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CASE STUDY ON LONG ROTATION EUCALYPT PLANTATIONS IN NEW SOUTH WALES

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Comments and feedback are welcome.

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ABSTRACT

This report is an output of the project *Hardwood Plantations in the Tropics and Subtropics* (GCP/INT/628/UK), funded by the United Kingdom and executed by FAO. The overall aim of this project was to contribute to regional and global planning of timber (specifically hardwood timber) supplies in the medium-term. This study covered the case study of long rotation eucalypt plantations in New South Wales, Australia.

Most plantations in Australia have been established and managed by State Government forestry agencies for industrial wood supply to enhance rural employment and long term land use as well as to provide a return to the government. Other plantation investment has been by pulp and paper processors for their own supply and more recently by tax driven investment schemes and overseas pulpwood buyers. Virtually all private hardwood plantation investments are based on short (<20 years) rotations which are not likely to produce large quantities of sawlog or veneer logs.

State Forests of New South Wales (State Forests) has been harvesting eucalypt plantation sawlogs, veneer logs and pulplogs for the last five years. Volumes are anticipated to increase substantially as the existing 45,000 hectare resource matures. New plantings as joint ventures with private landowners are also likely to lead to a long term increase in the plantation resource.

Private investments in pulpwood only regimes or pulpwood components of sawlog regimes are likely in the short term but the State Government is keen to attract investments into the long term or sawlog component as well. Facilitation of these investments include establishing a major operational and research program that is solving many of the impediments restraining private investment.

The growing of native species as plantations will build on the processing and marketing expertise of the native forest industry, and allow a transition to a more environmentally sustainable resource with supply security and economies of scale. These “non conventional” plantation species mean genetic improvement programs, growth models, silviculture and wood quality issues all need long term development, a role that government can greatly enhance, particularly if done in partnership with the private sector.

Cash flow, as well as long term returns, are essential if landowners are to participate and, this is further encouraged if plantations can integrate with existing land uses such as cattle grazing. The ownership and trade of Forestry Rights, which can be held separately from the ownership of the land, facilitates landowner involvement and minimises community discontent from large scale land acquisition by plantation investors. A trained and rewarded workforce in combination with a system of workplace standards will minimise costs and maximise yields but only if the infrastructure is in place to efficiently deliver the wood to the wood buyers.

Current timber pre tax real rates of return are estimated at 3 to 7%/year. These rates have the potential to increase with the sale of carbon credits (adding some 2 to 4% return on current values), increased log prices as native forest supplies diminish, growing costs reduce with economies of scale and increased yields of long rotation hardwood plantations result from genetic improvement.

It is the combination of all these improvements in returns that will attract the private investment required to achieve the long term aims of an estate of 100,000 to 150,000 hectares on the north coast of New South Wales.

ACRONYMS

APM	Australian Paper Manufacturers
DWT	Deadweight tonnage
HDA	Harris Daishowa Australia Ltd
NSW	New South Wales

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1 THE STATE FORESTS OF NEW SOUTH WALES EUCALYPT PLANTATION PROGRAM

1.1 History

Eucalyptus species dominate Australian native forests and historically have been the principal hardwood species supplied to the domestic sawmilling industry. Desirable features include high strength and attractive appearance suited to a wide range of uses. Some 20 of the 700 or so eucalypt species have been processed for pulpwood, with two species (*Eucalyptus globulus*, *E. grandis*) now among the premier kraft pulping species worldwide.

Whilst extensive areas of native eucalypt forest remain in Australia there has been a move to source more wood from eucalypt plantations. This has been driven principally by a reduced supply of large (>40 cm small end diameter) logs, a conversion of timber production areas into conservation reserves and wood quality issues. Community concern over the harvesting of native forests is maintaining this trend and encouraging the continued establishment of plantations.

Some 170,000 hectares of eucalypt plantations are currently grown around Australia, expanding at a rate of about 25,000 hectares per year. Pulpwood plantations predominate; 120,000 hectares expanding at about 18,000 hectares/year are ostensibly being grown for pulpwood only, principally for the Japanese pulp and paper industry. By contrast, State Forests has pursued integrated regimes based on sawlog production (Appendix 1).

State Forests has been planting eucalypts for over 50 years and currently manages a eucalypt plantation estate of about 45,000 ha. Originally used as a method of re-establishing native forests after harvesting, plantations are now established by State Forests on cleared grazing land. There is an estimated 47,000 ha of eucalypt plantations in New South Wales, of which about 12,000 ha was established by Australian Paper Manufacturers (APM) in the 1960s and 1970s. Over the same period State Forests established about 15,000 ha. A small area (<1500 ha) of *E. nitens* plantation is grown near the Victorian border by Harris Daishowa Australia Ltd (HDA).

The APM and HDA aim was to produce pulpwood, while State Forests aim has been to produce sawlogs and veneer logs although until recently they have not been intensively managed. APM sold their estate to State Forests in 1975 when they decided not to proceed with a pulpmill at Coffs Harbour. State Forests has gradually been thinning the estate leaving a valuable sawlog resource. In addition a further 15,000 ha has been planted by State Forests since 1993.

The bulk of the older resource (planted in the 1960s and 1970s) occurs in the Coffs Harbour and Wauchope areas. The State Forests sites being predominantly ex forest, were often burnt, cleared, planted and fertilised with a small amount of fertiliser. Cultivation (ripping, ploughing), weed control, or use of genetically improved seed was generally not undertaken. The main species planted is *E. pilularis* (blackbutt), a valued sawlog species.

