercial thinning of 270 ha of cypress, again extracting an estimated volume of saleable logs at an average of $5\text{m}^3/\text{ha}$ and a net royalty of $\$18/\text{m}^3$;
- ➔ **Year 52-60** - commercial thinning of the remaining area at 25 ha/yr (again, this assumes contractors will thin an area of 25 ha).

It has been assumed that following non-commercial thinning, land which was currently ungrazed is capable of supporting 1.5 DSE/ha for a periods of 10 years until canopy closure again reduces pasture growth. This allows additional stock to be run on the farm over this period.

Note that the analytical time-frame in this study was set at 60 years and therefore only includes the financial impacts of the logging cycle for cypress pine up to part of the way through the commercial thinning operation.

Table 3.2 Structure of case study farm A

Item		
Total farm area		1784 ha
Approximate area available for existing native timber management		600 ha
Average carrying capacity (whole farm)		3.52 DSE ^a /ha
Additional carrying capacity generated on cypress lock up areas following non-commercial thinning ^b		1.5 DSE.ha for a period of 10 years after thinning
Dominant soil type		Granite based soils
Average annual rainfall		850 mm
Livestock numbers:		
	Merino ewes	600
	Merino wethers	800
	Merino hoggets	450
	Adult cattle	180
	Young cattle	162
Weaning rates:		
	Ewes	75 %
	Cattle	90 %
Wool production:		
	Ewes	2.9 kg/head
	Wethers	3.5 kg/head
	Hoggets	1.5 kg/head
Farm labour situation:		One full-time manager operator plus casual assistance as required
Opening equity level		74%

a. DSE = dry sheep equivalent, the amount of energy required to maintain one dry sheep for a 12 month period.

b. Assume stock are not excluded after thinning.

Figure 3.3 Native timber cover on case study farm A

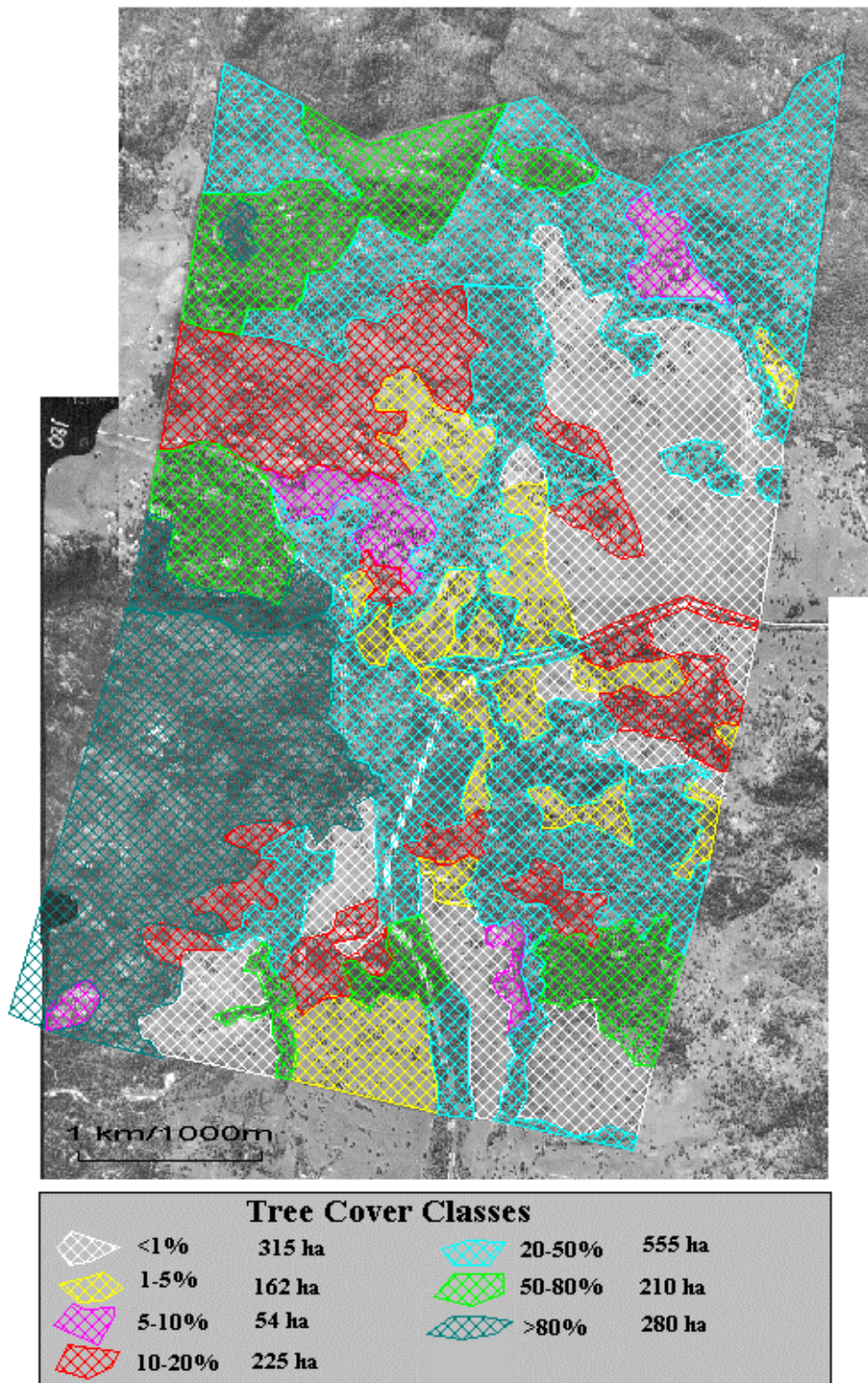


Table 3.3 Management regime for cypress pine

Operation	Timing	Cost/returns	Comments
Harvesting large trees = logging	Year 0 - large trees will be around 100-120 years of age	If performed by a logging contractor, net returns (ie. royalties or stumpage prices)will be in the order of \$18/m ³ on steep country and up to \$36/m ³ on flat country	Retain regeneration 4-6 m in height Fell to waste commercially non-viable large trees
Non-commercial thinning	1-5 years after logging	Average cost in the vicinity of \$200/ha when performed by a contractor	Performed with a brush-cutter and will take 10-20 hours/ha depending on stand density Retain most commercially viable trees at a spacing of about 6m In some areas, it may be possible to make this a commercial thinning by selling thinned timber as vineyard poles This operation should encourage some additional pasture growth
Commercial thinning	50 years after logging when most 6 x 6 m spaced trees have reached commercial size	Royalty of around \$18/m ³ where trees are 14-24 cm diameter at chest height	Around half the total number of trees are harvested leaving a basal area of 6-8 square meters per hectare.
Harvesting large trees = logging repeated	Year 100 - large trees will be around 100 years of age		

Source: Nicholson (1997), personal communication with SF NSW advisory officers and local saw-millers

3.3.4 Case study farm B

Case study farm B is located in the Kingstown area of northern NSW and falls within the boundaries of the Uralla LGA. This is a family owned business which also operates with a significant level of off-farm income.

The operational features of this business are set out in Table 3.1 and a farm map showing timber cover classes is provided in Figure 3.5.

Unlike the previous case study farm, the dominant commercial native timber species on farm B are native hardwoods (see Figure 3.4). While there are a range of eucalypt species on the farm, those of most commercial interest include:

- Silvertop stringybark (*Eucalyptus laevopinea*);
- Red stringybark (*E. macrorhyncha*);
- Youmans stringybark (*E. youmannii*); and
- New England blackbutt (*E. andrewsii*)

Figure 3.4 Typical eucalypt native forest - case study farm B



These species are commonly taken by saw-mills in the region which pay around \$25/m³ royalty for these species (though this varies according to stand size, quality, site access and distance from the mill).

However, this case study farm has a small fixed saw-mill on site and the owners are interested in sawing their own timber on-farm. They are currently negotiating with a

Table 3.4 Structure of case study farm B

Item		
Total farm area		978 ha
Approximate area available for existing native timber management		400-500 ha
Average carrying capacity (whole farm)		2.87 DSE ^a /ha
Additional carrying capacity generated on cypress lock up areas following non-commercial thinning	1 DSE/ha for a period of 10 years after thinning	
Dominant soil type		Granite based soils
Average annual rainfall		850 mm
Initial livestock numbers:		
	Merino ewes	800
	Merino hoggets	560
	Adult cattle	50
	Young cattle	35
Weaning rates:		
	Ewes	70 %
	Cattle	70 %
Wool production:		
	Ewes	3.5 kg/head
	Hoggets	1.5 kg/head
Farm labour situation:		One full-time manager operator plus casual assistance as required
Opening equity level		69%

a. DSE = dry sheep equivalent, the amount of energy required to maintain one dry sheep for a 12 month period.

local building supply firm to supply them with around 10 m³ of sawn timber per week. This would attract a price of at least \$320/ m³. At present, the species mix put through the mill is approximately 80 per cent stringybark species and 20 per cent blackbutt.

The saw-milling operation would require hiring additional labour - 2 men for three days per week to assist with timber sawing and one man for 4 days per week to assist with cutting and mill maintenance (ie. 10 man days per week). The cost of this labour has been estimated at \$120 per day plus workers compensation and compulsory superannuation loadings of 24 per cent. On the basis of a 60 per cent recovery, this is a labour cost of \$89.65/ m³ to deliver 10 m³ of sawn timber per week.

The farm manager would be largely responsible for performing the cutting, de-barking and log snagging operations using existing farm machinery. Based on SF NSW estimates of harvesting costs of \$15/ m³ and the farm managers estimates of fuel and maintenance costs of \$6/ha, the total cost of the log harvesting operation is estimated as \$81/ha.

Again, a farm visit with a SF NSW advisory officer was arranged to estimate timber growth rates, sustainable harvest yields and quality. It was estimated that around 5 m³/ha of harvestable timber might be extracted across the entire farm, although this varied significantly at different sites. Timber growth rates were estimated at around 1-2 m³/ha (SF NSW advisory forester, personal communication 1998)

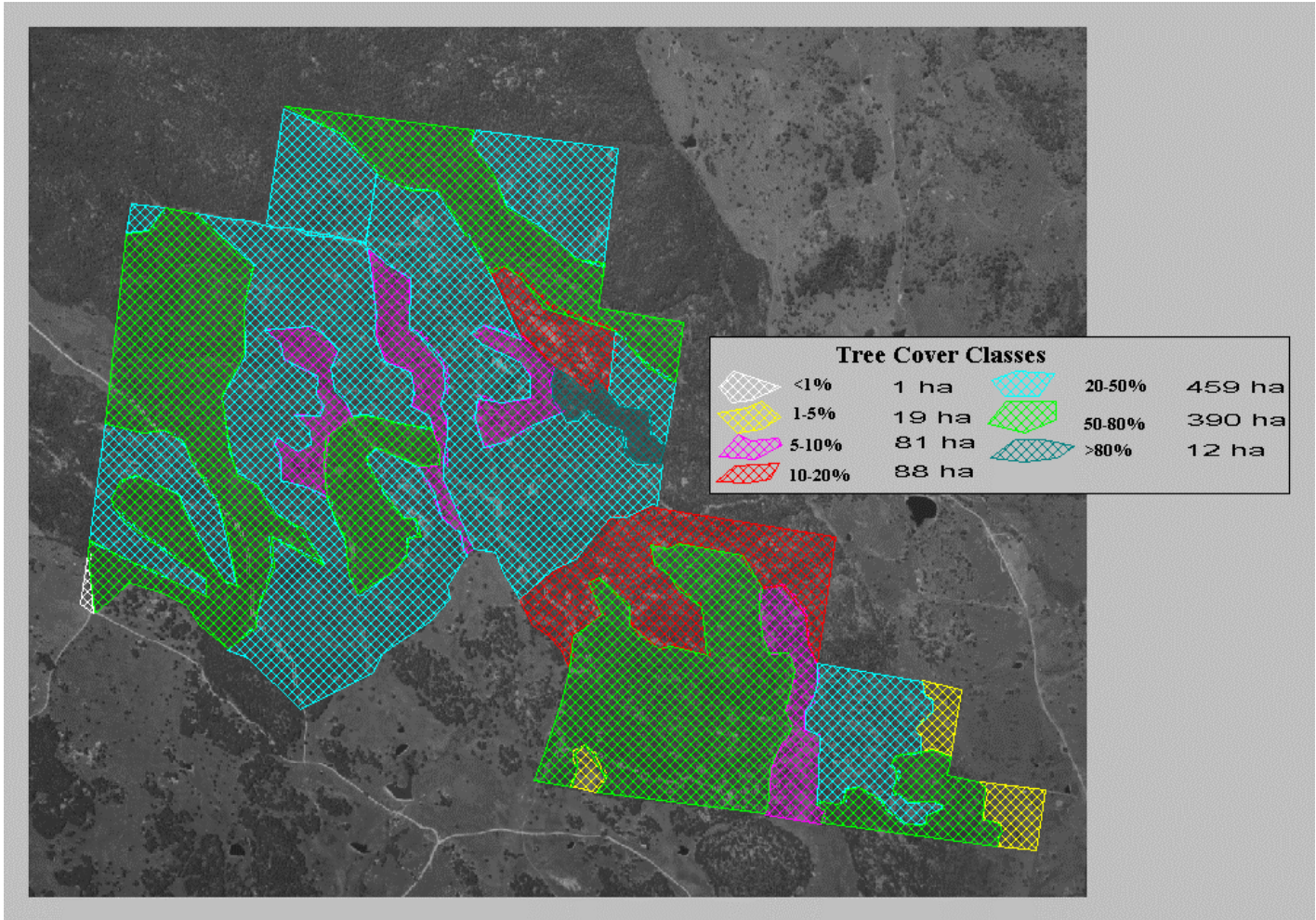
To provide 10 m³ of sawn timber per week at a recovery rate of 60 per cent requires 865 m³ of logs to be harvested per year. Given a current average standing harvestable timber volume of 5 m³/ha, 173 ha of the timbered area would need to be logged each year. At this rate, the entire area suitable for timber management would be logged over three years.

