Summary

Australia’s wood consumption has been static for a decade. We use 20 million m$^3$ of wood annually to meet our sawn timber, wood panels and paper needs, through domestic production and imports. Our plantations can currently supply 26 million m$^3$ of wood a year. These supplies are projected to increase over the next 40 years without any expansion to Australia’s plantation estate. Even if Australian plantation manufacturers displace all imported wood products and all domestic native forest wood products, export markets are required to absorb Australia’s existing plantation resources. Australia’s so called forest products trade deficit problem is not because of insufficient wood resources. Our softwood and hardwood plantations can do the job across all the major products, alone, and now.

Australia’s key forest industry policy issue is whether to export processed or unprocessed plantation wood products. Environmental, employment and economic arguments overwhelmingly favour Australia travelling the processing path. It’s time Australia’s forest policy put plantation processing on the pedestal, instead of the competing native forest sector, and instead of the hardwood chiplog planting program with its worrying export price trends.

Australia’s existing hardwood plantations can support three large scale pulp and paper mills within a decade: one each in Western Australia, the Green Triangle and Tasmania. Perhaps one plantation based pulp mill will be built. It is possible that not one is built – for economic not environment reasons. Most of Australia’s plantation resource will be exported unprocessed as chips.

In my view, Australia has already planted a hardwood chip glut. Our native forests currently supply around a third of the global hardwood chip trade. In the very near future, Australia with its maturing hardwood plantations is projected to slightly more than double its supply in a market that it is already a major player. Hardwood chip demand in the Asian Pacific region is not growing fast enough to absorb this near immediate supply. If native forests remain in the supply equation, it is unlikely Australia’s additional supply can be absorbed without further woodchip price declines. Real prices for Australian hardwood chip exports have declined by an average 2.8 per cent per annum over the decade ending 2004.

China is presented as the saviour of this emerging hardwood chip oversupply problem. But its booming wood demand is concentrated on softwood logs and comes with a sting. As wood imports to China soar, the real price falls: on softwood logs by an average 3.7 per cent per annum since 1998 when the boom started. Realising new unprocessed wood export opportunities is likely to require a willingness to sell at lower wood prices. This is fundamentally different to the view of China adding to a (falsely diagnosed) global wood shortage and driving wood prices up for Australian plantation investors to take an easy profit picking.
Recommendations

A. Develop a taxation approach to plantation forestry that does not exacerbate the hardwood chip glut. The current taxation arrangements for investors wishing to sell-out before harvest should be maintained.

B. Advise the Commonwealth Government on the need for a plantation processing industry policy with this sector taking precedence over the competing native forest sector and plantation growers. Whilst manufacturing issues would dominate the policy content, it could include options for finessing the industry’s softwood and hardwood plantation sawlog resource.
Introduction

1. This submission presents information and analysis to develop the forestry policy context for the taxation treatment of plantations. It comments on each of the Committee’s terms of reference.

2. Despite covering a wide territory, the submission is brief: more detailed information and discussion is available in the three papers included as attachments to this submission.

3. Terminology:
   - Wood – fibre under the bark of trees, logs.
   - Wood products – products manufactured from wood, primarily paper, wood panels and sawn timber.
   - Forests – includes both plantations and native forests.
   - Plantations – trees planted and managed in an agricultural context primarily for wood production.
   - Native forests – forests with trees predominantly native to the locality and where natural regenerative processes operate either fully or in part for the recovery of canopy structure following natural or artificial disturbance.

Australia’s forest industry

4. Commodity production dominates Australia’s forest industry: both its plantation and native forest sectors. Forestry industry commodities include all logs, woodchips and pulp; and most paper, wood panels and sawn timber. The highly standardised nature of commodities requires producers to compete largely on price and use cost reduction strategies to maintain profit margins. Commodities constitute around 95 per cent of Australia’s forest industry output. The industry is inevitably highly attuned to the price-cost squeeze of commodity production. Specialty products, primarily high appearance sawn timber for furniture and flooring, take a very small proportion of Australia’s native forest log cut: estimated at less than 5 per cent. The global forest industry is also highly commodified.

5. Cultural and environmental factors combined quite early in Australian forestry to generate two wood supply regimes. Wood is supplied from native forests: primarily state owned and managed by foresters who theoretically aim to retain the native forest ecosystem’s self-regenerating capacity. Plantations – an agricultural growing regime – now provide a significant alternative softwood and hardwood resource for commodity wood products manufacturers. The two regimes are competitors in intermediate and final product markets.

6. Which regime is used to supply wood for commodity wood products manufacture has fundamental implications for industry efficiency – largely through scale economies for plantation processors – and employment and the environment. In most cases, a plantation based commodity industry enhances all three relative to a native forest based commodity industry. The main exception is where native forests continue to be cleared for plantation establishment, as happens in Tasmania.

7. Switching Australia’s commodity based forest industry from native forest wood to plantation wood is a desirable public policy goal. Significant substitution has happened in domestic
manufacturing, notably sawntimber. Limited plantation for native forest substitution has happened in hardwood chip production particularly for export markets, which is now the main destination for Australia’s native forest wood.

Table 1. Australian production of wood and wood products and unprocessed wood exports by wood source 2003/04

<table>
<thead>
<tr>
<th></th>
<th>Unit</th>
<th>Plantation</th>
<th>Native forest</th>
<th>% plantation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood production</td>
<td>000 m$^3$ roundwood</td>
<td>15 000</td>
<td>9 900</td>
<td>60</td>
</tr>
<tr>
<td>Sawntimber &amp; wood panels</td>
<td>000 m$^3$ finished product</td>
<td>5 014</td>
<td>1 166</td>
<td>81</td>
</tr>
<tr>
<td>Wood for domestic pulp production (figures for 2002/03)</td>
<td>000 m$^3$ roundwood</td>
<td>2 815</td>
<td>695</td>
<td>80</td>
</tr>
<tr>
<td>Other wood products</td>
<td>000 m$^3$ finished product</td>
<td>353</td>
<td>417</td>
<td>46</td>
</tr>
<tr>
<td>Unprocessed wood - chips &amp; logs</td>
<td>000 m$^3$ roundwood</td>
<td>4 653</td>
<td>5 763</td>
<td>45</td>
</tr>
<tr>
<td>% of wood exported unprocessed</td>
<td></td>
<td>31</td>
<td>58</td>
<td></td>
</tr>
</tbody>
</table>

Source: Clark J. 2005.