The ex-APM resource is predominantly *E. grandis* (flooded or rose gum). APM purchased cleared farmland and used similar establishment techniques to that of State Forest except some grasses were scalped off prior to planting.

Whilst weed competition, unimproved genetic material and delayed thinning have reduced potential yields, these older plantations have been invaluable in gaining knowledge and industry acceptance of hardwood sawlog rotations.

1.2 Current situation

Partly as a result of government decisions to reduce harvesting of native forests (in response to community demands), a program to expand the plantation estate on cleared land has been initiated. Since 1994, a joint venture program between State Forests and landowners has seen about 5,000 ha planted on cleared land already owned by 160 landowners. Another 10,000 hectares has been established by State Forests on land it has purchased or owned, partly to establish the nucleus of an expanded joint venture estate. Expansion of the plantation estate will most likely be joint ventures between private landowners and State Forests with investors. State Forests currently plants between 5,000 ha to 10,000 ha/year on a range of tenures. Government funding for the plantation program is being phased out as private investment arises.

The current eucalypt processing industry on the north coast of NSW is based on a range of sawmills, a veneer/plywood mill, several pole/pile/girder mills, and a range of secondary processors including parquetry and tool handle factories. There are limited markets for the pulpwood component with only one major outlet (woodchip export) and one minor outlet (hardboard) but this is set to improve with considerable market interest in plantation grown pulpwood for export.

1.3 State forests marketing

State Forests marketing approach is to complement the native forest resource, with the plantations providing economies of scale, consistency and a secure long term supply. This will allow processors to undertake long term investment and marketing programs. A major competitive advantage is that processors are familiar with processing and marketing eucalypt and there is generally good domestic market acceptance of eucalypt wood products.

1.4 Geographic areas

Due to rainfall, soils, markets and land availability, the north coast of NSW represents one of the best areas for eucalypt plantation potential in Australia. In addition small areas of irrigated eucalypt plantation are being established in the south west of NSW (Riverina) by State Forests, but a number of technical and market aspects are still to be resolved. The north coast of NSW is thus the focus of this document.

Initial calculations from State Forests estimate approximately 980,000 ha of land potentially suitable for eucalypt plantations north of Newcastle to the Queensland Border and east of the Dividing Range. The principle criteria for land suitability are that the land is predominantly cleared, less than 18 degrees slope and has greater than 900 mm average annual rainfall. All the land is privately owned and generally within 100 km cartage distance of a processing centre such as a sawmill.

Landholdings range in size from 1,500 ha approximately 100 kilometres inland to 50 ha near coastal urban areas. Average planted parcel size on private land (joint ventures) is in the region of 25 ha but ranges up to 400 ha. State Forests planting areas are usually in the range of 200 to 2,000 ha.

1.5 Infrastructure and markets

State Forests recognises that a constraining factor to plantation investment on the north coast has been the long cartage distance to ports for the “pulpwood” component.

The two ports suited to the cartage of export pulpwood (logs or chip) are Brisbane and Newcastle. They are the only ports able to dock and load 440,000 DWT/3 million cft grain capacity which are the minimum size for competitive cartage to northern Asia, the dominant location of hardwood fibre importers. Rail extends from the port of Brisbane to the port of Newcastle about (900 km) and passes through the centre of the plantation suitable area with several sidings available for loading (Figure 1). There is also a good road network parallel to the rail line and extending inland into other plantation areas.

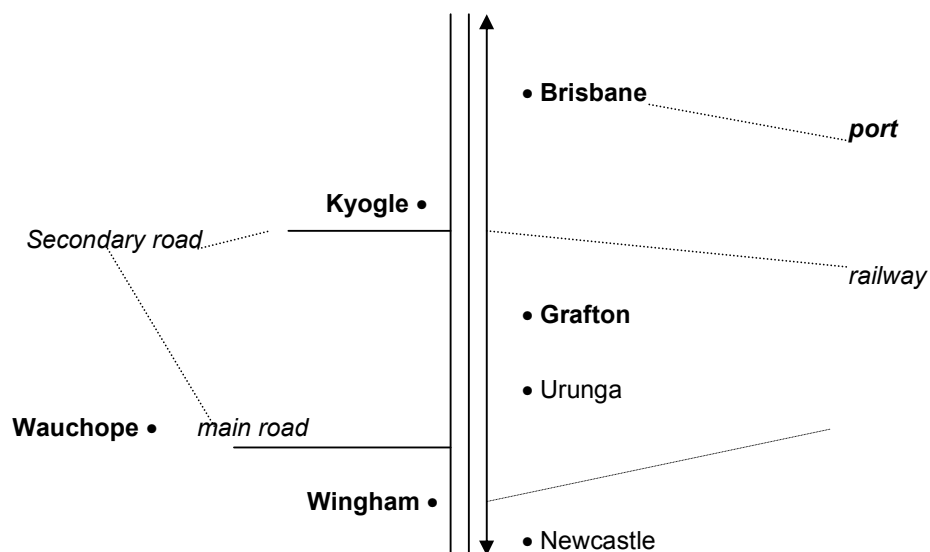


Figure 1. Supply zones of at least 10,000 plantable ha within a 100 km radius of a logical processing or distribution point (supply zone centre) form a continuous chain along the north coast.

1.6 Physical environment

The north coast of NSW has a subtropical climate with a year round average rainfall in the south (near Newcastle), to a defined summer rainfall maximum in the north. It includes much of the natural distribution of *E. grandis* (Flooded gum). Other important timber species include *E. pilularis* (Blackbutt) and *Corymbia maculata* (Spotted gum formerly named *E. maculata*) both important sawlog, veneer log and pole species. These three species along with *E. dunnii* (Dunn’s White gum) form the principal species of State Forests plantation program on the north coast along with smaller areas planted to other species

Below, are the climatic requirements of the principal eucalypt commercial species planted by State Forests (Table 1). The north coast generally averages between 1000 and 1800 mm annual rainfall with few or no frosts near the coast.