The SF NSW advisory forester then recommends (conservatively) leaving a 10 year recovery period before the logging cycle recommences and performing a thinning operation to promote the growth of the better quality trees at the same time as logging occurs.

Given these recommendations, the timber management timetable would be:

- ➔ **Years 0-3** - log and thin 173 ha per annum, removing 865 m³ of logs per annum and thinning the logged area at a cost of \$112/ha (based on estimates by the farm owner and SF NSW). Thinning would be performed by chainsaw and brush cutter. Current stand density is estimated at between 200-300 stems/ha and this would be reduced to around 150 stems/ha;
- ➔ **Years 9-11** - repeat the logging and thinning process as for Years 0-3. Although it is likely that less thinning would be required following the initial thinning in Years 0-3, thinning costs have been assumed to remain at \$220/ha;
- ➔ **Years 11 onwards** - repeat the above cycle allowing 10 year recovery periods.

Figure 3.5 Native timber cover on case study farm B



As for farm A, the landholders experience is that the logging and thinning operation will allow additional stock carrying capacity. In this case it is estimated at an additional 1 DSE/ha on thinned land lasting for 10 years. However, due to the regular thinning cycle adopted in this case, the stocking rate benefit builds over the initial 3 year period then persists for the duration of the 60 year analysis time-frame (unlike the cypress example, where the benefit lasted only 10 years after the first commercial thinning). Again, it is assumed that stock exclusion after thinning is not necessary.

Due to the lack of market opportunities for thinnings in the region at the current time, thinned timber would be pushed into piles using a tractor and left to break down naturally. As a result, no commercial thinnings revenue is realised.

3.3.5 Case study farm C

This farm is also located in the Kingstown area of northern NSW, however it is south west of case study farm B and falls within the Manilla LGA. Again, it is a family owned farm operating with significant levels of off-farm income.

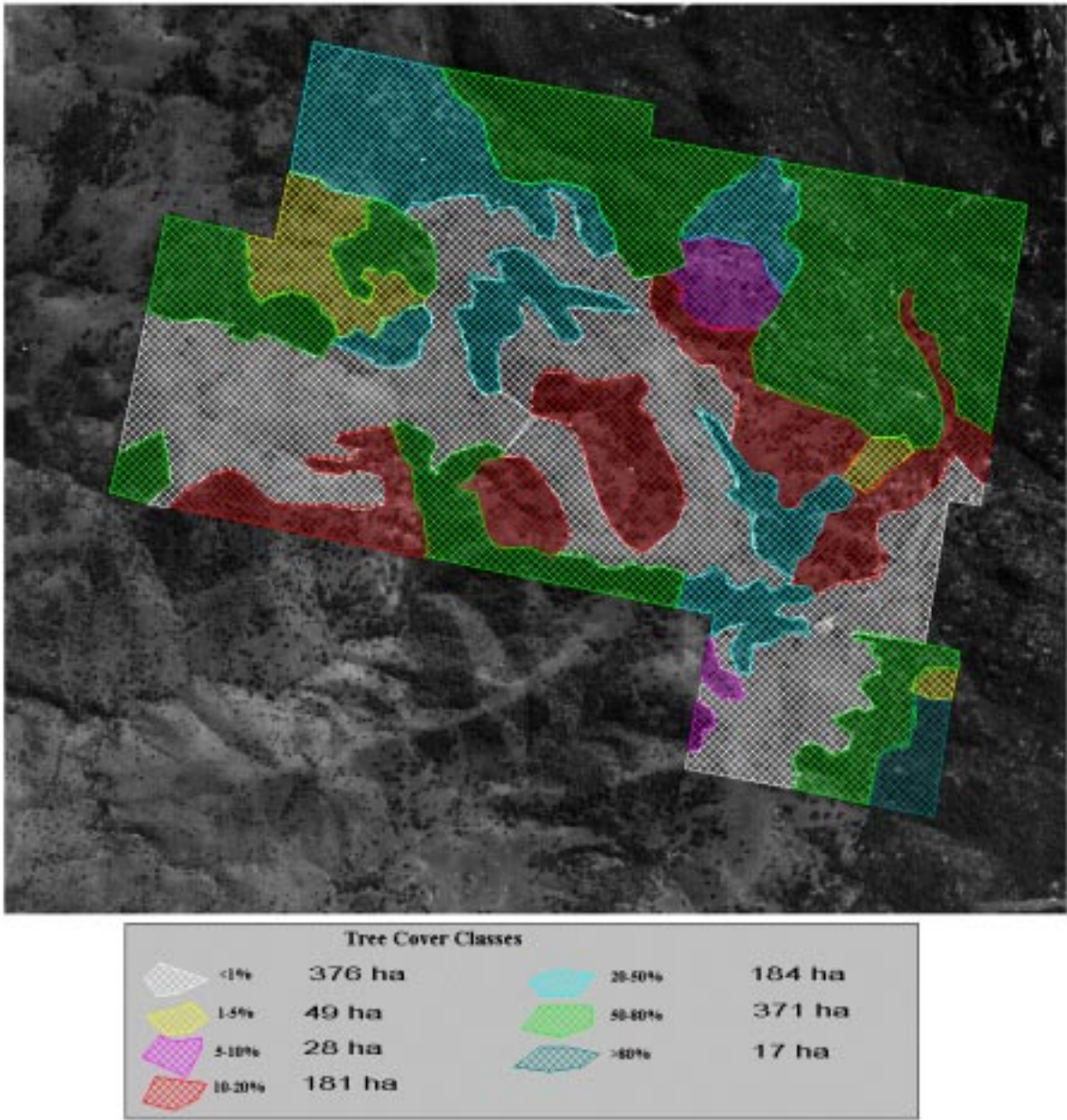
The operational features of this farm are set out in Table 3.5 and the farm map is provided in Figure 3.6. This business is currently undergoing a quite extensive improvement program having recently changed hands. The new owners' objectives are to increase stocking rates which were previously at sub-optimal levels and implement a program of time-control grazing. This will require additional expenditures on pasture improvement, fencing, livestock and additional water for stock.

Relative to the other farm businesses in this study, this business is quite diverse. In addition to wool and beef production, the objective over the next 5 years is to develop a 2nd cross lamb enterprise. The merino ewe enterprise is non-self replacing with replacements purchased in annually. Merino ewes are crossed with a 1st cross sire to produce 1st cross ewes (1st cross male lambs being sold). 1st cross ewes are then crossed with a terminal sire to produce 2nd cross lambs. Generating the carrying capacity to support these enterprises will require a substantial investment in pasture improvement which has been scheduled over the next five years (Year 0-4 in the analysis).

Table 3.5 Structure of case study farm C

Item		
Total farm area		1223 ha
Approximate area available for existing native timber management		230 ha
Average carrying capacity (whole farm)	3.27 DSE/ha initially increasing to 5.89 DSE/ha over the next 5 years	
Additional carrying capacity generated following non-commercial thinning		Not applicable
Dominant soil type	Granite and basalt based soils	
Average annual rainfall		800 mm
Livestock numbers:		
Merino ewes		500
Merino hoggets		213
1 st cross ewes	Initially zero, building to 500 in 5 years	
Merino wethers	Initially 2000 building to 4000 in 5 years	
Adult cattle		75
Young cattle		64
Weaning rates:		
Merino ewes		85 %
1 st cross ewes		100%
Cattle		85 %
Wool production:		
Merino ewes		3.6 kg/head
1 st cross ewes		3.3 kg/head
Wethers		4 kg/head
Hoggets		1.5 kg/head
Farm labour situation:	One part-time manager operator plus casual assistance as required	
Opening equity level		52%

Figure 3.6 Native timber cover on case study farm C



As with farm B, native timber on this farm is dominated by hardwoods (see Figure 3.7). Those of the most commercial value include:

- New England blackbutt (*E. andrewseii*);
- Red stringybark (*E. macrorhyncha*); and
- Youmans stringybark (*E. youmannii*).

In general, site quality is poorer and timber density lower on this farm relative to farm B. At an estimated average stand density of around 100-150 stems/ha, the Advisory Forester recommended that thinning to manage timber was unwarranted and an opportunistic harvesting operation for trees of harvestable dimensions (30 cm small end diameter minimum and log length of at least 2.6 m) would provide a de-facto thinning response. It would also produce adequate soil disturbance to promote regeneration.

Again, it was estimated that at present, there is a maximum 5m³/ha of harvestable timber in the areas where timber management is proposed and that a logging period of 15 years should be observed between harvests to allow smaller trees to reach millable dimensions. A stumpage price of \$25/ m³ is assumed.

Unlike farm B where areas of good site quality allow the prospect of improved growth rates and timber yields through thinning, this response is unlikely on farm C so a timber yield of 5m³/ha probably represents the maximum yield attainable. An additional five year recovery period has also been factored in.

The timber management timetable is therefore:

- ➔ **Year 0** - log entire 230 ha to be managed. No thinning is undertaken;
- ➔ **Year 1-14** - recovery period;
- ➔ **Year 15** - repeat logging operation;
- ➔ **Year 16** onward - repeat above cycle allowing 15 year recovery periods.

In this case, it is assumed that no additional stocking benefits are generated through the native timber management program, due to the initial low stand density and the lack of a dedicated thinning program.

Figure 3.7 Typical eucalypt native forest - case study farm C



3.3.6 Case study farm D

This farm is located in the Jeogla area of northern NSW, and falls within the Dumaresq LGA. It is a family owned farm operating with significant levels of off-farm income.

The operational features of this farm are set out in Table 3.6 and a map is provided on pages 50 and 51.

Future development of this farm is somewhat undecided at present, however plans revolve around modifying the use of water on the farm using key-lining techniques and investigating the options for farm forestry. In terms of farm forestry, the owners are interested both in the management of existing timber and planting trees. Some areas of blue-gum have already been planted.

The close proximity of an on-farm sawmill provides additional options for timber management on this farm. The owners have also expressed interest in the scope for performing value-adding of sawn timber (drying and dressing).

The farm is divided into three separate blocks and the owners also have a lease on some 6 500 ha of SF NSW land where cattle are run over winter. Cattle are the only livestock enterprise in the business. Note that the owners are only considering native timber management on two of the three blocks, therefore property maps showing timber cover have only been provided for the two blocks of interest.

Table 3.6 Structure of case study farm D

Item		
Total farm area		870 ha
Approximate area available for existing native timber management		150 ha
Average carrying capacity (whole farm)		7.23 DSE ^a /ha
Additional carrying capacity generated following non-commercial thinning		0
Dominant soil type	Granite and basalt based soils	
Average annual rainfall		1500 mm
Livestock numbers:		
	Adult cattle	298
	Young cattle	248
Weaning rates:		
	Cattle	95%
Farm labour situation:	One part-time manager operator plus casual assistance as required	
Opening equity level		100%

a. DSE = dry sheep equivalent, the amount of energy required to maintain one dry sheep for a 12 month period.