Exporting wood products or unprocessed wood?

8. Australia’s use of wood to meet its wood products needs (whether domestically made or imported) has been static over the past decade. According to ABARE figures, which I consider to be slight over-estimates, Australia requires 20 million m$^3$ of wood annually to meet our domestic wood products consumption (ABARE 2005). Australia’s sawntimber consumption has been static since the early 1970s, and increased paper recycling, additives and fillers have prevented much of the growth in paper consumption flowing back into increased wood consumption. Paper recycling is an important wood saving strategy aimed at cost reduction.

9. Bureau of Rural Sciences published projections of Australia’s plantation wood supply indicate a current plantation resource availability of 26 million m$^3$ per annum. This is projected to steadily increase (due to maturing resources and productivity improvements) over the next 40 years without any expansion in Australia’s plantation estate from its 2000 coverage (Ferguson et al., 2002). Even if Australian based plantation manufacturers displace all imported wood products and all domestic native forest wood products, export markets are required to absorb Australia’s existing plantation resources.

10. THE KEY FORESTRY POLICY ISSUE IS WHETHER TO FACILITATE EXPORTS OF UNPROCESSED WOOD (LOGS & CHIPS) OR PROCESSED WOOD PRODUCTS. THIS SHOULD BE THE CONTEXT FOR THE COMMONWEALTH’S REVIEW OF THE TAXATION TREATMENT FOR PLANTATION FORESTRY.
11. It is naive to dismiss Point 10 as suggesting ‘picking winners’ and then allow the laissez-faire/comparative advantage default. Australia’s forest industry has been saturated in industry subsidies and props for decades. The distortions are significant and have promoted unprocessed native forest wood exports over Australian manufacturing. A similar trend is emerging in the plantation sector.

**Hardwood chip exports, extra-ordinary profits and distorted plantation investment decisions**

12. The biggest distortion appears in native forest woodchipping. From its long entrenched commercial power (created by persistently low state government chiplog royalties and regional monopoly buyer positioning), hardwood chip exporting is now heavily influencing the nature of Australia’s plantation growing sector.

State native forest agencies demonstrate their commercial viability with less than transparent financial reporting. Confusion keeps the jury out. The distortions, however, are evident when we examine the financial statements of an enterprise whose sole business is exporting native forest woodchips – the Eden based South East Fibre Exports Pty Ltd. It made a 24 per cent profit (after tax earnings as a proportion of shareholders’ equity) in 2003 (South East Fibre Exports Pty. Ltd., 2003). This was not an exceptional year: the company has enjoyed three decades of similar extra-ordinary profits exporting woodchips from public native forests. I have identified nothing to suggest why other Australian based native forest chip export operations would not experience similar extra-ordinary profits.

The financials in the hardwood plantation prospectus documents are constructed with the implicit assumption that these extraordinary profits will remain and flow through to the investor/grower. In my view, as the global hardwood chip market shifts further into plantation resources (therefore usually away from state businesses), the extra-ordinary profits now enjoyed by the Australia native forest chip exporters will attract a battle between the overseas chip buyers, plantation prospectus companies and private investor/growers. The latter are the least powerful in this three-way contest. I expect the stumpage prices and/or income returns for hardwood chiplogs assumed in many prospectus documents since the mid 1990s will be higher than what investor/growers are likely to realise. This arrangement distorts investment decisions in Australian plantation forestry; in favour of short rotation hardwood and against longer rotation softwood and hardwood plantations.

**Hardwood chip glut**

13. According to the projections in Ferguson et al. 2002, Australia’s existing hardwood plantations can supply sufficient wood for three large pulp and paper mills within a decade: one each in Western Australia, the Green Triangle and Tasmania. Perhaps one plantation based pulp mill will be built. It is possible that not one is built: not for environmental constraints but because of commercial risk associated with the structure and pricing behaviour of the global pulp and paper industry and the commercial interests of Australia’s monopoly printing and writing paper producer with its strength in domestic and imported paper merchanting. Most of Australia’s existing hardwood plantation resource will be sold into the global woodchip market as will the resource from future plantings.

14. In my view, Australia has planted a hardwood chip glut. Around 24 million m$^3$ per annum of hardwood chips are traded globally, mainly in the Asia-Pacific region. Australia supplies
approximately one third of the market with the USA supplying another third and the rest supplied mainly from Chile and South Africa. Australian hardwood chip exports are mainly sourced from native forests (around 5.6 million m$^3$ per annum); plantations currently provide around one million m$^3$ per annum. Australia’s existing hardwood plantations are projected to supply 8.3 million m$^3$ per annum of pulplogs over 2005-09, increasing to 10.8 m$^3$ per annum over 2010-14 (Ferguson et al. 2002). [Some foresters have advised me the projections may be 10 to 15 per cent too high, which I allow for.] In the very near future, Australia is projected to slightly more than double its supply in a market that it is already a major player. Hardwood chip demand in the Asian Pacific region is not currently growing fast enough to absorb this near immediate supply. If native forests remain in the supply equation, it is unlikely Australia’s additional supply can be absorbed without further woodchip price declines. Real prices for Australian hardwood chip exports have declined by an average 2.8 per cent per annum over the decade ending 2004.

15. In contrast to the wood supply and demand information presented in many plantation prospectus documents, trends in real prices for wood traded in global markets suggest no looming global wood shortage:

- Global exports of industrial wood have increased strongly over the past decade, but real prices have continued trending down (figure1).
- Real prices for Australian exports of hardwood and softwood chips continue to trend down (figure 2).
- China’s booming wood demand is accompanied by steadily declining real prices for softwood logs (by volume, its biggest wood import), steadily declining real prices for tropical hardwood logs (by volume, its second biggest wood import) and flat real price trends for the much smaller volume imports of chips and non-tropical hardwood logs (figures 3 & 4).