Table 1. Climatic requirements of four eucalypt species estimated by Booth and Pryor (1991)

	Mean annual rainfall (mm)	Rainfall ¹ regime	Dry season (months)	Mean max temp hottest month (°C)	Mean min temp coldest month (°C)	Mean annual temp (°C)	Absolute min temp (°C)
<i>E dunnii</i> ²	1000-1750	s,u	0-6	27-30	0- 3	Na.	unknown
<i>E grandis</i>	700-2500	s,u	0-5	25-34	3-18	14-25	>-8
<i>E maculata</i> ³	650-2000	s,u	0-7	24-32	0-13	12-23	>-8
<i>E pilularis</i>	750-1850	s,u	0-6	22-31	5-12	15-22	>-6

¹u, uniform or bimodal; s, summer. Na = not available

²*E dunnii* data from State Forests

³*E maculata* includes *E henryii* and *E maculata* ssp *grayii* now called *Corymbia maculata*, *C varigata*

Table 2. The product versatility of four eucalypt species

COMMON NAME	EUCALYPTUS SPECIES	PULP	POLE	SAWLOG	VENEER
Dunn's White Gum	<i>E dunnii</i>	√	X	√	√
Flooded Gum	<i>E grandis</i>	√	X	√	√
Spotted Gum	<i>C maculata</i>	√	√	√	√
Blackbutt	<i>E pilularis</i>	√	√	√	√

The eucalypts species planted have the ability to produce biomass rapidly in the first few years which makes them eminently suited to economic plantation yields. The wood properties of these species are summarised in Appendix 2.

1.7 Growth rates

The resource established in the 1960s and 1970s is principally *E grandis* and *E pilularis* on coastal sites in the Coffs Harbour and Wauchope areas. The growth rates of these stands represent the genetic and silvicultural inputs of 20 - 30 years ago as well as the limited markets to allow timely thinning. Yields have also been reduced by delayed thinning (due to a lack of markets) and discounts to harvestable areas resulting in rotational yields (35 to 40 years) in the region of 10m³/ha/year.

The growth rates of more recently planted stands appears significantly higher, some over 30 m³/ha/year, depending on the silvicultural treatments, degree of genetic improvement and site quality. Average yields are regarded as growth of 15 m³/ha/year over a 20 year period but are improving with each new planting. The aim is to keep minimum harvestable tree size at least 0.1 m³. An example of a growth model scenario based on more recently planted stands is shown in Table 3.

Table 3. Growth model scenario for eucalypt plantation in NSW

Site quality	Years	Operation	Pulp tonnes	Small sawlogs m ³	Large sawlogs & veneer m ³
Low	10	thinning	70		
	20	thinning	50	15	
	30	clearcut	80	30	100
Moderate	10	thinning	85	10	
	20	thinning	40	50	20
	30	clearcut	40	50	145
High	10	thinning	80	30	
	20	thinning	30	60	40
	30	clearcut	40	70	200

The data above is indicative only

1.8 Log product size and value

Product specification and log royalties are shown in Table 4. This data represents industry averages as at June 1998 and represents native forest eucalypt regrowth values as well as eucalypt plantation values.

Table 4. Product specification for eucalypt

Product	Min length metres	Max length metres	Small end diameter (ub) min max (cm)	Royalty range \$AUS/m ³
Pulp	2.4	5.0	8	\$4 - \$20
Small sawlog	2.4 (*)	-	20 (*)	\$15 - \$40
Large sawlog	2.4		25 - 30 (*)	\$25 - \$100
Veneer	2.7		28	\$25 - \$100
Pole	8.0	Size varies	15	- \$30 - \$123
- medium		with diameter	30(varies)	
- large		and length		

(*)For plantations 15 cm may be possible

In the last few years 20,000 to 50,000 m³/year of plantation eucalypt sawlogs and veneer logs have been sold to the domestic processing industry and this is expected to increase as older stands are harvested. This has allowed the processors to learn how to handle plantation logs which tend to be smaller in diameter and more prone to splitting and drying stresses than native forest logs. A number of processors have now retooled to process smaller logs which are also arising from regrowth native forests following earlier harvests. The State Government has tied some future wood supply and grant money to this retooling in an effort to smooth the transition away from large "old growth" logs.

1.9 Wood security

The system of land titles in NSW recognises the creation of a Forestry Right providing for a document to be registered establishing the right to plant, maintain and harvest a crop of trees to

someone other than the landowner. The forestry right legislation is based on the ancient concept of profit á prendre. Profit á prendre is a right in the trees which can be freely traded as something separate from the ownership of the land.

The Timber Plantations (Harvest Guarantee) Act 1995 seeks to remove impediments to the harvesting of plantation timber. This is principally through the removal of environmental and development consents if harvesting activities conform to a code of practice.

1.10 Landowner support

Convincing landowners to participate in long rotation (up to 40 years) joint ventures has been a major challenge particularly where the returns from the joint venture are not received until each harvest (crop share joint ventures). This has been easier for landowners with non farm income to accept as they are better able to afford to set land aside for at least ten years. In recognition of this, State Forests has introduced another joint venture agreement that makes annual payments to landowners as “rent” for the first ten years of the rotation. After this time the stand is thinned and an increase in cattle grazing is possible. The ability to integrate grazing (after about age 2) in the plantation has been an important factor in landowner’s minds.