Figure 3.8 Native timber cover on case study farm D. Property 1

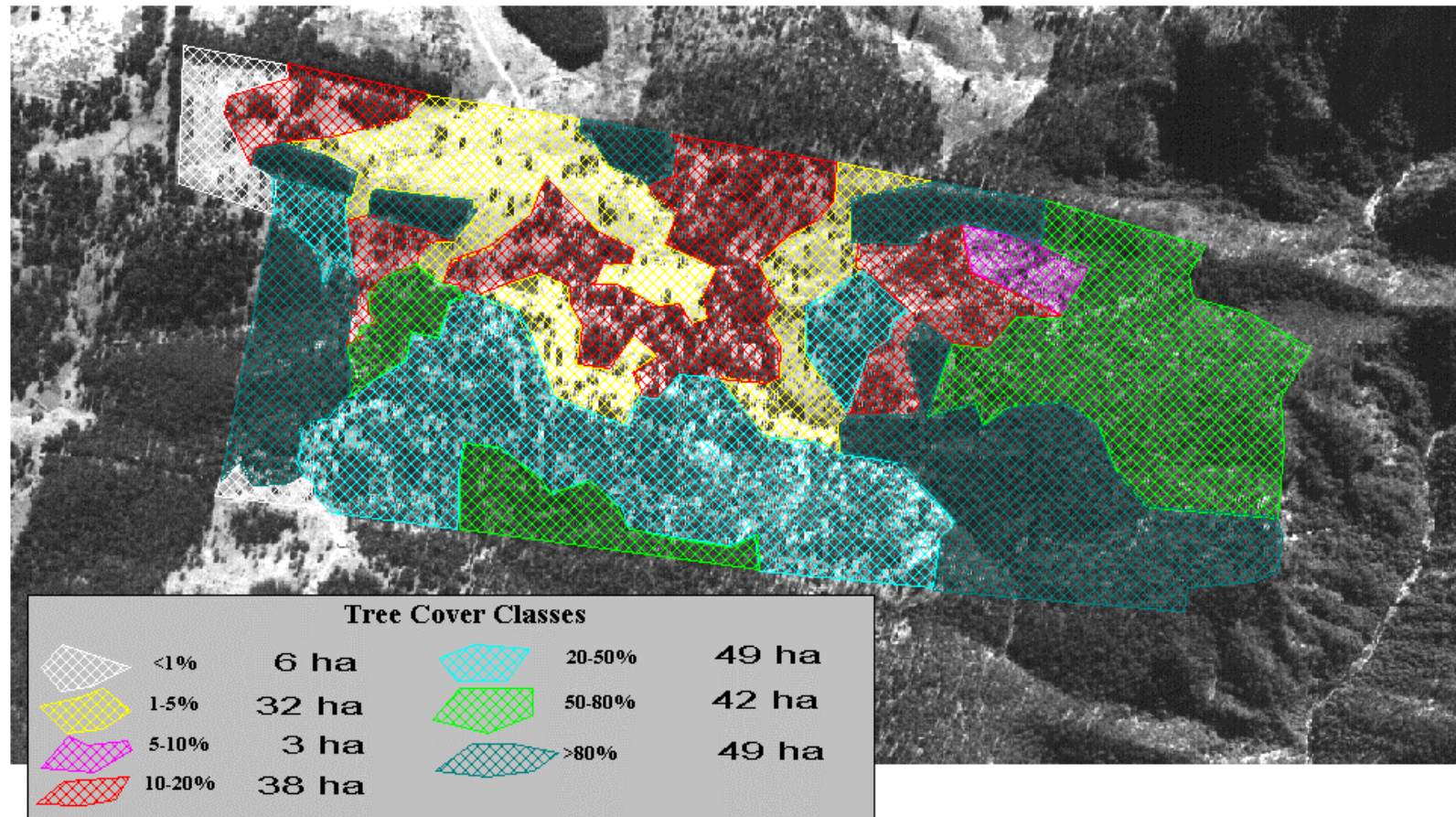
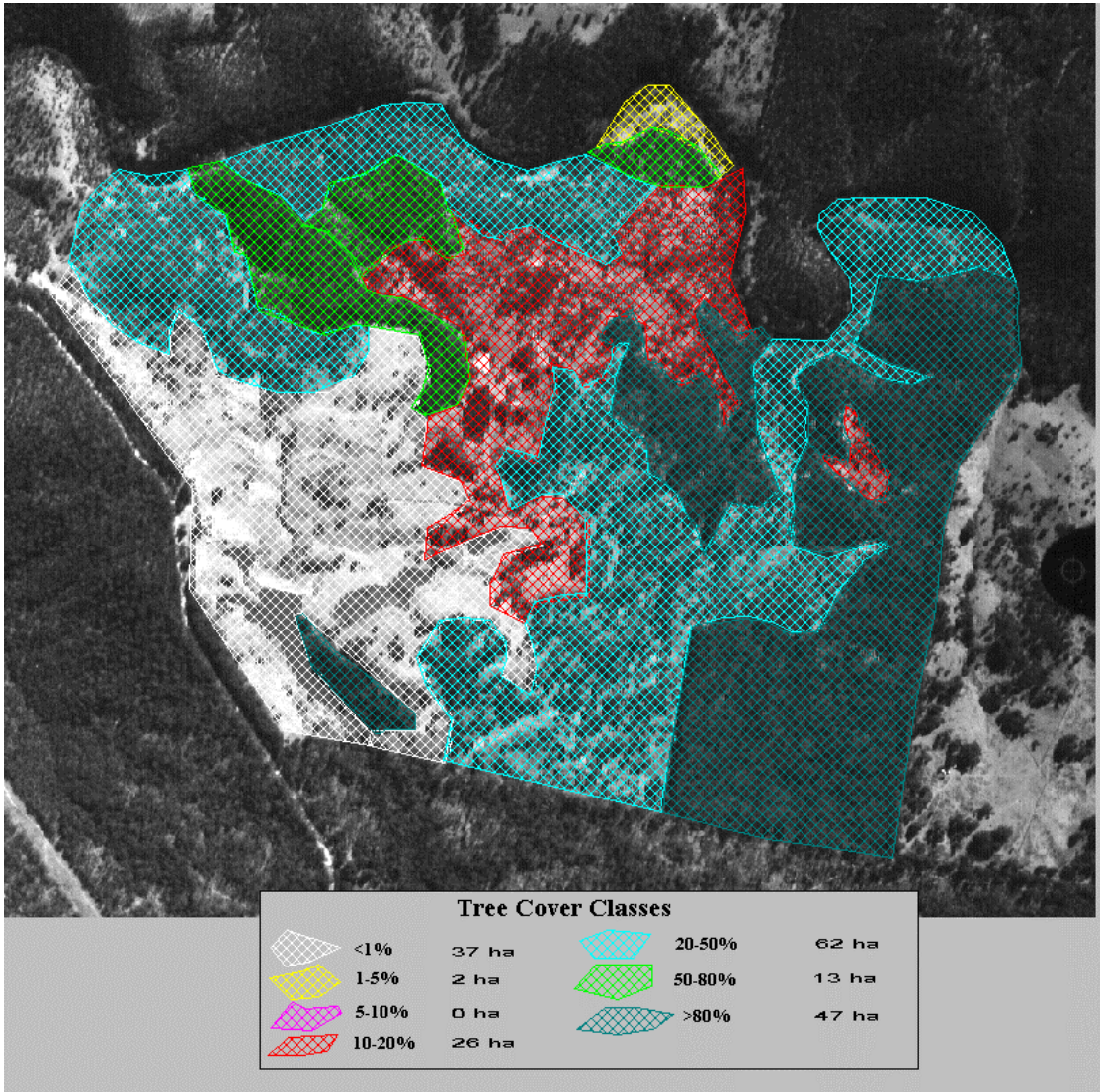


Figure 3.8 continued

Property 2



As with case study farms B and C, native timber on this farm is dominated by hardwoods (see Figure 3.). However, growth rates will be higher on average on this farm due to the higher annual rainfall. The most commercially valuable species include:

- New England blackbutt (*E. andrewseii*);
- Red stringybark (*E. macrorhyncha*);
- White or ribbon gum (*E. viminalis* and *E. nobilis*);
- Silvertop stringy (*E. laevopinea*);
- Messmate (*E. obliqua*);
- Tallowood (*E. microcorrys*); and
- Blue gum (*E. saligna*).

Figure 3.9 Typical eucalypt native forest - case study farm D



Discussions with a local sawmiller who has many years of experience logging both the case study farm and surrounding property indicates that Silvertop stringy is the preferred species for structural timber uses. This is usually sold to builders in Armidale. Lower grade timber is used for structural purposes in the local mining industry. Blue gum is also commonly used to produce feature-grade type boards (Dave Smith, personal communication 1998).

In terms of the de-barking operation, it was noted that the stringybarks are much easier to work with as the bark could be skidded off using a tractor blade. Blue gum must be debarked within 12 hours of felling, else debarking with an axe is required which is viewed as being an expensive operation.

It is also noteworthy that the Fennings mill at Walcha sources timber from SF NSW coups in this area and used species such as *E. viminalis/nobilis* to produce high value, kiln dried feature grade timber products for export.

Although a visit was made to the farm with an advisory forester from SF NSW, details on a preferred management regime and sustainable harvest volumes are somewhat uncertain.

The local sawmiller was able to provide some insights and historical estimates on these issues. A culling operation of lower quality trees on a nearby farm had yielded around 10 m³/ha of structural timber for use in the mines. Typical stumpage prices paid to the landholder for this operation were around \$25/m³ and this involved the landholder performing the cutting, snagging and loading operations. For better quality logs of around 50-60 cm dbh, the sawmiller pays \$30/m³ and performs the cut/snig/load operation himself (David Smith, personal communication 1998).

These estimates are supported by information from SF NSW advisory foresters based at Walcha (see Table 3.7) for the Styx River State Forest (farm D borders on this State Forest).

Table 3.7 Timber growth parameters for the Styx River State Forest

Parameter	Value
Current mean annual increment at a stem density of 600 stems/ha (m ³ /ha/year)	0.58 (range of 0.34 - 0.68)
Potential mean annual increment with thinning to 8-10m spacing or 150 stems/ha (m ³ /ha/year)	1.0
Current rotation length (years)	20-25
Potential rotation length with thinning (years)	10
Current average yields (m ³ /ha)	Quota logs - 11.6 Salvage logs - 11.6

Source: SF NSW, personal communication 1998.

On private property in this area, thinning operations are often carried out using a Tordon Axe™. Thinning to 6m spacings (ie. 280 stems/ha) has been suggested as an optimum spacing by the sawmiller. Cost estimates are around \$120/ha however it was indicated that this is only worthwhile if the thinning is commercial in nature. Chemically treated trees are left standing for later use or sale as firewood. Thinnings cut with an axe can be used for poles in the mines or fencing timber where trees are 10-30 cm in diameter. There is also some scope for allowing a contractor in to perform a scavenging operation where timber is delivered to the wood-chipper at

Dorrigo. This typically returns less than \$10/ m³ (David Smith, personal communication 1998).

In other instances, a de-facto thinning operation is performed where trees with poor form of around 50 cm diameter are culled and sold as mine timber.

In contrast, the SF NSW preferred thinning regime in this region would result in wider spacing (8-10 m) leaving around 150 stems/ha as the final crop. At present, SF NSW do not thin as no market is available. It was also noted that while thinning improves growth rates, this had a negative impact on log quality and sawing characteristics (SF NSW, personal communication 1998).

For farm D, the financial impacts of timber management are estimated on the basis of thinning stands to 6m spacings at a cost of \$232/ha. Following this operation, a conservative log yield (relative to the SF NSW estimates) of 10m³/ha is assumed with a 10 year recovery period between logging. On this basis, logging 15ha/annum will allow a continuous logging operation to take place across the 150 ha to be managed. Sensitivity testing of these assumptions is explored.

The timber management timetable is therefore:

- ➔ **Year 0-14** - log and thin entire 150 ha at a rate of 15ha/annum;
- ➔ **Year 15-24** - each coup is rested for 10 years before logging recommences;
- ➔ **Year 25 onwards** - repeat logging cycle.

It is assumed that no additional stocking benefits are generated through the native timber management program.

Costs and returns associated with kiln drying and dressing were also estimated and included in the analysis to examine the feasibility of producing dressed timber. The key assumptions for this analysis are listed in Table 3.8.

The local sawmiller has indicated that many of the species in the area are suitable for further value adding in this manner, particularly *E. saligna*, *E. nobilis* and *E. laevopinea*.

The information on kiln drying costs were based on the FORTECH (1994) study of kiln drying options for sawmills and based on the figures for the Woodmeiser™ Kiln. This kiln has a capital plus installation cost of \$20,000 and a capacity to dry 384m³ of timber per annum. Given the base assumptions for farm D, the amount of timber supplied per annum would be far below the capacity of the kiln and as a result, timber from other sources would be required to operate the kiln up to capacity. The analysis performed here assumed that both milling and kiln drying/dressing is performed on a contract basis.

The green sawn timber prices quoted by the sawmiller here are significantly higher than those assumed for farm B. This may be a reflection of the better quality species available in the area of farm D. It also probably reflects the long term experience of the sawmiller in the industry and his ability to access more lucrative markets.

Table 3.8 Assumptions for producing dressed timber for case study farm D

Item	Value
Harvesting cost (\$/ha) ^a	156
Milling cost (\$m ³) ^b	100
Mill recovery (%) ^b	45
Drying/contract dressing cost (\$/m ³) ^c	222
Proportion of timber suitable for drying/dressing (%)	25
Proportion of timber sold as green sawn	75
Green sawn timber price (\$/m ³) ^b	\$475
Dressed timber price (\$/m ³) ^d	\$882

a. Based on SF NSW estimates for labour plus fuel and maintenance allowance

b. David Smith, personal communication 1998

c. FORTECH (1994)

d. SF NSW, personal communication 1997

4. Project Results

For each case study farm, business performance was simulated where no native timber management was performed and compared to a scenario where native timber was managed in the manner prescribed by the SF NSW advisory officers. In addition, some of the basic assumptions used for the timber management regime were varied to gauge their effect on financial performance. Results for each case study farm are set out below.