Trade and substitutability between species and growing regimes in a comfortably supplied global market favours emerging, large volume wood buyers (i.e. China). Realising new wood export opportunities for Australia is likely to require a willingness to sell at lower wood prices. This is fundamentally different to the view of China adding to an existing global wood shortage and driving wood prices up for Australian plantation investors to take an easy profit picking.

Consolidate and focus on processing

16. Producing wood is not a dynamic global industry. Thirty years ago wood production generated around 1 per cent of global economic activity. In 2003, it generated 0.4 per cent. Low volume growth, partly due to wood saving technology in manufacturing, and declining real prices explain wood’s declining economic relevance. Processed wood products also contribute less to global economic activity, but the decline for paper and wood based panels has been significantly less over the 30 year period. Sawntimber’s global economic relevance has fallen, in percentage terms, as much as that for wood (figure 5). If the Commonwealth wishes to promote the forestry industry rather than actual global growth businesses, these trends and their underlying reasons favour policy aimed at processing wood products rather than growing wood for exporting unprocessed.

17. Because wood is a major cost in making wood products (Industry Commission 1993), manufacturers invariably support government incentives for plantation investment. The
policy outcomes, however, can sometimes work counter to the interests of plantation processors. They, the processors, need to clearly articulate their specific interests to government, separate from grower groups. The following example illustrates the point. Many players have advocated privatisation of softwood plantations to stimulate investment in plantation wood growing. The new owners (often superfunds) tend to have a more rosy profit outlook than tree growing can actually deliver. Tree growing is farming and the days of big profits in agricultural commodities are over. With profit expectations unmet, these corporates will pressure the processors by trying to shift more costs back onto them and renegotiate contracts especially over log prices. If the grower corporates cannot deliver the returns the financial markets require (but tree farming can’t deliver), then we will see a second round of plantation asset sales and more uncertainty to processors.

18. Australia’s forest industry policy needs a fundamental update to realise the spread of economic, employment and environmental advantages in shifting all commodity production to plantations with plantation processing set as the overriding goal. This work should precede consideration of taxation tools.

Terms of reference

A. The commercial viability and current tax treatment of plantation investment
   - Plantation wood growing appears to be at the low profit end for the sector relative to processing and sales operations. This is a familiar agricultural industry pattern.
   - The wood price trends articulated in this submission cautions expectations of a rosy commercial outlook for commodity wood.
   - Removing Commonwealth and State Government subsidies to the competing native forest sector is the most efficient first step for promoting the plantation sector.
   - If the Commonwealth wishes to promote plantation forestry, it should focus the goal on plantation processing investment and let this arm of the industry drive plantation establishment.
   - Given the underlying wood export price trends, it is not clear why Australia should specifically support wood growing primarily for unprocessed wood exports through the taxation system.

B. Whether the operation of the Income Tax Assessment Acts impede investment in longer-term forest rotations that produce higher value products.
   - Longer rotations producing bigger logs for sawntimber and veneer does not correlate to ‘higher value products’:
     - Exporting native forest woodchips is the highest value added (revenue less costs) forestry business in Australia.
     - Value added per unit of wood used is highest for paper, followed by wood based panels, then sawntimber/veneer/plywood, then log and chip exports.
   - The high appearance sawntimber sector receives more attention than justified by its less than 5 per cent resource up-take. Pressure to change the taxation provisions for this small activity may be more about creating a more favourable secondary market for plantation investment generally. This would enable current investors who may have become more pessimistic about their returns to sell-out whilst general perceptions of its future are still relatively strong.
C. The role of state and territory governments in plantation industry development as investors, growers and land managers and any implications this has for competitive neutrality with regard to tax liabilities and incentives.

- Wood growing may return around 6 to 8 per cent. That doesn’t satisfy listed companies. It satisfies state governments and maybe some private investor/growers.
- Privatising plantations at this point in time may undermine the sector’s manufacturing arm and destabilise significant regional employment. Concern for competitive neutrality between public and private growers needs to be moderated with recognition of Australia’s long time forest policy that has worked against the interests of plantation processing and therefore kept processing investment lower than it otherwise should be.
- None of the above implies that (imputed) tax liabilities and incentives should be different for government business enterprises.

D. The capacity to adapt existing tax policies to contribute to achieve the Australian and state government’s desire to achieve a greater integration of plantation and natural resource management policies to improve the management of salinity and water quality.

- Non taxation approaches, commencing with land use planning followed by more targeted policy tools is likely to be more effective.
- The other integration task is within the industry, linking plantation growing with plantation processing.

E. The relative roles and effectiveness of the tax system and expenditure programs in the delivery of assistance to the industry.

- The first task is to decide on setting plantation processing as the overriding goal for Australia’s forest industry, then develop a plantation processing industry policy with the appropriate tools.

References


Industry Commission 1993, Adding Further Value to Australia’s Forest Products.

South East Fibre Exports Pty. Ltd., 2003, financial statement for year ended 31 December 2003 lodged with ASIC.
Figure 1. Real price for global exports of wood

Source: FAOSTAT.

Note: Wood exports comprise wood in the round, chips, particles and wood residues. fob = free on board and is the price excluding customs, insurance and freight costs. Prices deflated by US CPI 1982-84 = 100.

This figure updates figure 8 in Clark J. 2001.
Figure 2. Real prices for Australian chip exports

![Price Graph](Image)

**Source:** ABARE 2005, *Australian Commodity Statistics 2004*.

**Note:** fob = free on board and is the price excluding customs, insurance and freight costs. Green tonne is the weight of chips before drying. Prices deflated by the Australian CPI 1989/90 = 100.

This figure updates figure 10 in Clark J. 2001.
Figure 3. China - imports of logs and chips

Source: FAOSTAT.