Further incentives to landowner participation are the ability to include the sowing of shade tolerant pasture species, planting of non harvestable areas such as creek banks and narrow (>50 m) shelterbelts as part of the joint venture arrangements. Crop share joint venture partners can purchase some or all of State Forests’ share of the plantation and can also increase their share of the harvest by undertaking some of the establishment and maintenance tasks.

The majority of pulpwood joint venture arrangements are of the annual “rental” form with the landowner having little or no equity in the trees. Most industrial investors have sought a mix of joint ventures with farmers and some land they own themselves.

1.11 Community support

There is widespread community support for plantations because of their employment and wealth generating values, as well as the positive environmental attributes such as reduced weed infestation and improved water and soil protection. Both the forests products industry and the green movement are supportive of the expansion of plantations in New South Wales and recognise that an attractive investment environment is essential for this expansion to take place.

2 MAJOR IMPEDIMENTS TO INVESTMENT IN AUSTRALIAN PLANTATIONS

2.1 Dominant role of government

The State Governments own, manage and market over 70% of the plantation resource in Australia as well as the bulk of the native forest wood supply. Their historical role as providers of wood to industry is now much broader and sometimes in conflict with this – for example excluding harvests for conservation reasons.. Government wood sales compete with the private sector. On the other hand some investors feel more confident investing with a government partner as this may

enhance their guarantee of supply. Some governments are now releasing prospectuses allowing the small investor to participate in “safe” forestry investments.

A National Forest Policy Statement (1992) has been signed by all State and the Federal Governments but few of its recommendations have been implemented. For example, in planning legislation forestry tends to be discriminated against compared to traditional land uses, particularly by local government although this is contrary to the National Forest Policy Statement. Some of these inequities are exacerbated by subsidies to other land uses e.g. tariff protection but this has not been a significant factor in recent time.

Export controls on plantation logs and chips have been a deterrent to investment in pulpwood plantations and whilst these controls have recently been removed, there have been conflicting government signals that confuse overseas investors. Whilst foreign investment guidelines exist they are not perceived as a major impediment to investment, particularly in the joint venture scenarios where land is not being purchased.

2.2 The lack of transparent and competitive markets

Private (investor) growers have long complained about the market behaviour of the dominant government suppliers which undermine their investments such as setting an artificially low rate of return, not publicising log sale prices (commercial in confidence), and so on. On the other hand, private growers do benefit from some government wood sales as it is the scale of the public resource that usually attracts the processing industry in the first place.

Government growers can also benefit from lower costs compared to the private grower. Whilst much of this stems from economies of scale some levies and taxes are not paid by government. For example State Forests has been exempt from sales tax on vehicles and equipment and does not pay local government rates (by law).

Government growers have also probably benefited from a lower cost of capital and a lower risk premium built into their borrowing cost compared to private growers. On the other hand government plantation programs have often pioneered new plantation resources where an individual private grower would not have taken the initial risk. This has been particularly in the case of sawlog regimes for two reasons; the long time frames for the bulk of revenue to flow and the fact that a number of different products are grown. Most sawlog regimes in Australia take at least 30 years whilst most private investment horizons are about half this. Whilst a number of products are produced, most investors to date have been wood buyers interested in buying just one product such as pulpwood, and integrated regimes would involve them in ‘non core’ business.

Much of the skills and knowledge base that is part of Australian plantation practise has flowed from the government programs into private industry. This has now matured to the extent that cooperative research is done by government and private industry in partnership.

2.3 An unsympathetic tax regime

In comparison with many other countries seeking to expand plantations, Australia has a relatively unattractive tax environment. For example;

- The rate of corporate tax is very high (36%);

- Taxable income can only be spread over a limited time at harvest, rather than a whole rotation;
- Expenditure can only be claimed against income received in that year, although primary producers can carry forward losses for up to seven years;
- Capital gains tax issues with regard to plantations are complex;
- Some tax rulings have been retrospective.

2.4 Uncertainty with regard to land availability, yields and other risks

With their large plantation base and public funding, government growers have probably taken bigger risks and have been prepared to accept more uncertainty than many private growers and indeed other private land users. It is often many years later that these risks have been quantified and this is particularly the case with long rotations. New investors who probably have a higher expectation of returns than, say, existing industry will usually insist on carefully quantifying all major factors such as land availability, yields, costs and risks. Governments have played a major role reducing these uncertainties and risks.

2.5 Relatively poor track record of past non-industrial investment

Many plantation investment schemes in Australia in the past 30 years have been tax driven, with the major gains flowing to the investor at establishment. A lack of subsequent management and indifferent markets has tainted forestry investment in the eyes of private investors. When combined with a couple of well publicised “plantation investment failures”, there is a somewhat sceptical view by potential investors.

Government based incentive schemes have also generally had limited success because of a lack of on going management and restricted markets for the pulpwood components in some areas. They were expensive (sometimes >\$100/ha/year) to administer and had little “flow on”. Although largely abandoned now, the schemes that gave away seedlings/subsidised small plantings have helped many landowners become familiar with the concept of growing trees and makes the idea of industrial scale forestry less daunting. State Forests’ experience with joint ventures suggests that most landowners are very receptive to planting if they see trees growing in their neighbour’s paddocks and they are or will be receiving a reasonable financial return from the trees. Joint ventures aim to provide landowners with a partner (State Forests) who will provide on going management expertise and market all the plantation products for the best return.