Financing arrangements and debt levels varied significantly across the case study businesses (eg. some businesses had no debt, some with debt were making principal repayments and some were making interest-only payments). To cater for this and to standardise the comparisons, calculations were performed on the basis of Net Farm Incomes (NFI), where NFI is defined as:

- Income from agricultural activities and timber sales

less

- Agricultural and timber variable costs
- Unallocated overhead costs
- Livestock purchases

This figure provides an estimate of NFI at full equity and measures the ability of the business to meet financing and farm family expenses. The Net Present Value (NPV) calculations are also based on NFI at full equity over time.

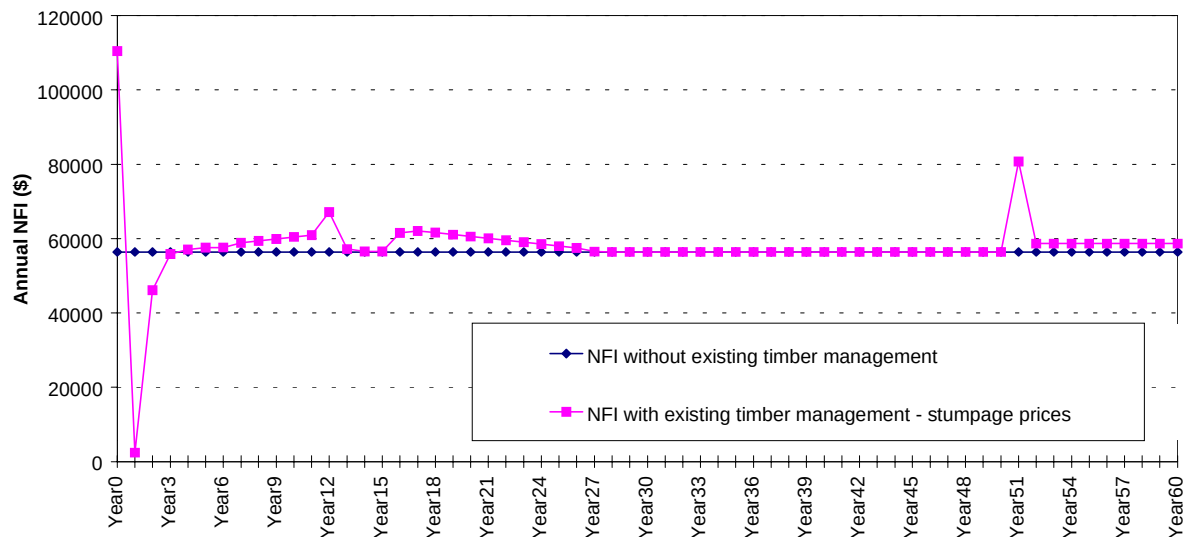
4.1 Case study farm A - cypress pine management

4.1.1 Annual business NFI

The annual business NFI patterns for the with and without cypress management regimes have been plotted in Figure 4.1.

There are several points which emerge from this analysis with respect to the managed timber scenario:

Figure 4.1 NFI with and without cypress management - case study farm A



- There is an initial peak in NFI in Year 0 as the initial logging revenue is received;
- NFI drops sharply in Year 1 as non-commercial thinning commences on the 270 ha portion of timbered land. In terms of whole-business cash flows (ie. where financing, taxation, and family costs are included), this is offset somewhat by a reduced tax liability as a result of the large expenditure on thinning;
- NFI rises gradually between Years 5-12 as the cost of thinning falls (only 25 ha per year being thinned) and the benefits of additional grazing capacity due to thinning begin;
- After Year 12, NFI falls as the benefits from stocking rate increases on the 270 ha portion end due to canopy closure. There is another small rise in NFI for Years 15-18 as non-commercial thinning ends;
- Between Years 18-28, NFI gradually falls to reach a steady state as the stocking rate benefits phase out;
- Finally, at Year 51, NFI rises sharply as commercial thinning commences on the 270 ha portion. NFI then falls to remain slightly above the without timber management level as commercial thinning takes place on the 25 ha portions.

In contrast to this variable NFI pattern, the no timber management cash flow scenario is stable.

It is difficult to tell from the NFI analysis whether or not a net financial benefit over the 60 year period has been achieved by introducing a timber management regime.

For this reason, NFIs have been expressed in Net Present Value terms such that a more direct comparison can be made.

4.1.2 Net present values

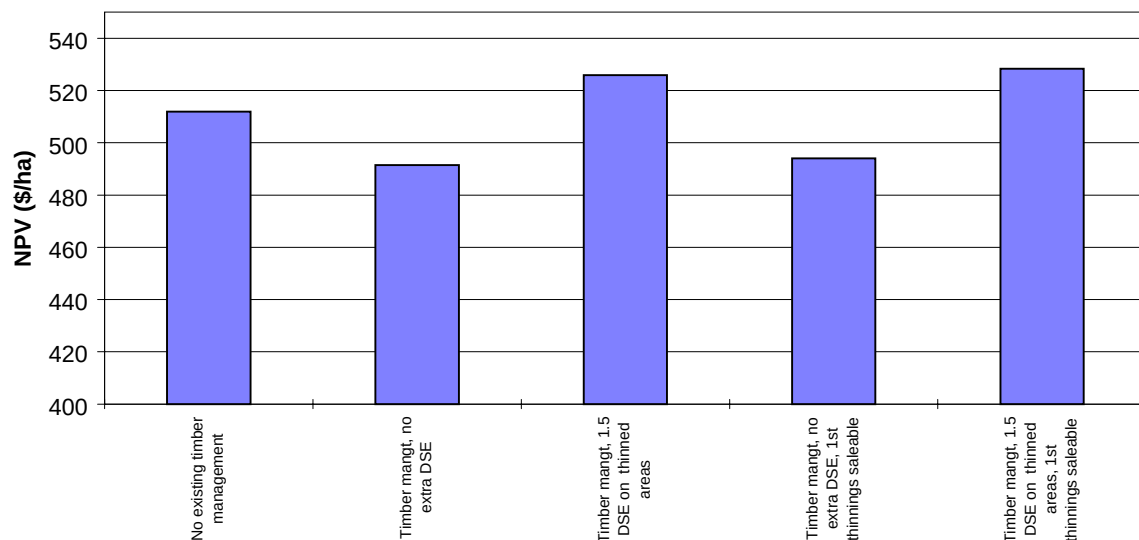
4.1.2.1 Stocking rates versus timber benefits

Net present values per hectare were calculated (assuming a discount rate of 6 per cent) for a range of assumptions about timber management, changes in stocking rates and where first thinnings are saleable as vineyard poles for \$10/m³ (Figure 4.2).

There are several key points which emerge from the NPV calculations:

- Without an increase in stocking rates (assumed to be 1.5 DSE per hectare on thinned areas and lasting for 10 years from the time of thinning), there is no net gain in benefit from managing cypress for timber under the regime used in this study. In fact, NPV/ha fell relative to the situation where no timber management was carried out;

Figure 4.2 Estimates of net present values for cypress management - case study farm A



- Where the stocking rate benefits are applicable, NPV is improved by around 2-3 per cent over the no timber management scenario;
- Having access to early thinnings sales (ie. first non-commercial thinnings become commercial) improves the timber management option only marginally where no stocking benefit apply, yet this option still produces a slightly lower NPV than the no timber management option.

These results suggest that under the base set of assumptions used in the financial model, if thinning does not have a positive effect on stocking rates, the costs of the thinning regime cannot be justified over the 60 year time frame.

Because the 60 year analysis covers the costs incurred by thinning, but does not capture the potential yield benefits, the analysis time frame for farm A was extended to 115 years such that revenues from the second logging period were captured (ie. the payoff for thinning was realised).

Between Years 60-115, extra commercial thinning revenues from the 25 ha management blocks are realised. At Year 101 the 270 ha management block is logged for a second time and in Years 102-115 the remaining 25 ha management blocks are logged. During this period, it is assumed that other farm production levels remain constant.

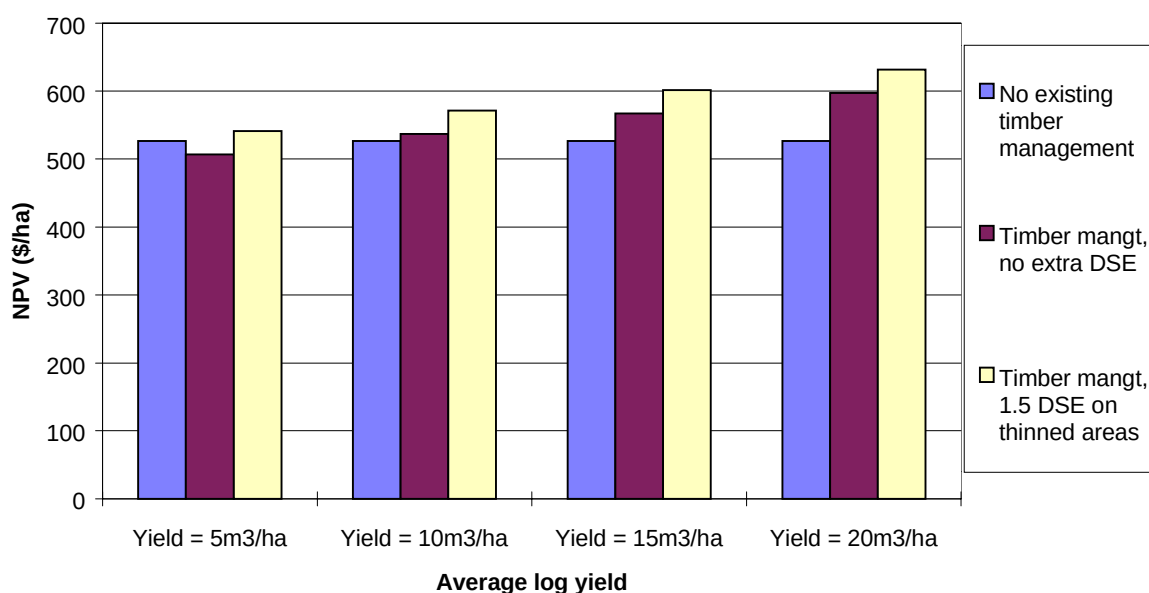
Even after these long-term logging revenues were factored in, the scenario rankings in terms of NPV estimates are the same as for the 60 year analysis. **Again, this suggests that the stocking rate impacts of existing timber management are driving the financial result.** This is because by Year 100+, discounting of the logging revenue would be very high and therefore would not off-set the impact of the early up-front thinning expenditures.

4.1.2.2 Thinning costs and silvicultural response

There are important questions surrounding the costs of thinning and the growth response that is generated through thinning. Unfortunately, in native timber stands (cypress and particularly hardwoods in this region), the response in terms of increased timber production due to thinning is largely untested. While these responses are known with more certainty in plantation situations, this is not the case for many stands of existing timber.

In the base analysis, it was assumed that even with early thinning, the average commercial thinning and harvest volumes were 5 m³/ha. The sensitivity of this assumption was examined by altering the volumes of timber harvested after thinning (both at the commercial thinning and final harvest stages). Results of this analysis are shown in Figure 4.3.

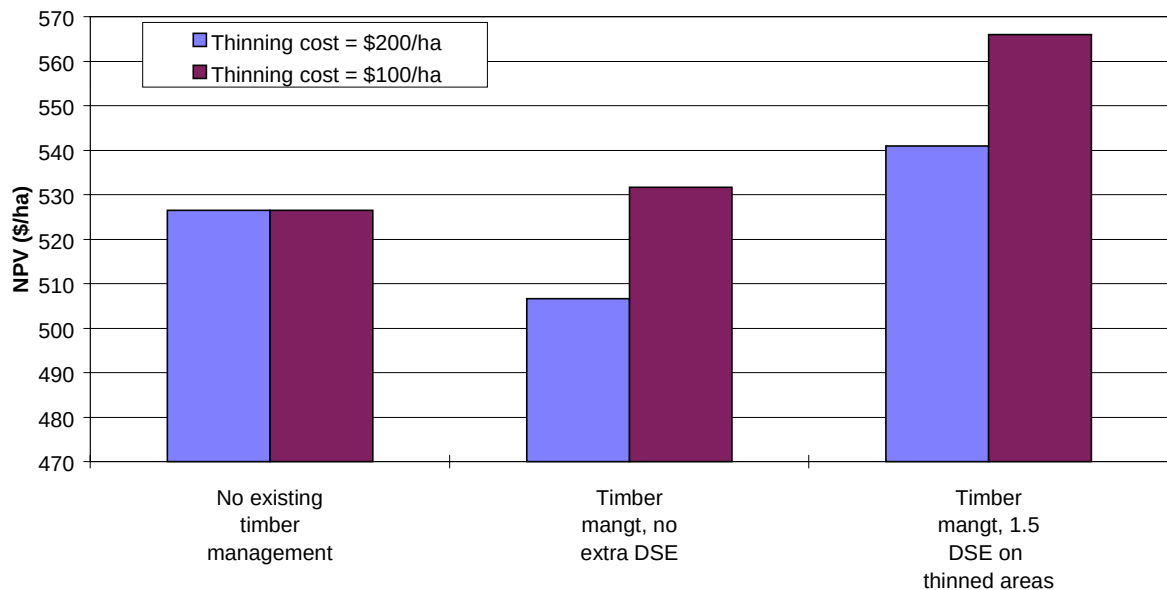
Figure 4.3 Effect of cypress log yield levels on net present value - case study farm A



It is again apparent that the assumed stocking rate benefits which flow from cypress thinning are important. However, where no stocking rate improvements for the 10 years following thinning occur, there is a gradual rise in NPV as timber yields increase though these NPVs are lower than the situations where stocking rate benefits operate. Again, this is partly a function of the fact that stocking rate benefits occur early in the analysis period while the benefits from improved timber yield occur much later so are heavily discounted. Even so, once timber yields reach 10 m³/ha, the NPVs are higher where timber is managed even in the absence of stocking benefits. At higher timber yield levels, timber contributes more to the increase in NPV than stocking rates suggesting that where a significant growth response from thinning is realised, cypress management becomes a financially viable option.