Figure 4. China - real prices for wood imports

Source: FAOSTAT.
Prices deflated by US CPI 1982-84 = 100.
Figure 5. Contribution of wood and wood products to global economic activity

Source: FAOSTAT and IMF for estimated global GDP.

Australian production of wood and wood products in 2003/04
disaggregated by wood source

Judy Clark
Centre for Resource and Environmental Studies
The Australian National University

July 2005

1. Introduction

Neither the Australian Bureau of Statistics (ABS) nor the Australian Bureau of Agricultural and Resource Economics (ABARE) use a wood source (native forest and plantation) disaggregation as the basis for wood industry statistical reporting. ABARE reports some production data by wood source, but not consistently across all wood and wood products. This paper fills the gaps to provide estimates of Australia’s production of wood and wood products (excluding fuel wood) and exports of unprocessed wood in 2003/04 disaggregated into plantation and native forest sources. Data sources and assumptions are provided in the discussion and tables. Wood input for paper production is estimated using 2002/03 industry data.

2. Australian wood supply

ABARE reports annual roundwood removals with hardwood disaggregated into native forest and plantation sources and softwood (mostly plantation) not disaggregated (Australian Bureau of Agriculture and Resource Economics 2005, p. 55). These data exclude logs sold for fuel wood.

2.1 Plantation log cut

The plantation log cut can be estimated by deducting from softwood roundwood removals (14.701 million m³) the estimated volume of native forest softwood removals (mostly for sawn timber) and adding the volume of hardwood plantation removals (1.384 million m³). ABARE reported that in 2003/04, Australia’s native forest softwood sawn timber production was 111 100 m³ (Australian Bureau of Agriculture and Resource Economics 2005, p. 9) processed from an estimated 278 000 m³ of logs (assuming a 40% sawn timber recovery). It is estimated that log removals from Australia’s plantations totaled 15.0 million m³ in 2003/04.

2.2 Native forest log cut

Australia’s native forest hardwood log removals totaled 9.600 million m³ in 2003/04 (Australian Bureau of Agriculture and Resource Economics 2005, p. 55). The native forest log cut was
estimated by adding the native forest softwood log volume (278 000 m$^3$). With this adjustment, it is estimated that log removals from Australia’s native forests totaled 9.9 million m$^3$ in 2003/04.

3. Australian production of sawntimber and wood panels

It is estimated that 5.0 million m$^3$ of sawntimber and wood panels were made from plantation grown wood in 2003/04 accounting for 81 per cent of Australian production (table 1).

<table>
<thead>
<tr>
<th>Table 1 Australian production of sawn timber and wood panels 2003/04 (000 m$^3$ finished product)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
</tr>
<tr>
<td>Made from plantation wood</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Sawntimber</td>
</tr>
<tr>
<td>Particleboard</td>
</tr>
<tr>
<td>Medium density fibreboard (MDF)</td>
</tr>
<tr>
<td>Hardboard</td>
</tr>
<tr>
<td>Plywood</td>
</tr>
<tr>
<td>Total sawntimber and wood panels</td>
</tr>
</tbody>
</table>

4. Australian production of pulp and paper

Australia uses recycled paper, imported and domestically manufactured pulp, fillers and cotton linters as the material inputs for its paper production. Recycled paper is the single biggest fibre source and accounted for 48 per cent of Australia’s paper production in 2002/03 (Australian Paper Industry Council p. 7).

The Australian Paper Industry Council reports plantation and native forest input for Australian pulp and paper production. Wood input reported in tonnes was converted to m$^3$ assuming 1 tonne of native forest (virtually all regrowth) wood and plantation hardwood (mostly from Victoria’s Latrobe region) used in Australian pulp production = 0.9 m$^3$ and 1 tonne of softwood plantation wood = 1 m$^3$.

<table>
<thead>
<tr>
<th>Table 2 Wood used for Australian pulp and paper production in 2002/03 (000 m$^3$ wood)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
</tr>
<tr>
<td>Softwood</td>
</tr>
</tbody>
</table>
5. **Australian production of other wood products**

Other wood products comprise railway sleepers, fencing and mining timbers, poles and piles. Fuel wood is excluded from this exercise.

**Table 3** Wood used for other products - Australia 2003/04 (000 m$^3$ finished product)

<table>
<thead>
<tr>
<th>Source</th>
<th>Plantation</th>
<th>Native forest</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Railway sleepers</td>
<td>0</td>
<td>19</td>
<td>ABARE 2005, p. 55.</td>
</tr>
<tr>
<td>Fencing, mining, poles</td>
<td>353</td>
<td>398</td>
<td>ABARE 2005, p. 55 and assuming that all softwood production is plantation based.</td>
</tr>
<tr>
<td>piles and other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>353</td>
<td>417</td>
<td></td>
</tr>
</tbody>
</table>

6. **Australian production of unprocessed wood exports (logs and chips)**

**Table 4** Australian exports of unprocessed logs and chips 2003/04 (000 m$^3$ roundwood equivalent)

<table>
<thead>
<tr>
<th>Source</th>
<th>Plantation</th>
<th>Native forest</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardwood chips</td>
<td>949</td>
<td>5594</td>
<td>ABARE (2005, p. 55) reported 1 173 000 m$^3$ of hardwood plantation chiplogs produced for pulp and paper production. The Australian Paper Industry Council (p. 6) reported 249 000 tonnes (estimated 224 000 m$^3$) used for domestic production. Total native forest and plantation hardwood chip exports of 4 165 100 bone-dry tonnes (ABARE 2005, p. 50) multiplied by 1.68 to convert to m$^3$ (Neilson &amp; Flynn 1998, p. xiv). An allowance of 6.5% for chip losses and fines (Australian Forest Growers 1996) was made. The native forest component was calculated by netting out plantation-based exports.</td>
</tr>
<tr>
<td>Softwood chips</td>
<td>2 538</td>
<td>0</td>
<td>ABARE 2005, p. 50 with bone dry metric tonnes multiplied by 2.47 to convert to m$^3$ (Neilson &amp; Flynn 1998, p. xiv) and allowing 6.5% for chip losses and fines (Australian Forest Growers 1996).</td>
</tr>
<tr>
<td>Softwood logs</td>
<td>1 166</td>
<td>-</td>
<td>ABARE 2005, p. 40 and assuming half of unspecified logs were plantation sourced.</td>
</tr>
<tr>
<td>Hardwood logs</td>
<td>-</td>
<td>169</td>
<td>ABARE 2005, p. 40 and assuming all hardwood logs are native forest sourced and half of unspecified logs are native forest sourced.</td>
</tr>
</tbody>
</table>
7. **Summary**