3 ANALYSIS OF FACTORS INFLUENCING INVESTMENT IN NSW LONG ROTATION EUCALYPT PLANTATIONS

The principal technical, economic and policy factors influencing investment in long rotation (20 to 40 years) eucalypt plantations in NSW are discussed below. Factors that apply Australia wide are also discussed.

3.1 Technical factors

Technical factors are principally biological factors that influence the scale, risks and returns of the plantation investment. The most significant technical limiting factors are those preventing large

planting areas of uniform tree size and species. This is a combination of the varying soil types and widespread occurrence of native vegetation even on sites that have been cleared in the past. Many native species can re-establish vigorously after burning, clearing and grazing and the decline of dairying and beef cattle grazing. Large areas on the north coast start to regenerate to native species as well as weeds. Despite this there are very stringent laws regarding the clearing of native species on these areas and this has significantly reduced the planting area, raised growing costs and potentially reduced yields (suppression by remnant trees).

Variation in soil types results in a change of species and thus potentially regimes and productivity. With the exception of *E. grandis* there is little in the way of genetically improved material available for planting and no species which can be planted on a broad range of soil types. For example, *E. pilularis* will only succeed on well drained soils that are not subject to frost. State Forests has undertaken a major genetic improvement program for its four main species but it will still be several years before large quantities of improved genetic material are available. Aside from overseas genetic improvement programs of *E. grandis* there has been very little genetic improvement to the other species.

As native species, the plantations are vulnerable to a range of native pests and diseases. Generally there is sufficient natural control of the pests without the need for broadscale artificial control. However, significant yield loss can occur during times of growth stress such as drought and this has resulted in more resilient but slower growing species such as *Corymbia maculata* being planted.

The genetic improvement program aims to incorporate the genetic values of pest and disease tolerant individuals and this may allow a reduction in the number of species planted. Fewer species will make introducing improved material easier and enhance economies of scale in production and marketing.

Although genetic improved planting material is likely to provide large gains to investors, the selection of non standard species such as *E. pilularis* (as against standards such as *E. grandis*) is a deterrent to investors until the growth potential has been proven. State Forests has been able to provide a significant amount of confidence to investors with *E. pilularis* because of the large areas planted 20 to 30 years ago even though it is sourced from unimproved seed. Where older stands are lacking, such as with *Corymbia maculata*, the ability to provide important information for investors such as a robust growth model is much harder.

3.2 Economic factors

The economic factors that influence investment are those that impact on costs and returns in a direct way. Other factors that indirectly influence costs and returns are dealt with as technical, policy or social factors.

The pre tax real return on investment in long rotation eucalypt plantations on the north coast of NSW has typically been in the order of 1 to 4%/year. This is the result of a multitude of factors including low yields, low log prices and high costs. In the last few years a number of these factors have improved plantation internal rates of return to between 3 and 7% and rising. Whilst substantial investment is likely above 10% (benchmarking survey), significant interest is now being shown. The generally low yields have been discussed under growth rates, but have been

exacerbated by the lack of processors set up to recover higher value products from smaller (<40 cm) logs and the lack of pulpwood markets in some areas.

Table 5. The main biological factors that influence the scale, risks and returns of eucalypt plantation investment

Biological factors	Which encourage investment	Or discourage investment
Species	Local/native to area ie known to grow; Potential to develop niche markets due to different species.	Limited tree breeding and testing; Species unfamiliar in overseas markets.
Soils	Some large areas of good soil available.	Highly variable – results in having to change species.
Rainfall	Coastal area – generally all areas receive > 1,000mm/yr; Some areas >2,000mm.	Occasional droughts
Frosts	Coastal strip generally benign with out of season or severe frosts rare.	Frost sensitive species
Pests & Diseases	Wide range of host species on native pests; Scope for significant genetic improvement for tolerance.	Wide range of native pests which can have a significant impact on growth, form and wood quality.
Remnant vegetation	Significant areas of native forest are already reserved.	Much of the north coast is already forested.
Weeds	Landowners keen to replace weeds with trees.	Expensive to control.
Fire protection	Good history of fire protection and well established infrastructure.	Occasional severe fire danger days.

The consequent postponement of thinning resulted in some stands "locking up" and an increase in insect attack on stressed trees. The impact on growth is significant with thinned stands of *E.pilularis* peaking in current annual increment at age 12 whilst an unthinned stand peaks at a significantly lower level some 6 to 10 years later. Timely thinning may reduce rotation length by up to a third. The low intensive management applied to the stands established in the 1960s and 1970s has also reduced merchantable yields.

3.3 Log prices

State Forests' dominating position in the log supply market makes it difficult for investors to "feel" the market. Prices are not generally published and are often contained within complex price matrices. Prices are rarely based purely on current market factors, and this is seen sometimes in the discrepancy between private wood sales and the State Forests' "quota" log prices. The fact that both supply and log price are determined by government decree, rather than market forces, has been a deterrent to investment.

In addition to the "lack of transparency" issue, a perception by private investors is that log prices may be kept low for political or social reasons. There is little doubt that some native forest log prices are well below the growing costs for comparable size material, although log price increases in the last few years have reduced this discrepancy.

Where there have been private plantation growers (such as softwood growers) in NSW these growers have sometimes been excluded from the market in State Forests' wood supply that deals

with industry. There is scope for more of these smaller growers to be part of larger wood supply arrangements.

3.4 Production costs

Australia has relatively high plantation growing costs associated with land acquisition, establishment and maintenance compared to many competing countries, reflecting higher input costs. Actual indicative costs including roading, harvesting and transport for the north coast of NSW are shown in Appendix 3.

Land prices have risen sharply where there has been large scale plantings by a number of competing players. For example, in south west Western Australia land values have tripled in seven years and (pulpwood) investors are now looking elsewhere to expand.