Given that the costs of thinning are substantial (around \$200/ha) and occur early in the analysis period, the effect of lower thinning costs (\$100/ha) were examined (Figure 4.4). The base rate of \$200/ha represents the typical costs associated with having contractors do the work, though this figure is influenced by stand density. On some properties, it may be possible for the landholder to perform thinning themselves where time allows, although most would require some initial guidance on how to perform the operation so as to maximise timber production. Similarly, improvements in chemical thinning techniques may lead to future reductions in thinning costs.

Figure 4.4 Effect of thinning costs on cypress net present value - case study farm A



From Figure 4.4 it is apparent that thinning costs are an important element in the financial performance of cypress management. Even where no additional stocking benefits can be captured, halving the thinning costs generates a small improvement in NPV of 5 per cent.

4.2 Case study farm B - native eucalypt management

4.2.1 Annual business NFI

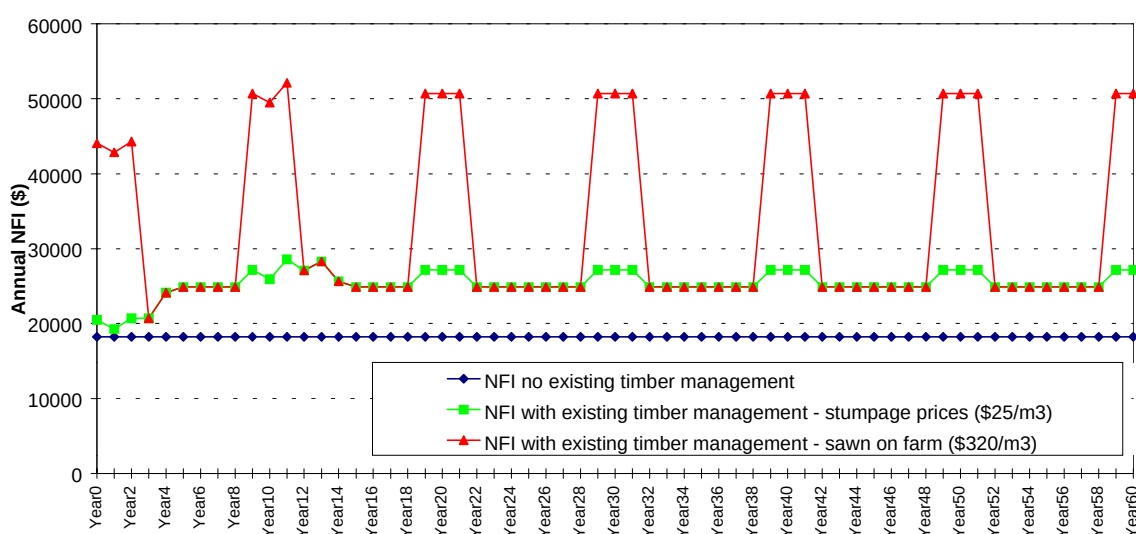
Case study farm B is somewhat unique in that the capacity to saw timber on farm exists. For the basic management regime described above in section 0, two alternative scenarios were examined:

1. Where timber is sawn on farm (with the accompanying logging and milling costs incurred by the landholder) and sold at \$320/m³; and
2. Where the same volumes of timber are harvested by the local saw-mill at a stumpage to the landholder of \$25/m³.

These are compared with the base case situation where the farm operates without a native timber enterprise.

The annual NFI patterns for these three options are shown in Figure 4.5.

Figure 4.5 NFI for native eucalypts management - case study farm B



The key points to note from this analysis are:

- Where timber is sold at sawn prices, early NFIs are significantly higher than for the other two options;
- For both of the timber management options, NFI is consistently higher after Year 4 as stocking rate benefits are fully operative across the entire 400ha of managed timber;
- **Where stumpage prices are paid for the timber, NFI is around \$6 600 per annum higher after Year 4 relative to the base case. However only \$2 250 of this advantage comes from timber production. Increased livestock carrying capacity contributes to the bulk of the NFI improvement.**
- **Where timber is managed, milled on-farm and sold as sawn timber, NFI is more volatile yet consistently higher than for the base case scenario. During timber harvest years, there are peaks in the annual NFI. In these years, timber revenues exceed timber management and milling costs by around \$26 000/annum.** Combined with the assumed stocking rate benefits, this provides a significant income advantage over the base case. Here, the majority of the income improvement is derived from timber income during harvest years.

In a whole-farm context, it should also be noted that where timber is sawn on farm, tax liabilities are significantly higher in harvest years (in the vicinity of \$7 000-13 000 higher than where timber is sold at stumpage prices).

4.2.2 Net present values

4.2.2.1 Stocking rates versus timber benefits

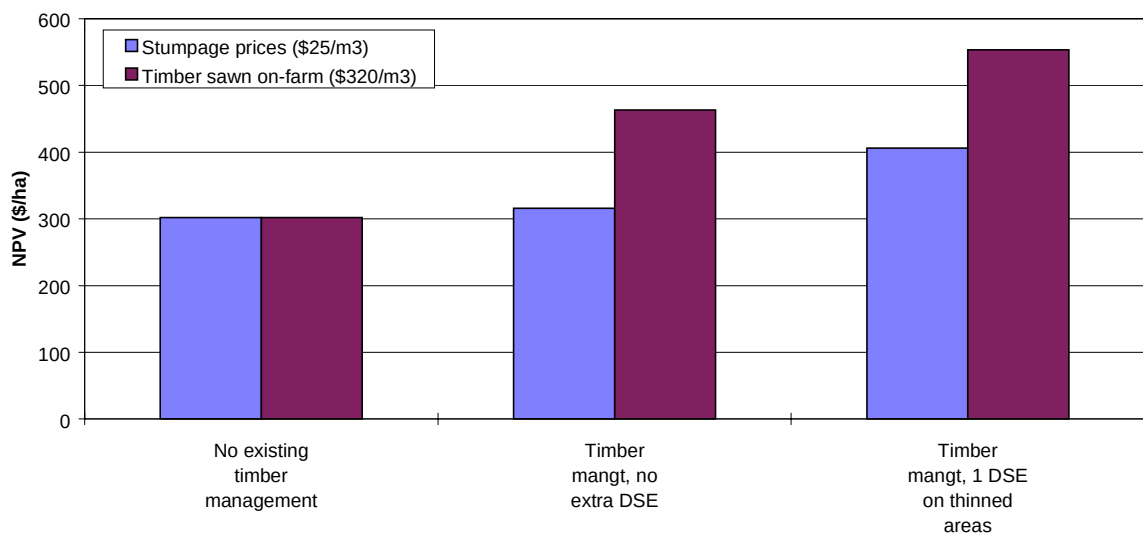
NPVs have been calculated to perform a comparison of each management option over the 60 year time frame. Again, the impact of assumptions about stocking rate changes have been examined to address the issue of whether the benefits of timber management are derived largely from timber production, changes in stock carrying capacity or both.

The issue of thinning costs is also explored as advice from the SF NSW Advisory Forester was that significantly less thinning was required on this farm because of lower stand density, relative to the cypress situation described above. The sensitivity of this assumption was tested.

From Figure 4.6 it appears that selling native eucalypt logs at stumpage prices is marginal, even where a relatively small thinning cost of \$112/ha applies.

Sensitivity testing indicated that thinning costs would have to fall to virtually zero (where there are no stocking rate benefits) for the NPVs associated with selling timber at stumpage prices to be comparable with selling sawn timber.

Figure 4.6 Estimates of net present values for eucalypt management - case study farm B



Where thinning costs match those which applied to cypress (\$200/ha - see section 0), managing eucalypt forest to sell at stumpage prices does not appear viable, even where the stocking benefits outlined above are available.

Where timber is sawn on farm however, a thinning cost of \$112/ha appears justifiable. Even where no carrying capacity benefits are assumed, relative to the base case, NPV is increased by nearly 34 per cent. With an increase in stocking rates, NPV improves by 83 per cent.

Even at a thinning cost of \$200/ha, selling sawn timber still provides a significant NPV advantage over the base case both with and without stocking benefits.

These results indicate that where timber is managed and sold at stumpage prices, the majority of the economic benefit is derived from stocking rate improvements. However, where timber is sawn on farm and sold as sawn product, the economic benefits derived from timber outweigh those gained from increased stocking.

4.2.2.2 Thinning costs and silvicultural response

As with cypress, little is known about the growth response of Northern Tablelands hardwoods to silvicultural management (Ernie Chiswell - Forestry Consultant, personal communication 1998). This adds a significant element of risk to the decision to make expenditures on thinning operations, particularly where the landholder is only achieving stumpage prices.

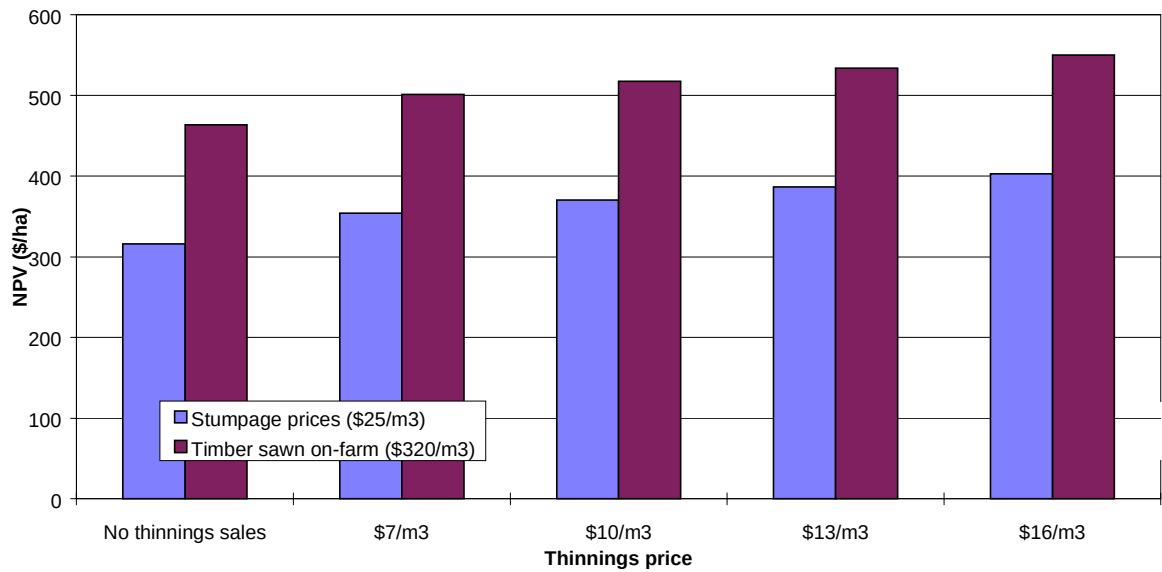
Based on the assumptions described above and at a thinning cost of \$200/ha, if selling at stumpage prices, harvest yields of about 9 m³/ha would be required (in the absence of stocking rate improvements) to justify timber management from a financial viewpoint. This represents a doubling of the current estimated timber yields on this farm. Again, this demonstrates the critical interaction between thinning costs and timber growth response in managing existing native timber.

4.2.2.3 Markets for thinnings

Another important farm forestry issue on the Northern Tablelands is the lack of markets for thinnings. With the exception of using small logs for farm timber (fence-posts etc), there are limited uses for small logs and other tree wastes.

To illustrate the impact of thinning sales on the financial performance of the timber management program for farm B, a range of thinning sales prices were simulated (Figure 4.7). These prices cover estimated current returns for pulpwood at around \$7/tonne and small sawlogs at around \$15/m³ (SF NSW data, personal communication 1997). A thinnings volume of 5 m³/ha was assumed and the thinnings cost was \$112/ha.

Figure 4.7 Impact of access to thinnings sales on net present value - case study farm B (no stocking rate benefits)



The ability to sell early thinnings has a significant positive effect on the returns to existing timber management in this case.