**Table 5** Australian production of wood and wood products and unprocessed wood exports by wood source 2003/04

<table>
<thead>
<tr>
<th>Wood production</th>
<th>Unit</th>
<th>Plantation</th>
<th>Native forest</th>
<th>% plantation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawntimber &amp; wood panels</td>
<td>000 m³ roundwood</td>
<td>15 000</td>
<td>9 900</td>
<td>60</td>
</tr>
<tr>
<td>Sawntimber &amp; wood panels</td>
<td>000 m³ finished product</td>
<td>5 014</td>
<td>1 166</td>
<td>81</td>
</tr>
<tr>
<td>Wood for domestic pulp production (2002/03)</td>
<td>000 m³ roundwood</td>
<td>2 815</td>
<td>695</td>
<td>80</td>
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<tr>
<td>Other wood products</td>
<td>000 m³ finished product</td>
<td>353</td>
<td>417</td>
<td>46</td>
</tr>
<tr>
<td>Unprocessed wood - chips &amp; logs</td>
<td>000 m³ roundwood</td>
<td>4 653</td>
<td>5 763</td>
<td>45</td>
</tr>
<tr>
<td>% of wood exported unprocessed</td>
<td></td>
<td>31</td>
<td>58</td>
<td></td>
</tr>
</tbody>
</table>
References


The global wood market, prices and plantation investment: an examination drawing on the Australian experience

JUDY CLARK*
Centre for Resource and Environmental Studies, Australian National University, Canberra, Australia 0200
Date submitted: 17 March 2000 Date accepted: 8 September 2000

Summary
A global wood shortage generating real inflation-adjusted price increases for wood has been a long and widely-held expectation. This paper assesses the validity of this view by examining global trends in wood and wood-products consumption, developing a model to explain movements in wood prices and testing it empirically. No evidence was found of increasing real prices for wood over the long-term, indicating that there is no looming global wood shortage. A global wood shortage is not predicted because technology is increasing resource productivity, enabling wood products to be made using less wood, and also increasing wood supply. It is superficial to interpret this to mean that there is little to worry about from a native forest biodiversity perspective. The analysis presented in this paper suggests that real prices for wood are likely to continue to fall. This will discourage commercially-driven investment in plantation establishment on existing agricultural land. But industrial pressure will continue for a wood resource that is attractive in cost and quality terms, increasing the risk of biodiversity loss through intensification of native forest management and clearing of native forests for plantations. It is prudent to consider approaches that encourage plantation investment on existing agriculture land using the price mechanism. Currently, much private sector plantation investment is based on price expectations derived from an incorrect view of an imminent global wood shortage. Withdrawing old-growth forests from commodity wood supply is likely to increase wood prices in line with widely-held, though apparently false, expectations and also deliver an absolute best ecological outcome. As increasing volumes of wood become available from maturing plantations, government policy changes will be required to ensure that levels of logging in native forests actually decline rather than new markets being found for native forest wood. Despite its strategic commercial importance, little is known about the potential of the existing global plantation estate to supply wood. Addressing this information gap is a timely task that would enhance industry policy and clarify future plantation investment requirements.

Keywords: wood prices, global wood deficit, wood consumption projections, plantations, forest conservation, old-growth forests

Introduction
Some analysts forecast a global wood shortage (Simons Consulting Group 1994; Apsey & Reed 1994). They consider that population and per caput income growth will continue to drive up wood demand, particularly in developing regions, whilst wood supply is constrained by the catch-up effects of unsustainable logging and deforestation and increasing conservation demands. Forecasts of global wood shortages fuel expectations of increasing real (inflation adjusted) prices for wood. In contrast, other analysts cast doubt on the likelihood of a looming global deficit in wood, finding scant evidence of increasing real prices for wood in global markets (Sedjo & Lyon 1990; FAO 1997).

An expectation of increasing real prices for wood stimulates investment in plantations that compete against native forests as a source of wood. If these price expectations are unrealized because a global wood shortage has been incorrectly forecast, investment in plantations could collapse.

The aim of this study was to examine the evidence for a looming global wood shortage and to explore the implications of the findings for plantation investment and native forests. Trends in global consumption of wood and wood products are reviewed, specifically incorporating the effects of technological change embodied in new products and processes. Projecting consumption by extrapolating past trends, a widely-practised methodology, means that the effects of technological change on wood demand and supply cannot fully be captured. The study presents a theoretical model to explain long-term movements in wood prices that is tested empirically.

The following terminology will be used in this paper:

- Wood is the fibre under the bark of trees. In this paper, ‘wood’ refers to logs and particles of wood that are used to make industrial wood products, namely sawn timber, wood-based panels and paper. Wood used for fuel has been excluded from the analysis presented in this paper.
- Plantations are trees that are planted and managed in an agricultural context where wood production is the major objective. Other multi-purpose tree crops (for example
rubber, oil palm, coconuts and fruit trees) also contribute to wood supply but wood production may not be their primary objective. This paper focuses on trees planted primarily for wood production.

- Native forests are forests in which the plant species are predominantly native to the locality in which the forest occurs and where natural regenerative processes operate either fully or in part for the recovery of canopy structure following natural or artificial disturbance.
- Growth rates over long periods have been calculated using ordinary least squares regression incorporating all annual data over the period as specified. This removes the distortions of compound growth rate calculations based only on end-point data.