Establishment costs for eucalypt plantations tend to be high because of their sensitivity to weed competition and the lack of cost effective residual herbicides that can be legally used. State Forests has undertaken a major herbicide screening program and the long term benefits of this will see weed control costs fall significantly. In response to community concern State Forests has demonstrated that herbicide usage is essential for successful plantation establishment and that they can be applied with no off-site impact.

Maintenance costs are also high because of the fire protection costs but as the plantations of more fire tolerant species such as *E pilularis* and *Corymbia maculata* mature so these costs will fall. Major cost savings are also expected as the area of joint venture increases with the landowner partner often living on site and providing surveillance.

High roading costs are the result of strict environmental standards on steeper and more erodable sites and will be higher per tonne for thinnings under integrated regimes than the clearfall under a pulpwood regime.

Harvesting integrated eucalypt plantations has been a little more expensive than other species because the open crown allows a substantial understorey to develop. The variation in tree size because of wild seed with its varying growth rate (even within a seedlot) also increases harvesting costs.

Transport costs have sometimes been increased by local government discriminating between log haulage and say livestock haulage. This has mainly been imposed on plantation wood because high volumes are carried on the one route in a short time.

Despite the relatively high cost environment, Australia is perceived as one of the most attractive countries for overseas plantation investment. A history of political certainty, stable exchange rates and low inflation are significant attractive features to investors.

3.5 Social factors

Community support for native species plantations is generally high in Australia. With an educated and potentially vocal population this support is essential for any large scale investment program. Current factors favouring plantations are an upsurge of (largely urban) environmental concern

about the clearing of native forests in the past and the relatively low economic return from alternative land uses. These are summarised below.

Table 6. Social factors influencing eucalypt plantation investment

Social factors	Which encourage investment	Or discourage investment
Community support	Widespread support for native species plantations including conservation groups.	Community may have unrealistic expectation especially with regard to full domestic processing of pulpwood
High expectation of environmental practises	Stringent environmental laws and codes reassure many investors	Forestry expected to fulfil higher environment standards than farmers
Employment	High employment numbers in forestry sector relative to other land uses reinforces community support	Employment costs – both numbers and cost may not be internationally competitive.
Native species habitat		Risk that endangered species found in plantations – possible expectation that plantation will be reserved from harvest.
Urban forestry perception	Opportunity to educate public – (sustainable use of renewable resource) versus other materials etc	Native species plantations look like native forest – risk of inability to harvest or manage to optimise timber production.

3.6 Carbon trading

Recent widespread discussion about the potential of plantations to capture greenhouse gases has also put plantations in a positive public light. There has also been a surge of interest from landowners in the possibility of receiving income from carbon credits from plantations on their land. Whilst the market mechanisms remain to be worked out, it is likely there will be a positive result leading to an increase in plantings.

State Forests has already made a carbon trade with a greenhouse gas emitter and there is the prospect of this trading increasing rapidly. Of note is the entry into the investment field of non traditional plantation investors, such as the energy sector. State Forests' position is that if it can facilitate the development of the carbon credit trading system, there is a large potential investment base, and particularly for solid wood regimes that store carbon for a long time.

3.7 Policy factors

Policy factors have had an important influence over the investment history of eucalypt plantations in NSW. This is largely because of the dominant role of government as a forest owner and grower, and the lack of forest ownership by industry. For many years State Forests was obliged to supply (native forest) wood to industry under a "quota" system that was based more on historical rights than market forces. Until recently, there has been little incentive for industry to invest in its own plantation resource, as the privately owned native forests were viewed as a buffer to any government supply shortfall. However, the declining availability of easily accessible large logs from private land and greater environmental constraints on harvesting and roading, have resulted in some processors retooling to handle smaller logs or exiting the industry. At the same time traditional hardwood products such as house framing have been largely replaced by plantation softwood because of its consistency and ease of use. As a result the silvicultural regimes are

designed to favour the recovery of high value wood products such as flooring and plywood, the implication being that State Forests will receive a higher log return.

However it has largely been a political motivation to provide a future resource for the sawmilling industry that has driven the State Forests eucalypt plantation program. It has been the additional environmental and social benefits from the program that have satisfied the State Government that the program was worth funding. These benefits include carbon sequestration, reduced stream turbidity, reduced stormflow, reductions in water tables and weed infestations, improved biodiversity compared to pastures and increased rural employment compared to beef cattle grazing. The costs which include a reduction in total water yield were deemed to have been outweighed by the benefits by an estimated 11 to 1.

Table 7. Legislation that impacts on plantation investment in northern NSW

Policy factors	Which encourage investment	Or discourage investment
Native Vegetation Conservation Act	Reassure investors that only cleared land is to establish plantations	Significantly reduces net area available for plantation Assessment needed before any plantation established
Environmental Planning and Assessment Act	Reassures investors that full understanding of all impacts of plantations before establishment	Environmental impact assessments can be lengthy and expensive
Harvest Guarantee Act	Provides security of harvest/compensation	
Local Government		Don't always provide "as of right" ability to establish plantations. Section 94 contributions not predictable
Forestry right	Ensures security of tree ownership separate from the land. Easily identified	
Private tenure	Secure and legally enforced property ownership of land	
Legal requirement to remove noxious weeds	Can encourage landowners to replace weeds with plantations	Maintenance costs

4 LESSONS LEARNT

Plantations have been very successfully grown by State Governments and industry for some time in Australia. Marketing of the plantation products in particular the thinnings is where many investment plans have not fulfilled expectations. This is particularly relevant for integrated regimes where thinning is as important as an income source as much as a silvicultural tool. State Forests sees major synergies in having pulpwood investors for the thinnings and other investors including State Forests for the other products. Difficulties include for example selling the pulpwood component of *E.pilularis* which is primarily grown as a valuable sawlog species. Pulping and non commercial thinning research and genetic selection particularly if pooled amongst a number of growers will solve such problems.