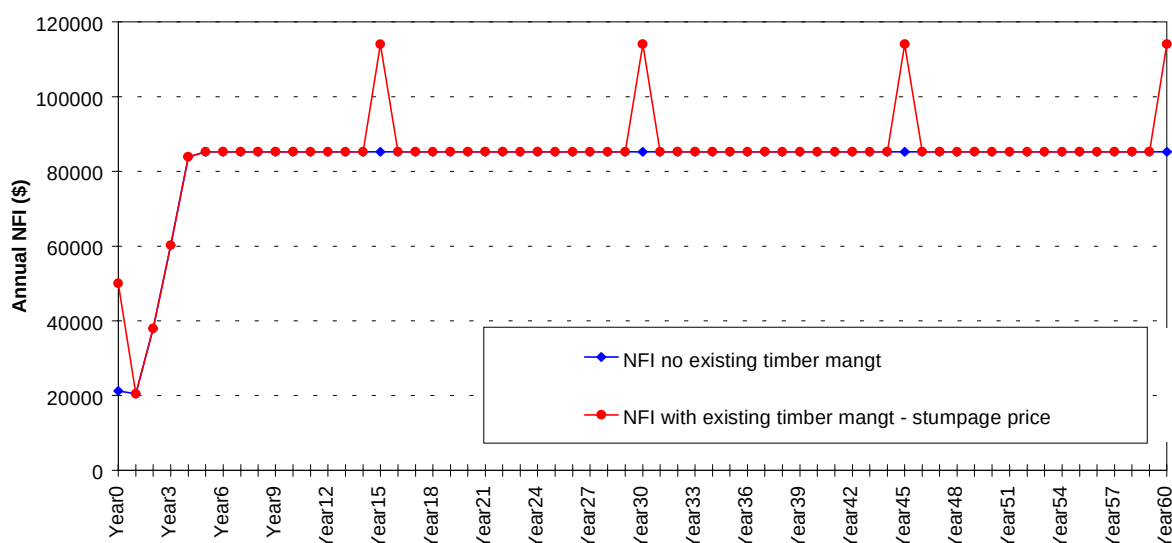
Again however, there is a strong interaction with the cost of thinning. Where thinning costs \$200/ha and timber is sold at stumpage prices, although thinning sales have a positive effect on NPV, it is not until thinnings returns exceed \$16/m³ that this option is better than the no timber management option.

4.4 Case study farm C - native eucalypt management

4.4.2 Annual NFIs

The annual NFI pattern for farm C is provided in Figure 4.8. Key features of this pattern are:

Figure 4.8 Cash flows for native eucalypt management - case study farm C

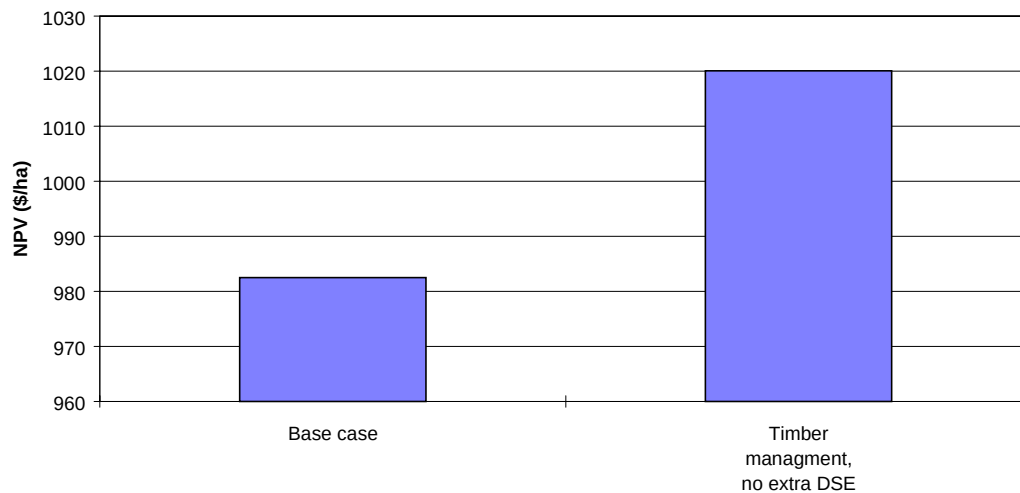


- NFI early in the analysis period is volatile for two reasons:
 - * In Year 0, timber revenues from the initial harvest boost NFI where native forest is managed for timber;
 - * In Years 1-5, NFI increase significantly as livestock number increase under the farm development program. The additional income from livestock more than compensates for the increased expenditures on pasture improvement;
- NFI become stable after Year 4 for the base case;
- **Where timber is harvested under a 15 year logging cycle, NFI is also relatively stable and at the same level as the base case, with the exception of peaks every 15 years when an additional \$29 000 of timber income is realised. Note that taxation liabilities rise substantially in the timber harvest years by around \$18 000, despite the use of tax averaging;**
- **Perhaps the major NFI benefit in this instance occurs during the first two years of the analysis period where timber revenues help to offset the additional expenditures on farm improvement.**

4.4.3 Net present values

The eucalypt management regime outlined above for this farm generates an improvement in NPV of around 4 per cent over 60 years relative to the base case (Figure 4.9).

Figure 4.9 Estimates of net present values for eucalypt management - case study farm C



A 4 per cent improvement is not a large additional benefit over a 60 year period and again suggests that managing native timber for harvest and sale at stumpage prices is a marginal exercise in economic terms, particularly where no stocking capacity benefits are captured.

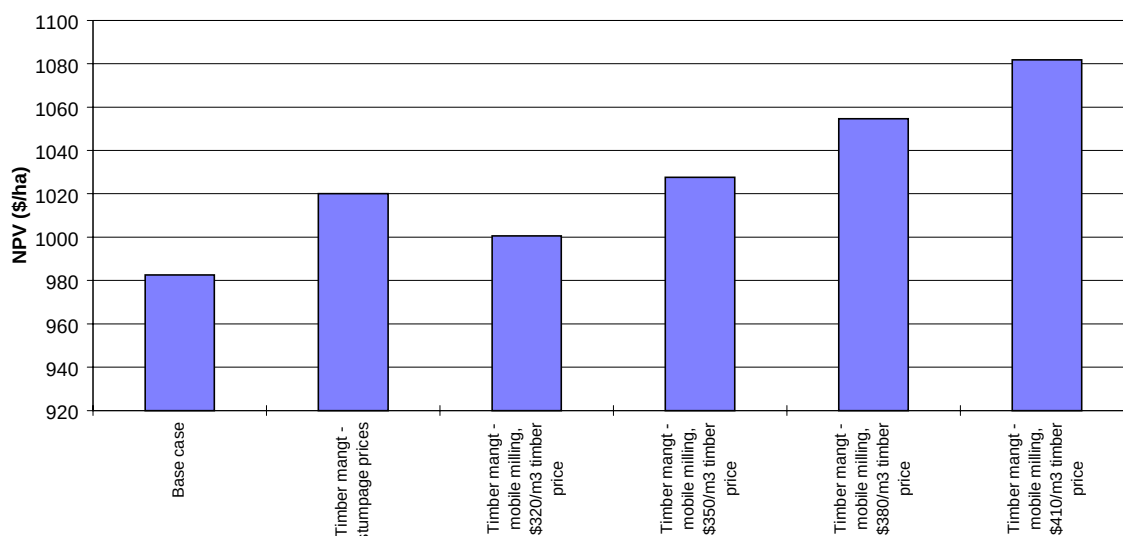
As was the case for farm B, moving further down the processing chain to improve the returns from farm timber may be a more attractive financial option. Where market outlets for processed farm timber can be found, this provides a greater financial opportunity to the landholder.

4.3.2.1 Mobile saw-milling

Given that few landholders are likely to construct their own mills on-farm, utilising the services of a mobile saw-miller is an option. This alternative was investigated for farm C. The same timber management regime was used, but it was assumed that a mobile mill was hired at a cost of \$300/m³. Discussions with local mobile saw-millers have revealed that charges range from \$115/ sawn m³ where the landholder conducts the cutting and snigging operation, to \$300/ sawn m³ where the miller performs the entire logging and sawing operation.

A range of prices were examined to test sensitivity to sawn timber sale prices. Results in NPV terms are shown in Figure 4.10. Unless prices in excess of \$320/ m³ can be obtained, hiring the services of a mobile mill at \$300/ sawn m³ generates a worse financial result than selling timber at stumpage prices.

**Figure 4.10 Impact of alternative timber product sales and sale prices
- case study farm C**



However, where sawn timber sales off-farm can be secured at prices above \$350/m³, using the services of a mobile saw-miller becomes the preferred option.

This result relies on the ability of landholders to find markets for their sawn timber on a regular basis. Where they are harvesting only sporadically, this is likely to be difficult as many of the larger markets will require a regular, reliable supply of sawn timber of a minimum quality.

The formation of local timber supply networks amongst landholders is perhaps one mechanism for overcoming this problem. Even so, landholders must be aware that local markets for structural timber are volatile and heavily influenced by the performance of the building trade. As a result it may be difficult to find local wholesalers/retailers who are willing to enter into any form of long-term supply agreement with groups of landholders.

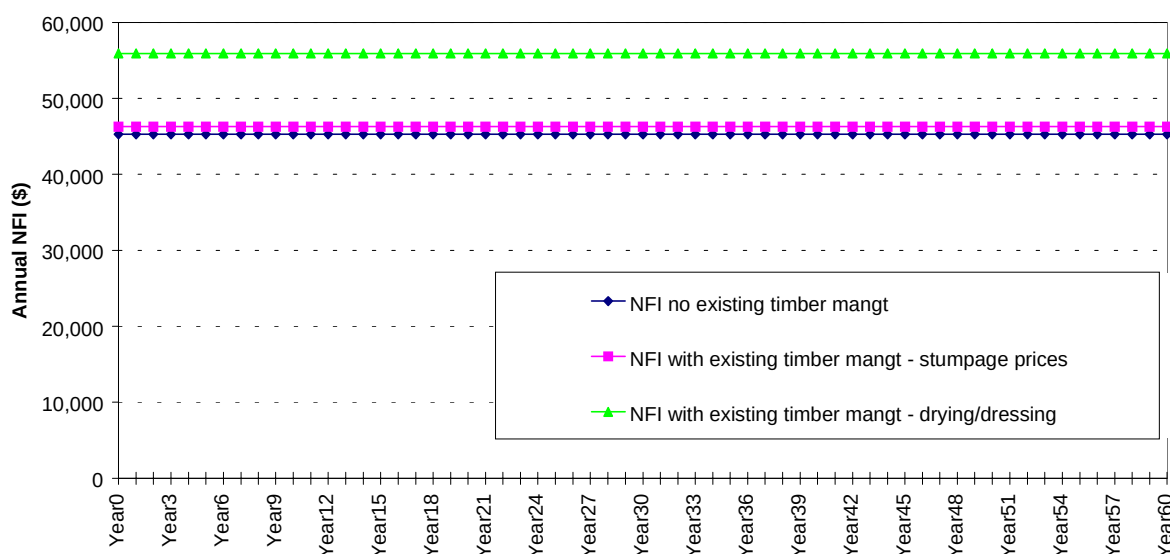
Discussions with the farm manager about the results outlined above indicated that the preferred option might be to harvest the existing native timber in an opportunistic manner when timber prices were high. Another option is to supplement cash flows with income from timber when commodity incomes are low.

4.5 Case study farm D - eucalypt management

4.4.1 Annual business NFI

The annual business NFI patterns for the with and without eucalypt management regimes have been plotted in Figure 4.11.

Figure 4.11 NFI with and without eucalpyt management - case study farm D



There are several points which emerge from this analysis with respect to the managed timber scenario:

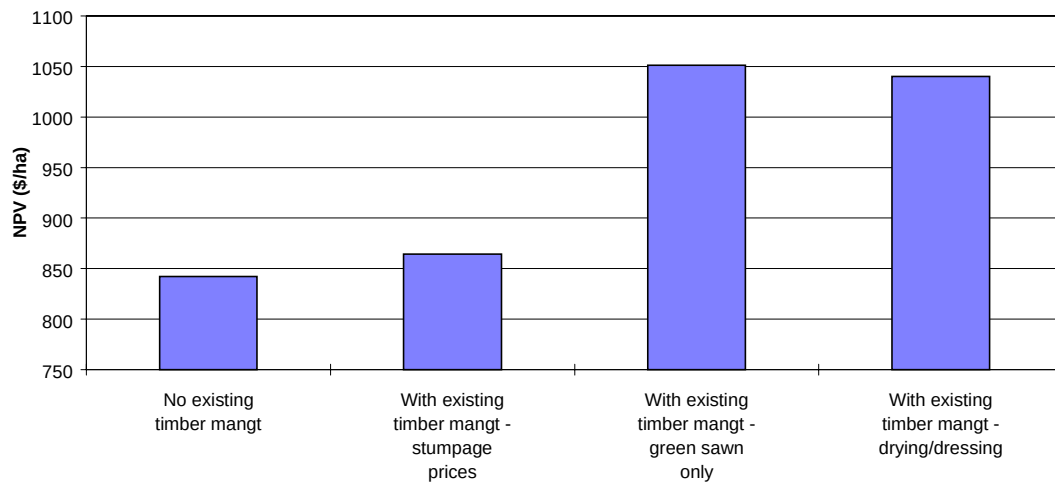
- Because harvest areas were set at only 15ha such that a continuous level of harvest was possible and no stocking rate benefits are assumed, there is no fluctuation in annual NFI under each scenario;
- Selling timber at stumpage prices only increases annual NFI by around \$1000. This is because the assumed thinning costs of \$232/ha offset a large proportion of the timber revenue of \$300/ha. **Again, this indicates that selling at stumpage prices is a marginal option where thinning is carried out unless significant timber growth benefits can be obtained.**
- Where it is assumed that timber harvested from the farm is contract milled and 25 per cent of the milled timber is dried and dressed, NFI is improved by around \$10,000 per year.