Consumption of wood and wood products

Demand for wood is derived from the demand for paper, wood-based panels and sawn timber. These wood products compete against non-wood products in the market for packaging, communication, personal care, shelter and decoration (Sedjo & Lyon 1990; Lippke 1994; Clark 1995).

This section describes trends in wood and wood products consumption and examines the technology-driven changing relationship between finished wood products and wood input. Consumption was calculated using Food and Agricultural Organization (FAO) data by deducting exports from production and adding imports. Changes in stock levels cannot be allowed for because stocks data were not available. FAO time-series data used in this paper incorporate preliminary data for 1998 (FAO 1999).

Paper

Paper is made predominantly from wood pulp and recycled paper. Non-wood pulp, made from fibrous vegetable materials other than wood, accounted for 7% of fibre input for paper production in 1998 (FAO 1999a). Paper is the highest value and fastest growing sector of the global wood products industry (Table 1). The US$ value of paper, and other wood products consumed, was calculated by applying unit price import data for each product to the volume of product consumed.

Developed countries still consume the major share of world paper. This dominance is declining with developing countries accounting for more than half of the volume increase in global paper consumption during 1988–1998. A priority in developing countries for increased health standards is evident in the relatively high growth in consumption of wrapping and packaging papers and household and sanitary papers (Fig. 1). These papers are made predominantly from long-fibred softwoods to capture their strength properties and recycled paper to avoid the cost of wood pulping. Printing and writing paper is the slowest growing paper market in developing countries.

Wood requirements for global paper production are stagnating. This is because pulp made from wood is becoming less important in paper production. Wood pulp accounted for 81% of the fibre input for global paper production in 1968; 30 years later it accounted for 56%. Growth in global paper consumption is increasingly being met by recycled paper and

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<th>Volume (m³) growth 1968 to 1998 (% per annum)</th>
<th>Developed countries' consumption share 1998 (%)</th>
<th>Total world consumption 1998 (million m³)</th>
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<td>Wood for the above products</td>
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Figure 1 Absolute change in global paper consumption, 1988 to 1998. Numbers above the bars are % per annum growth rates over 1988 to 1998. Source: FAO (1999a).
to a lesser extent non-wood pulp, instead of pulp made from wood (Fig. 2).

The uncoupling of paper from wood pulp has intensified during the 1990s. Global paper consumption increased by an average 2.9% per annum over 1990 to 1998, but the use of wood pulp to meet this paper consumption grew by only 0.8% per annum over the same period. The use of recycled paper grew by 3.7% per annum and non-wood pulp by 2.7% per annum over the same period. The FAO expects these trends to continue, with projected consumption of wood pulp growing by only 0.6% per annum over 1997 to 2010 and wood pulp declining to 44% of the material input for paper production by 2010 (Zhu et al. 1998).

New, relatively high yield pulping technologies further weaken the linkage between paper and wood. Sedjo and Lyon (1990) note the adoption of wood-saving technologies such as chemi-thermo-mechanical (CTM) pulping which almost doubles traditional chemical pulp yields per unit of wood input.

Tree selection and breeding associated with plantation programmes complement wood-saving pulping technologies. Macrae et al. (1999) report 20% reductions in wood input per unit of pulp output using selected species in plantation growing regimes.

In combination, the projected increased use of recycled paper and continuing investment in wood-saving pulping technology will significantly constrain growth in wood input for paper production. Wood input required for wood pulp used in global paper production is likely to grow at less than 0.6% per annum.

Sawn timber & wood-based panels

The solid wood products market has seen a flow of new products such as particleboard, medium density fibreboard (MDF) and more recently oriented strandboard (OSB). Much of this new product development has worked to displace existing wood products rather than expand the overall market for wood and wood products (Apsey 1986; Nelson & Kelly 1998; von Weizsacker et al. 1997).

The traditional sawn timber product has borne the brunt of this competition (Table 1). Wood-based panel production has been stimulated by the increasing scarcity of large logs relative to small logs, scale economy attractions of large processing complexes, and on-going new product development to increase their application and market range.

The displacement of sawn timber by wood-based panels such as particleboard and MDF saves wood. The FAO (1999b) notes that the wood recovery rates for such wood-based panels are typically higher than for sawn timber and plywood. Ellis (1995) presents wood recovery rates for particleboard approximately 15-35% higher than sawn timber and plywood. Less wood will be used per unit of finished product as the global market share of wood-based panels continues to increase from its current low base (Fig. 3).

This changing product mix appears not to have been fully factored into the FAO’s latest consumption projections (Zhu et al. 1998) which show an abrupt decline in the market share of wood-based panels in 2000 (Fig. 3). It has been claimed that the FAO has persistently over-estimated sawn timber consumption relative to wood-based panels consumption.
Figure 3  Global consumption of sawn timber and wood-based panels. Sources: FAO (1999a) for actual consumption from 1968 to 1998; Zhu et al. (1998) for projected consumption in 2000, 2005 and 2010.

Figure 4  Contribution of wood and wood products to global GDP. Sources: FAO (1999a), International Monetary Fund (1999).
Wood : used to make sawn timber, wood-based panels and paper

Global wood production is growing relatively slowly in US$ value and volume terms. We can estimate the growth in the US$ value of global wood production relative to total world economic activity (measured by gross domestic product, GDP) by applying the FAO’s import price data to their wood production data and comparing this series with International Monetary Fund data on world GDP. This exercise shows that global wood production maintained a reasonably steady contribution to global GDP of an average 1.4% during the 1970s. Since then the US$ value of global wood production has grown at only one third the growth in global GDP. By 1998, wood production accounted for only 0.5% of world economic activity (Fig. 4).

Processed wood products have fared much better, with the exception of sawn timber. Sawn timber production accounted for 0.8% of global GDP in the 1970s. Since then its contribution has steadily declined and by 1998 it accounted for only 0.3% of global GDP. This contrasts with paper and wood-based panels that have experienced only moderate declines in their share of global economic activity (Fig. 4).