The move to utilise plantation eucalypt is greatly facilitated by the current processing of native forest material, in particular re-growth of similar species. This allows processors to retool in the short term to process re-growth but in the longer term they are likely to have a higher proportion of

plantation material. The aim is to provide a more consistent and secure supply of wood from the plantations which will be complemented by the re-growth. This will enhance economies of scale and build on the current processing and marketing expertise of the current native forests processors.

There has been value in measuring the non timber values of the plantations as a means of justifying investment by the government; this has helped State Forests to take advantage of the emerging market for carbon sequestration.

Generating community support through various publications and forums is fickle but worthwhile activity as is ensuring landowners can make money out of participating in the industry.

In New South Wales there are still a number of significant improvements which can further enhance investment in long rotation hardwood plantations:

- Log pricing should be publicised and price setting mechanisms made transparent. This includes prices of native forests logs because of their similarity to eucalypt plantation logs;
- Ensuring competitive markets for the whole tree;
- Removing planning discrimination of plantation forestry versus other rural land uses;
- Removing imbalances between private and public forest growers;
- Separating government growers from other government bodies, e.g. regulators, and the political process; and
- Providing a more sympathetic tax environment, particularly for long term investments such as sawlog rotations. The superannuation industry may provide a suitable model.

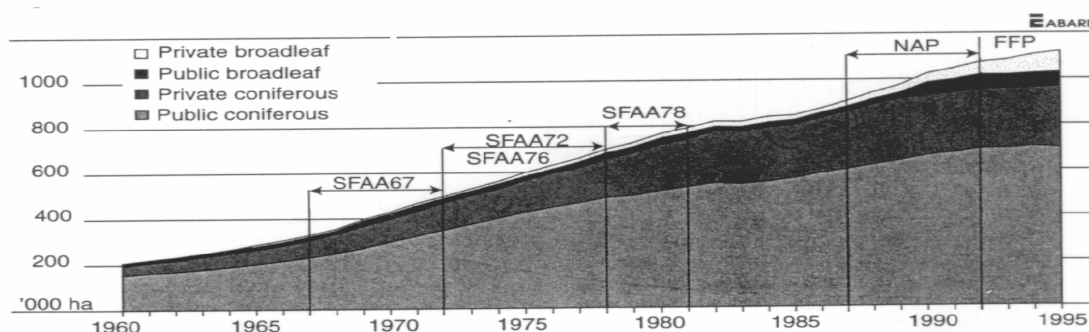
REFERENCES

- Burns, K., Hansard, A., Lawson, K. and Ball, A.** 1997. Plantation Development in Australia. Some Development Considerations. Australian Forest Products Statistics.
- Love, G., Yainshet, A. and Sledge, P.** 1997. Outlook for Australian Forest Products. Australian Forest Products Statistics.
- Margules Groome Pöyry Pty Ltd.** 1995. Australian Plantation Benchmarking Study for Austrade DIST DPIE.
- State Forests.** Numerous internal reports.

Appendix 1. Australian Government plantation programs

Scheme	Target	Incentive
Softwood Forestry Agreement Act (1967)	Aim for self-sufficiency: establish 26,000 hectares of softwoods a year (1967-71)	\$20 million provided to state forest agencies as 35 year loans
Softwood Forestry Agreement Act (1972)	Establish 22,000 hectares of softwoods a year (1972-76).	\$21 million of loans to the states over five years
Softwood Forestry Agreement Act (1976)	Establish 2500 hectares a year (1976-78)	Direct Funding
Softwood Forestry Agreement Act (1978)	Maintain existing softwood plantation areas	Direct funding
National Afforestation Program	Establish various broadleaf plantations to demonstrate potential for pulplogs	Direct funding (to encourage private interest)
Joint ventures	Develop hardwood and softwood plantations (example in Western Australia and Tasmania).	Joint commitment between landowners and industry and state forest agencies
Farm forestry program	Raise the profile of farm forestry to encourage greater investment by landholders	Initially \$15 million over four years with an additional \$36.5 million over the next four to five years under the National Heritage Trust in 1996-97
2020 vision	Encourage efficient operation of the market for investment in land resources	No direct incentives, but concentration on removing instances of market failure

Source: Resource Assessment Commission (1992 – updated) cited in Burns *et al.* (1997)



AUSTRALIA'S PLANTATION AREA

Notes: SFAA67: Softwood Forestry Agreement Act (1967); SFAA72: Softwood Forestry Agreement Act (1972); SFAA76: Softwood Forestry Agreement Act (1976); SFAA78: Softwood Forestry Agreement Act (1978); NAP: National Afforestation Program; FFP: Farm Forestry Program

Source: Love *et al.* (1997)

Appendix 2. NSW eucalypt plantation program properties and uses of plantation grown timbers