4.4.2 Net present values

4.4.2.1 Degree of timber processing

Net present values per hectare were calculated (assuming a discount rate of 6 per cent) for the no timber management scenario, where timber is sold at stumpage prices and where timber is milled and 25 per cent is dried and dressed (Figure 4.12).

Figure 4.12 Estimates of net present values for eucalypt management - case study farm D



The key points to emerge from the NPV calculations are:

- The net gain from managing timber and selling at stumpage prices is small (around a 3 per cent improvement in the NPV/ha only);
- Selling green milled timber generates the highest NPV/ha with a 25 per cent improvement over the base case;
- Where timber is milled and a portion is dried and dressed, there is a significant improvement in the NPV/ha of around 23 per cent over the base case. However, with the base assumptions this option is less desirable than simply selling green sawn timber.

Again, this finding suggests that where the landholder is able to move timber production further down the processing chain, and assuming markets for that timber can be found, the economic advantages are greater than selling at stumpage prices. However, it should be noted that this analysis has not accounted for the time invested by the landholder in securing processing services and finding markets for their timber.

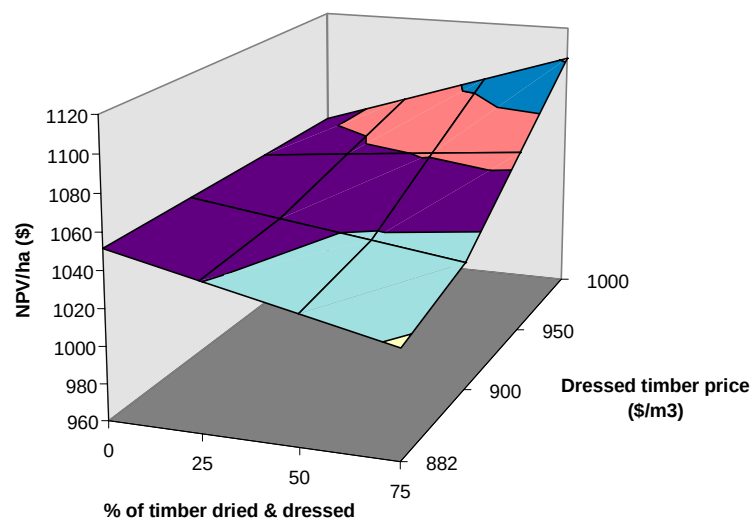
It is interesting to note that the production of green sawn timber appears to be a slightly better option financially than drying and dressing a proportion of the timber. This is because after allowing for milling costs, each cubic metre of green sawn timber returns \$375. For dried and dressed timber, after accounting for milling, contract drying/dressing and shrinkage, each cubic metre returns \$340, slightly below that for green sawn. The future sustainability of this differential in returns is however open to question given the growing volumes of structural softwoods coming onto world markets.

In the base analysis, a dried and dressed timber price of \$882/m³ was assumed. Given milling and drying dressing costs of \$322/m³ and a shrinkage loss of 25 per cent, the

sale price of dressed timber would have to rise to \$945/m³ to become competitive with green sawn timber at \$475/ m³.

The effect of varying the proportion and price of milled timber which is dried and dressed is shown in Figure 4.13. It is clear that in this case, drying and dressing large proportions of timber is only viable where the margin for dressed timber over green sawn is substantial.

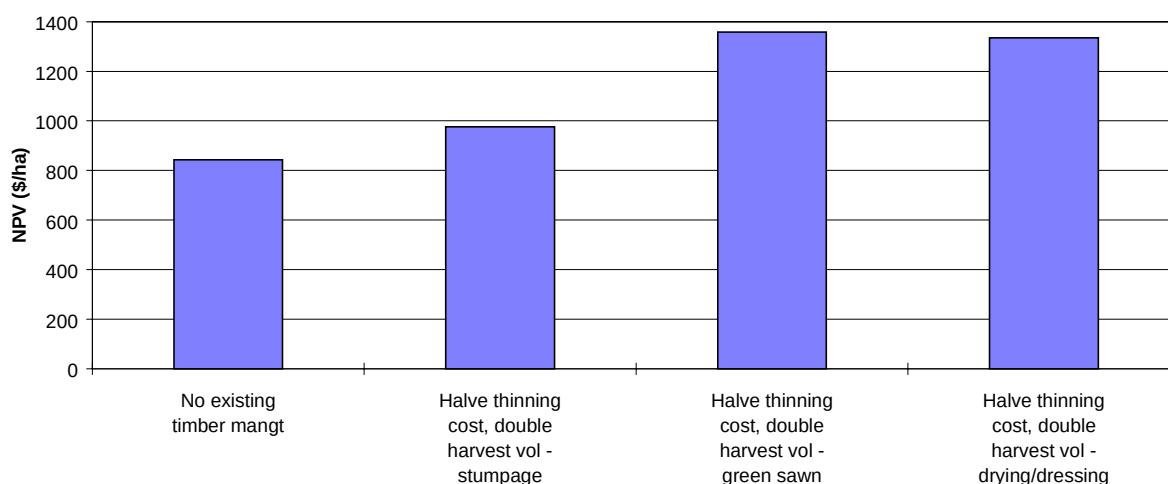
Figure 4.13 Value adding and net present values - case study farm D



4.2.2.2 Thinning costs and growth response

In the base analysis, it was assumed that early thinning at a cost of \$232/ha generated a harvest volume of 10 m³/ha. The sensitivity of the thinning cost and harvest volume assumptions were examined by reducing the labour cost associated with thinning by 50 per cent (which is realistic given the relatively low stem densities) and doubling harvest volumes (again, which is realistic given SF NSW yields from selective logging in the area without any thinning). The results of this analysis are shown in Figure 4.14.

Figure 4.14 Effect thinning costs and harvest volumes on net present value - case study farm D



Selling green sawn timber provides the highest financial performance, although drying and dressing some of the timber is still an option worth considering relative to selling at stumpage prices. With lower thinning costs and higher harvest volumes, selling at stumpage prices now generates a substantially higher NPV than the base case where existing timber is not managed (an improvement of around 16 per cent in the NPV/ha).

Results from this analysis support the findings of other recent studies of value adding in the hardwood milling industry (eg. Thompson *et al* 1997). **While recent government policy has emphasised the need to extract greater value from native timber through the production of high value end-use products, the profitability of such activities is not clear-cut.**

The work undertaken by Thompson *et al* (1997) together with anecdotal evidence from discussions with local sawmillers indicates that the profitability of timber value adding is erratic in nature and closely linked to the price differential between green sawn and dressed products.

The other important consideration for farm D is the area of timber harvested per annum. Given the growth rate assumptions for the region as estimated by SF NSW, it would only be feasible to harvest and thin some 15 ha per year if a regular annual harvest was required. This would generate around 150-300 m³ of timber per year.

As with the other farms in this study, scale problems might emerge with sawmillers or their contractors reluctant to mobilise equipment for such small volumes of timber (despite the results of the sawmill survey which suggested mills were willing to take parcels of timber as small as 50m³).

4.5 Comparing land use options on the basis of gross margins

The analyses performed above have been carried out on the basis of NFIs where both variable and overhead costs are included in the analysis and each farm is starting a timber management regime from its current land use status.

It is also useful to use the case study farms to perform a simple and more general gross margin per hectare analysis, based on the management regimes prescribed, but comparing the options for the use of a hectare of timbered land on each farm. Land use options include:

1. Clearing the land for grazing at a one-off cost of \$800/ha. Discussions with local contractors indicates that \$800/ha would represent a maximum cost, with clearing on the Tablelands generally costing \$400-\$800/ha. A figure of \$800/ha caters for pasture improvement costs.

It is assumed that any millable timber is sold at stumpage prices. The opportunity cost of future timber harvest income forgone is accounted for. Grazing gross margins have been estimated for each farm on a per hectare basis (these exclude overhead costs). This analysis assumes that stocking rates on the cleared land are equivalent to those on the remainder of the farm. This will not always be the case as some timbered sites are less suited to grazing due to factors such as slope and soil type.

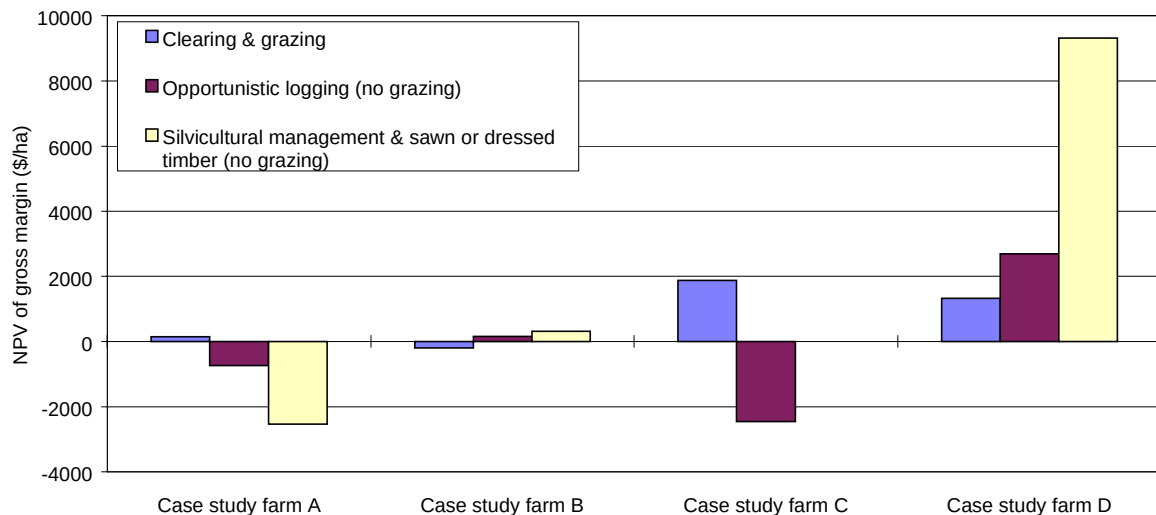
2. Performing opportunistic logging based on the specified rotation lengths and harvest volumes. Here, it is assumed no grazing takes place and the opportunity cost of the grazing gross margin forgone is factored in.
3. Silvicultural management of the timber (where feasible) and selling timber at either stumpage prices (Farm A), as sawn timber (Farm B) or as sawn and dried/dressed timber (Farm D). Again, the opportunity cost of grazing forgone is factored in.

The gross margins have been calculated over a 60 year period and discounted to generate an NPV per hectare value. Note that this figure is different to the NFI NPVs discussed in the sections above as it excludes overhead costs and interactions between timber management and livestock enterprises. The gross margin NPVs calculated here also include the opportunity cost of foregone grazing/timber revenues which might have been realised from the land.

The results of this analysis are provided in Figure 4.15. For farm A, the analysis reveals that either opportunistic logging (once every 100 years for cypress) or managing the cypress produce a negative NPV, while clearing and grazing produces a positive NPV of gross margin per hectare of \$148.11. The long rotation length and

cost of thinning cypress preclude using the land for timber production alone as a viable option in this case.

Figure 4.15 Gross margin NPVs for alternative land use options



For farm B, the result is quite different. Here, grazing gross margins are the lowest of the four properties and timber can be harvested more regularly (each coup can be harvested every 10 years). In this case, using the land to produce timber to sell at stumpage prices or selling sawn timber are preferable options to clearing and grazing. Selling sawn timber generates a gross margin NPV of \$316.52/ha.

Case study farm C has the highest livestock gross margin of the case study farms and the least potential in terms of managing existing native timber. For this reason, the clearing option provided the highest gross margin NPV. Using the land for opportunistic timber production was not an option as it generated a large negative NPV.

This was due to a combination of relatively low timber yields ($5\text{m}^3/\text{ha}$), longer rotations (15 years) and achieving only stumpage prices at $\$25/\text{m}^3$. While these parameters also applied to farm B, the low livestock gross margins on farm B made timber production a more attractive option. The high livestock gross margins foregone on farm C under opportunistic logging are the cause of the negative NPVs in this case. The silvicultural management of timber on this farm was not examined as thinning was deemed to be unnecessary due to low stem densities.

Livestock gross margins on farm D are also relatively high ($\$134/\text{ha}$), yet both opportunistic logging or silvicultural management and selling sawn/dressed timber produce a better financial result in gross margin terms. This is because of the higher timber yields ($10\text{m}^3/\text{ha}$), higher stumpage price ($\$30/\text{m}^3$), relatively short rotation length (10 years) and the scope for value adding.

Where it is assumed that all timber is sawn and 25 per cent is dried and dressed, the gross margin NPV per hectare of \$9 300 is around 7 times higher than for cattle production alone. However, it should be noted that sawn/dried/dressed timber is a significantly higher value-added product than live cattle.