The declining economic significance of wood production is caused by falling wood prices relative to prices for all other goods and services (examined later in this paper) and low rates of growth in the physical amount of wood used. The volume of wood used globally for paper, sawn timber and wood-based panel production increased by only 0.8% per annum over the 30 years ending 1998 (Table 1).

The derived demand relationship between wood and finished wood products has been gradually separating. The separation has intensified during the 1990s (Fig. 5). Over the six years 1992–1998 the volume of finished wood products consumed globally increased by an average 1.8% per annum, but global wood consumption increased by less than half this rate, namely an average 0.8% per annum. Paper recycling, the dominant wood-saving action, has been complemented by other wood-saving product and process developments (Sedjo & Lyon 1990; FAO 1999b).

Projected wood consumption
The FAO dominates global wood consumption projection work, but the projections have been criticized for the significance of revisions (usually down) and the persistent over-estimation of sawn timber consumption (A.J. Leslie, personal communication 1997). The first FAO projections of global wood consumption in 2010, published in 1993 (FAO 1993), were revised down by 30% in 1999 (Fig. 6). In addition to being optimistic in early projections, the FAO has
not realistically tracked wood-saving technology. The FAO recognizes the systematic errors in its methodology and has embarked on extensive re-modelling work (FAO 1997).

Dissatisfaction with FAO wood consumption projections has led to many analysts simply assuming a consumption growth rate. In Australia, the projections of global wood consumption prepared by Apsey and Reed (1994) and the Simons Consulting Group (1994) have been widely used in policy formulation (Cameron 1996; Centre for International Economics 1997; Ministerial Council on Forestry, Fisheries and Aquaculture et al. 1997). Both sets of projections appear to over-estimate consumption significantly. Simons Consulting Group (1994, p. ii) justify using a 1.4% per annum long-term growth in wood consumption based on an undocumented ‘consensus of international experts polled by the consultant’. Apsey and Reed (1994, p. 4) justify using an average 1.5% per annum long-term growth in wood consumption because it is ‘realistic on a world wide basis’. Their projections were revised down by 13% (Apsey & Reed 1998) due solely to commencing the assumed 1.5% per annum compound growth from a later year.

Continuing growth in global wood consumption requires high rates of economic growth in developing countries to offset stagnating wood consumption in developed countries and the effects of wood-saving technology.

**Wood supply**

Knowledge of global wood stocks and flows is seriously deficient. The years of debate and concern about forest resources have not generated a reliable global wood supply inventory. Recent calls for more reliable data and analysis of global wood sources has encouraged the FAO to undertake more extensive and ongoing work to develop an inventory of global wood supply. This work is proceeding (FAO 1999b) and is starting to fill some gaps in some regions, but it will be some time before a realistic global wood supply inventory is available and even longer for reliable projections of global wood supply to be made.

In the absence of reliable wood inventory data, industry analysts will continue to generate projections of wood supply to compare with the demand outlook. In these circumstances, it is impossible to generate precise long-term projections of global wood supply and demand. These projections provide a single point estimate of the difference between wood supply and demand (Apsey & Reed 1994; Simons Consulting Group 1994) that must be considered a notional deficit. However, projections of wood deficits create expectations of increasing real prices for wood.

Expectations of real price increases for wood are one of the most encouraging signals to invest in plantations. This is clearly observable in Australia, where government policy strongly supports a major increase in private sector plantation establishment (Tuckey 2000). Both the Australian government and the plantation wood growing industry are encouraged by projections of global wood deficits and expectations of increasing real prices for wood. An examination of private sector prospectuses to raise funds during the 1990s for plantation establishment in Australia shows that all have expectations of a global wood deficit. Most prospectuses examined assume future real prices for wood on the stump (prices before logging) that are significantly higher than current (native forest) wood prices after allowing for a quality differential (see for example Timbercorp Eucalypts Ltd 1999; Pacific Forest Corporation Ltd 1999). Part of the optimism may be attributed to an unrealistic expectation that the commercial benefits of public subsidies on native forest wood can be shifted from processors to private growers.

Expanding the global plantation estate could enable signifi-
Wood price trends: some theory

Long-term movements in wood prices are determined by the commodity nature of wood and technological change. Commodities are homogeneous products that usually meet established product standards. Commodity producers therefore compete mainly on price which is the factor that distinguishes, for buyers, one company’s product from others. Individual commodity producers are focused on selling their products at attractive prices to capture more sales. This means that there is constant downward pressure on prices. To maintain profit levels, commodity producers adopt a complementary on-going strategy of cost reduction. Technological change is the means by which this is achieved over the long term.

The price effect of technological change in commodity markets can be examined using the traditional supply and demand price model (Fig. 7). The model has been simplified to focus on capturing the relationship between the consumption of wood and wood products, wood supply and technological change. Linear supply and demand schedules are presented and the effect of competition from non-wood products has not been incorporated. Competition from non-wood products works to constrain wood price increases (Lippke 1994). Classification of the effect of technological change on wood demand and supply was based on Sedjo and Lyon (1990).

$D_{wp1}$ is the demand schedule for wood products in time period one, and it shows the relationship between the price for wood products and the quantity demanded and how sensitive demand is to changes in price (Fig. 7). $D_{wp2}$ is the corresponding derived demand schedule for wood. $S_{wp1}$ is the supply schedule for wood in time period one. The interaction of supply and demand generates a wood price at $P_1$ with $Q_1$ of wood consumed in time period one.

An increase in income will shift the demand for wood products to $D_{wp2}$, but the derived demand effect on wood is moderated by on-going wood-saving technology (for example higher yielding pulp technology, recycling, increased market share of wood-based panels). The demand schedule for wood shifts out to $D_{wp3}$; this is a smaller shift than that of the demand schedule for wood products (Fig. 7).

Wood-extending technology works to shift out to the right the wood supply curve. Such technology, again stimulated by cost-conscious commodity producers, includes new products or processes to take advantage of cheaper resources that previously were not viewed as part of the wood base. It also includes yield-enhancing technology such as native forest intensification and increasing plantation wood yields through productivity enhancement. Cost reducing strategies in the logging industry make previously inaccessible and sub-marginal forest areas feasible to log and also work to shift out the wood supply curve. $S_{wp3}$ represents the wood supply schedule at time period two (Fig. 7).