Species	Strength Group		Joint Group		Basic Density kg/m ³ **	Tangential Shrinkage (%)	% Unit Tangential Shrinkage	Durability Class	Lytic Susceptibility	Colour***	In Ground Use	Engineering Uses	Framing Above Ground		Dry, Dressed Products					Veneer and Plywood	Pulp and Paper	Gluability****	
	Unseasoned	Seasoned	Unseasoned	Seasoned									Exposed	Protected	Decking	Cladding	Internal Flooring	Paneling	Joinery and Furniture				
Blackbutt	[S3]	[SD3]	[J3]	[JD3]	540	[7.3]	[0.37]	[2]	NS	W	0	0	0	0	0	0	0	0	0	0	0	0	M
Rose Gum	S4	SD5	J3	JD3	460	8.0	[0.35]	[3]	NS	P	-	-	0	0	0	0	0	0	0	0	0	0	G
Spotted Gum	[S3]	[SD3]	[J2]	[JD2]	[600]	[6.1]	[0.38]	[2]	S	B	0	0	0	0	0	0	0	0	0	0	0	0	M
Dunn's White Gum	[S4]	[SD4]	[J3]	[JD3]	[550]	[10.6]	[0.36]	[2]	[NS]	P	-	-	0	0	0	0	0	0	0	0	0	0	G

* Values shown in brackets are provisional only and are based on limited data and informed assessment.

** Values for Basic Density were obtained from a limited number of samples.

*** Colour: W - White, yellow, pale straw to light brown. P - Pink to pink-brown. B - Brown, chocolate, mottled to streaky.

**** Gluability: P - Poor, M - Moderate, G - Good.

Appendix 3. Plantation costs, \$AUD (commercial in confidence)

Indicative direct establishment costs years 1 - 2: \$1,250 –2,250 per net plantable hectare.

Indicative direct maintenance costs years 3 – 10: \$50/ha/year
years 10 – 30: \$30/ha/year

Indicative harvesting costs \$12 – 23 per tonne

Indicative transport costs \$.05 - .18 per tonne per kilometre

Indicative land values \$1,000 - \$2,500 per net plantable hectare

Note that there are a significant number of assumptions used in deriving the above costs.

FAO - Forestry Department

List of Working Papers on Forest Plantation

- Working Paper FP/1 *Mean Annual Volume Increment of Selected Industrial Species.*
Ugalde L. and Perez O. April 2001.
- Working Paper FP/2 *Biological Sustainability of Productivity in Successive Rotations.* Evans J. March 2001.
- Working Paper FP/3 *Plantation Productivity.* Libby W.J. March 2001.
- Working Paper FP/4 *Promotion of Valuable Hardwood Plantations in the Tropics. A Global Overview.* Odoom F.K. March 2001.
- Working Paper FP/5 *Plantations and Wood Energy.* Mead D.J. March 2001.
- Working Paper FP/6 *Non-Forest Tree Plantations.* Killmann W. March 2001.
- Working Paper FP/7 *Role of Plantations as Substitutes for Natural Forests in Wood Supply – Lessons learned from the Asia-Pacific Region.*
Waggener T. March 2001.
- Working Paper FP/8 *Financial and Other Incentives for Plantation Establishment.*
Williams J. March 2001.
- Working Paper FP/9 *The Impact of Forest Policies and Legislation on Forest Plantations.* Perley C.J.K. March 2001.
- Working Paper FP/10 *Protecting Plantations from Pests and Diseases.* Ciesla W.M.
March 2001.
- Working Paper FP/11 *Forestry Out-Grower Schemes: A Global View.* Race D. and
Desmond H. March 2001.
- Working Paper FP/12 *Plantations and Greenhouse Gas Mitigation: A Short Review.*
Moura-Costa P. and Aukland L. March 2001.
- Working Paper FP/13 *Future Production from Forest Plantations.* Brown C. March
2001.
- Working Paper FP/14 *Forest Plantation Resources, FAO Data Sets 1980, 1990, 1995
and 2000.* Del Lungo, A. December 2001.
- Working Paper FP/15 *Global Forest Plantation Development: Review for FRA 2000.*
Vuorinen A.P. and Carle, J.B. April 2002.
- Working Paper FP/16S *Bibliografía Anotada Sobre los Efectos Ambientales, Sociales y
Económicos de los Eucaliptos.* Compilación de documentos
elaborados en inglés, francés y español entre 1985 y 1994.
Marzo de 2002.

- Working Paper FP/16E *Annotated Bibliography on Environmental, Social and Economic Impacts of Eucalyptus*. Compilation from English, French and Spanish Literature, 1985 to 1994. Revised (Combined) Edition, March 2002.
- Working Paper FP/17S *Bibliografía Anotada Sobre los Efectos Ambientales, Sociales y Económicos de los Eucaliptos*. Compilación de documentos elaborados en inglés, francés y español entre 1995 y 1999. Palmberg C., Marzo de 2002.
- Working Paper FP/17E *Annotated Bibliography on Environmental, Social and Economic Impacts of Eucalyptus*. Compilation from English, French and Spanish Literature, 1995 to 1999. Palmberg C., March 2002.
- Working Paper FP/18 *Tropical forest plantation areas 1995 data set*. Pandey D. May 2002.
- Working Paper FP/19 *Teak (Tectona grandis) in Central America*. De Camino, R.V., Alfaro, M.M. and Sage, L.F.M. May 2002.
- Working Paper FP/20 *Melina (Gmelina arborea) in Central America*. Alfaro, M.M. and De Camino, R.V. May 2002.
- Working Paper FP/21 *Case study of hardwood programmes in Fiji, Solomon Islands and Papua New Guinea*. Hammond, D. May 2002.
- Working Paper FP/22 *Case study of long rotation eucalypt plantations in New South Wales*. Heathcote, R. June 2002.
- Working Paper FP/23 *Case study of the tropical forest plantations of Malaysia*. Krishnapillay, D.B. June 2002.
- Working Paper FP/24 *Hardwood plantations in Ghana*. Odoom, F. June 2002.