While the magnitudes of the gross margin NPVs are very different to the NFI NPVs (as the latter are calculated on a whole-farm basis), the general findings are still the same:

- For the cypress system (Farm A), grazing is a more profitable option than managing timber on a per hectare basis. However, where timber management can be integrated with grazing, a better result than grazing alone can be achieved on a whole-farm basis. It must also be noted that where thinning can be carried out at lower cost, the gross margin situation for timber management will improve markedly.
- Where grazing is generating low gross margins (Farm B), the management of existing timber is a viable financial alternative. On a whole-farm basis, integrated livestock and timber management is a profitable option.
- Where grazing gross margins are high but timber productivity is low (Farm C), grazing is the preferred form of land use on a gross margin basis. Again however, on a whole-farm basis, integrated grazing and opportunistic logging provides a higher NFI than grazing alone even where timber is only sold at stumpage prices.
- Under conditions of higher timber productivity and quality, managing existing native timber can provide higher gross margins and NFIs than grazing alone (Farm D). This is the case even where grazing gross margins are relatively high. The ability to value add the timber greatly enhances the financial performance of the timber enterprise.

Another key point to emerge from this work is the need to perform a whole-farm analysis to clearly identify the financial effects of managing native timber on-farm. Gross margin analysis, while a useful tool, does not provide the entire financial story.

4.6 Using existing timber cash flows to fund plantation establishment

A further objective of this study was to examine the opportunities for funding plantation development from existing timber harvest revenues.

The costs of plantation establishment vary significantly based on factors such as:

- Ease of site access;
- Degree of ground preparation;
- Fencing requirements;

- Planting density (which will vary with species and timber production goals); and
- Establishment techniques (eg. the use of mulch, fertilisers and watering add to the costs).

To illustrate the cost variation, Table 4.1 has been constructed using information from a number of recent farm forestry studies and projects. For most eucalypt species in Northern NSW, SF NSW have suggested that an establishment cost of around \$1500/ha is a valid estimate (Rob Heathcote, SF NSW, personal communication 1997).

The management regimes suggested for case study farms B, C and D will produce the following levels of revenue on a per hectare basis (Table 4.2). Note that farm A is excluded since advice from SF NSW (Richard Reinstra, personal communication 1998) is that cypress pine is not suitable for plantations.

Revenues on a per hectare basis have been reported in two ways:

1. **As NPVs per hectare** - these provide an estimate of the additional net returns per hectare from managing existing timber. This figure accounts for all timber related costs and revenues as well as any grazing benefit revenues and is discounted back to a current value.
2. **As direct net income per hectare** - this measure includes only the net income from logging in a typical harvest year. Only the costs associated with the managed existing timber enterprise are included (no grazing benefits) and discounting over time is not used.

It is clear comparing the establishment costs in Table 4.1 and the returns from managing existing timber in Table 4.2 that in general, returns fall well short of offsetting the typical costs of plantation establishment.

However, there are other options for increasing the volumes of quality timber on farms other than following a strict plantation approach. The act of logging and thinning will usually result in sufficient disturbance of ground cover to promote re-growth of existing timber species.

There is also the option of re-planting exiting areas of timber at low densities (eg. 100 stems per hectare) once an initial logging has been carried out (Ernie Chiswell, Forestry Consultant, personal communication 1998). It may be possible to choose alternative suitable and desirable species for re-planting which provide better timber or exploit a particular market niche.

Table 4.1 Plantation establishment costs

Situation	Species	Planting density (stems/ha)	Cost item (\$/ha)								TOTAL
			Fencing	Ripping & mounding	Rotary hoeing	Rabbit control	Seedling purchase & planting	Herbicide application	Fertiliser application	Mulch, tree guards & watering	
Northern Tablelands farm woodlot - low cost establishment (1996 figures) ¹	<i>Pinus radiata</i>	1500	n/s	45	33	n/a	165-300	53	n/a	n/a	301-436
							(two applications)				
SF NSW establishment techniques - broadacre agroforest (1994 figures) ²	<i>Pinus radiata</i>	600	43	49	n/a	31	245	82	40	n/a	490
			(electric)				(labour @\$15/hr)	(two applications)			
Northern Tablelands native tree & shrub shelterbelts ³ (1995 figures)	Eucalypts, Acacia, Grevillia	1333	645	133	n/a	n/a	1652	n/a	n/a	400	2830
			(4 sides around belt)				(labour @\$15/hr)			(mulch & guards)	
Victoria - farm plantation - contract out ⁴ (1996 figures)	Pine or eucalypt		n/s	250	n/a	70	480	400	100	n/a	1300
Victoria - 40 ha pulp/sawlog joint venture plantation ⁵ (1996 figures)	<i>Pinus radiata</i>	1330	90	180	n/a	5	340	115	195	n/a	925
Northern Tablelands - 10 ha farm plantation ⁶ (1994 figures)	<i>Eucalyptus caliginosa</i>	827	390	51	n/a	n/a	530	70	78	24	1143
			(Netting fence)							(watering only)	

Table 4.1 continued

Situation	Species	Planting density (stems/ha)	Cost item (\$/ha)								
			Fencing	Ripping & mounding	Rotary hoeing	Rabbit control	Seedling purchase & planting	Herbicide application	Fertiliser application	Mulch, tree guards & watering	TOTAL
Northern Tablelands - native tree & shrub windbreak ⁷ (1995 figures)		1000	837	100	n/a	n/a	708	340	n/a	300 (guard, mulch, stakes, watering)	3285
Bunbury, Western Australia - 25 ha Blue Gum farm plantation ⁸ (1993 figures)	<i>Eucalyptus globulus</i>	n/s	40	150	n/a	10	350	220 (herbicide & insecticide)	110	n/a	880
North coast of NSW - Blackbutt plantation ⁸	<i>Eucalyptus pilularis</i>	830	200	270 (includes clearing & burning)	n/a	n/a	424	265 (pre and post planting control)	225 (at years 0 and 3)	n/a	1699 (includes other miscellaneous costs)

n/s = costs not stated, n/a = costs not applicable

1. John Taylor, Farm Forester, personal communication 1996
2. Clarke 1995
3. Simon Andrews, University of New England, personal communication 1996
4. Moore 1996a
5. Moore 1996b
6. Harris 1995
7. Susie Gaynor, Landcare Co-ordinator, personal communication 1996
8. Rob Heathcote, SF NSW, personal communication 1997

Table 4.2 Revenues from managing existing timber

Situation	Revenue (\$/ha)
Case study farm B	
Selling sawn timber - NPV terms over 60 years	251.46
Selling sawn timber - direct net income from sales on an annual basis	149.00
Case study farm C	
Selling timber at stumpage prices - NPV terms over 60 years	37.58
Selling timber at stumpage prices - direct net income from sales on an annual basis	125.00
Case study farm D	
Selling green sawn timber - NPV terms over 60 years	1051.50
Selling green sawn timber - direct income from sales on an annual basis	749.53

5. Conclusions and Discussion

The broad conclusion to be drawn from this work is that in most cases, and at current prices, the contribution from existing native timber management to farm financial performance is marginal on the Northern Tablelands. Similarly, the net revenues from existing timber management will only partially meet the costs of plantation establishment.

This is due to a number of factors, most importantly:

- The low growth rates and poor quality of native timber species in the region, resulting in low harvest volumes;
- The relatively low stumpage prices offered by local sawmills (in contrast to those offered by sawmills on the North Coast);
- A lack of markets for forest thinnings; and
- The inability of many landholders to take their timber resources further down the value chain.

It is likely that many landholders in the region will utilise their existing timber resources to generate additional income when farm income from traditional enterprises is low rather than managing timber for longer term cash flows. This procedure will usually entail allowing a local sawmill to perform selective logging on the farm and accepting stumpage prices for the timber harvested.

In terms of the analytical work performed in this study, there are several key points which can be made:

1. Thinning expenses in the vicinity of \$200 per hectare cannot be justified where managed existing timber is selectively harvested and sold at stumpage prices. Unless the growth response to thinning is such that timber harvest volumes are doubled, the revenue from royalties is unlikely to be sufficient to cover the costs of thinning. This is the case for both cypress pine and eucalypt species on the Tablelands.

Having made this point, it is important to note that in the Northern Tablelands environment, a thinning regime which costs \$200 per hectare may not be required, particularly in existing eucalypt stands. The initial low stem densities in this region (150-300 stems per hectare) mean that a much lower thinning intensity (or perhaps no thinning) can be carried out.

On some sites, the act of performing selective logging combined with the removal of the largest non-merchantable trees will reduce the basal area sufficiently to generate a substantial growth response. On many of the poorer sites on the Northern Tablelands however, it is likely that any growth response from thinning will be marginal (Rob Dyason, personal communication 1998).

2. Stocking rate improvements following thinning may be the key driver of economic performance for managed native timber. Case study results for both cypress pine and eucalypts indicated that where stocking rates could be increased

by 1.0-1.5 DSE/ha for 10 years following thinning, these stocking rate benefits generated more additional income than timber royalties.

3. Access to thinnings markets has a positive influence on the financial effects of managing existing native timber. However, where thinning costs were high, even with thinnings sales, it was difficult to justify the costs of thinning.
4. The ability to sell existing farm timber in sawn or dried and dressed form added substantially to the financial performance of the native timber enterprise. Even where no stocking rate benefits apply, selling sawn or dressed timber generated a significant financial advantage over selling at stumpage prices after allowing for the costs of milling and value adding. However, this option may not be available to many landholders and questions can be raised about the ability of landholders to access markets for value-added timber from their properties.

These findings are all heavily dependant upon the timber prices used in the analysis. It is likely that in the future, continuing restrictions to the supply of native hardwoods will generate significant price rises greatly improving the financial viability of managing existing timber.

In addition, there are a number of general issues which relate to farm forestry from either existing timber or plantations which require discussion in the context of this study.

These revolve around the level of integration between components of the forestry industry in a region and the regional economy as a whole. Much of the current analysis of farm forestry options is very specific in nature and is focused at the farm level (as is the case with a large component of this study). However, it is likely that for a competitive and substantial farm forestry sector to emerge, a far more integrated and 'big picture' approach will be required. This will include the consideration of issues such as:

- The size and quality of the existing resource from all sources (private and Crown plantations and existing timber);
- The current and potential level of processing capacity in a region;
- Availability of technical/advisory skills and labour;
- Infrastructure issues (eg. transport);
- Local issues relating to land zoning, rates etc;
- Wood flow planning;
- Uses for thinnings and waste materials;
- The availability of labour in the region; and
- Organisational structures for the supply of timber.

Without a careful consideration of these issues, including an analysis of existing regional strengths and information gaps, it is extremely unlikely that an integrated regional forestry industry will develop. An integrated industry is one where the timber products grown are aligned with the quantity and quality requirements of processors, whose requirements are in turn aligned with those of end-users. The chances of success are improved where the industry is based on the concept of adding value to what already exists and where any critical gaps in industry development are addressed at an early stage.

In the absence of a systematic approach to regional industry development, it is likely that much farm forestry will be *ad hoc* in nature with a few growers benefiting from small niche markets, but the majority finding that their product is largely unsaleable due to volume, quality or logistical shortcomings.

To extend this concept to the management of existing timber on the Northern Tablelands, there are a number of important information gaps which need to be filled. These include:

- The volume and quality of the existing resource. Although some information was presented on these issues at the start of this report, detail on resource quality is lacking. Similarly, information on annual wood flows would be required to attract new processing activity to the region or encourage existing processors to expand or modify their activities;
- There is a lack of information on the silvicultural response from thinning native forests on the Northern Tablelands, especially for eucalypt species;
- What are the costs of alternative thinning technologies for native forests in this region?;
- Can landholder networks or organisations be used to address supply volume and quality issues and to reduce the costs of accessing information and technical expertise? Landholders have also pointed out that access to labour with sufficient skills in forestry and sawmilling is likely to be an important obstacle;
- How can forest thinnings and waste materials from forestry activities and sawmills be utilised in an economic manner?
- What are the market opportunities for other timber products (eg. firewood and farm timber)?; and
- The intentions of government with regard to the management of existing native vegetation are a significant risk factor facing landholders. Until intentions are clearer, it is unlikely that landholders will invest in existing timber management.

In areas like the Northern Tablelands and North Coast of NSW where there are large volumes of existing native timber on private property, it makes little sense to focus all farm forestry activity on plantations. However, as outlined above, there are a number of critical information gaps which need to be filled before landholders will adopt more widely the management of the timber resources on their properties.

A final issue which was not addressed in this study, but which may alter these results substantially is the issue of carbon credits. If, as has been suggested, businesses that emit large quantities of carbon face increasing taxes which can be offset by purchasing carbon credits, the value of native forests may increase significantly. In addition to (or perhaps as an alternative to) managing private native forest for timber production, landholders may be able to lease a portion of their properties to carbon emitting businesses for carbon sequestration purposes.

Depending on the returns from this activity, this might be an attractive option for many landholders as it would mean a portion of their annual farm income is underwritten in a

relatively risk free manner. The potential for the carbon credit trading system to supplement farm incomes is an area worthy of further investigation.

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