At time period two, one possible outcome is that the derived demand for wood increases from $Q_1$ to $Q_3$, with the price for wood falling from $P_1$ to $P_2$. (The supply schedule $S_{wp3}$ and associated $P_2$ and $Q_3$ will be used in the discussion section of this paper.)

The direction of wood price movements depends on the relative slopes of the supply and demand schedules (depicting the responsiveness of supply and demand to changes in price – price elasticity) and their shifts. The demand for wood is highly price inelastic (FAO 1997; Zhu et al. 1998); demand is not particularly sensitive to price fluctuations. This is shown by the steepness in the slope of the demand schedule (Fig. 7). In contrast, wood supply is more price elastic and the supply schedule is flatter. Wood supply can be more responsive to price changes because of the significance of native forests that have not previously been commercially logged and also the capacity for regional short-falls in wood to be accommodated through trade. The FAO estimates that undisturbed native forests, with their built up stocks of wood, currently account for 43% of the area of forests available for global wood supply (FAO 1999d). This analysis implicitly supposes that sustainable wood yield logging schedules are often not adhered to (Dauvergne 1997).

The model presented above showed the conditions for wood prices to decline. If this were the case it implies that there is no wood shortage in the particular market. What is the empirical evidence for declining wood prices? The following section examines four long-term trends in wood prices in widely differing circumstances.

Figure 7 Wood price model. (See text for a description of the variables.)
Wood prices: the empirical evidence

Global wood export market

Global exports of wood have increased by an average 1.0% per annum over the 30 years ending 1998 (Fig. 8). Real prices for wood show an underlying downward trend, which was broken for a period by the oil shock followed by the early 1980s economic recovery. This price trend gives no support to the view that there is a global wood shortage, however the past does not necessarily reflect the future. The next decades may see significant conservation gains for native forests that trigger price spikes and expectations of on-going moderately high prices (Lippke 1994).

New Zealand radiata pine (Pinus radiata) log export prices

The United States’ decision to protect spotted owl habitat triggered a price spike and delivered significant financial benefits to exporters of radiata pine plantation sawlogs from New Zealand. Export prices for high-quality pruned radiata pine logs peaked in the September quarter of 1993, when prices were 135% higher in real terms than those in the September quarter of 1992 (Fig. 9). Within a year, real prices for pruned logs plummeted and have continued on a fairly steady downward path. By June 1999, export prices for pruned radiata pine logs were no different in real terms to those before the price spike. Real prices for all lower quality radiata pine

Figure 8  Real price for global exports of wood. Wood exports comprise wood in the round, chips, particles and wood residues. fob = free on board and is the price excluding customs, insurance and freight costs. Prices deflated by US CPI (Consumer Price Index) 1990 = 100. Sources: FAO (1999a); Reserve Bank of Australia for US CPI.

Figure 9  Real prices for New Zealand radiata pine log exports. fob = free on board and is the price excluding customs, insurance and freight costs. Prices deflated by NZ CPI December quarter 1993 = 1000. MQ = March quarter, SQ = September quarter. Sources: New Zealand Ministry of Agriculture and Forestry (1999); Reserve Bank of Australia for NZ CPI.
Export logs have tended to decline since the September quarter of 1993. Real prices for these logs in September 1999 were nearly 30% lower than their pre-spike prices.

**Australian eucalypt export woodchip prices**

The importance of price expectations for plantation investment decision-making is clearly evident in Australia’s eucalypt plantation programme targeted for the global chip market. Australia is a major player accounting for 25% of global softwood and hardwood chip exports (FAO 1999a). The annual rate of new, first rotation, eucalypt plantation establishment in Australia increased by 343% between 1995 to 1999 (Bureau of Resource Sciences 2000). The majority of these plantations have been financed through private sector prospectus-based investment (Kohler 2000; Cummine 2000). All prospectuses referred to looming global shortages of hardwood. Most prospectuses incorporate significant price increases for wood stumpages relative to native forest stumpage prices. The price data indicate no tightening of the global hardwood chip market. Real prices for hardwood chips exported from Australia declined by an average 1.1% per annum over the period 1981 to 1998 (Fig. 10).

**Chip import prices for the high growth Asian region**

Increasing real prices for wood could be expected in countries with high economic growth in the Asia-Pacific region, if domestic wood supplies cannot meet strong growth in wood products consumption. Importing chips has accommodated most of the wood deficit. The volume of chips imported into the ASEAN (Association of South East Asian Nations) region, China, Japan and Korea increased by an average 12.3% per annum over the period 1964 to 1998. Despite this strong growth, real import prices for chips showed no underlying upwards trend (Fig. 11).

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**Figure 10** Real prices for Australian chip exports. fob = free on board and is the price excluding customs, insurance and freight costs. Green tonne is the weight of the chips before drying. Prices deflated by Australian CPI 1989/90 = 100. Sources: Australian Bureau of Agricultural and Resource Economics (1998, 1999).

**Figure 11** Real prices for chip imports to the ASEAN, Japan, China & Korea. cif = price including customs, insurance and freight costs. Prices deflated by US CPI 1990 = 100. Sources: FAO (1999a); Reserve Bank of Australia for US CPI.
The wood price data examined in this paper cover a wide set of circumstances, namely the aggregated global wood market, a regional market exposed to and benefiting from a wood supply shock, a market with expectations of wood chip shortages, and a high-growth regional market with short to medium-term wood shortages. No evidence was found to support the argument that real prices for wood increase over the long term. On the contrary, in three of the four examples, real prices for wood showed a long-term downwards trend. The most optimistic price trends were for the high-growth Asian countries. Despite the significant increase in the volume of chips imported by high-growth Asian countries over the last three decades, average real import prices for chips during the 1990s were virtually no different to the prices paid during the 1960s.

These findings are consistent with the FAO (1997) which reported no evidence, based on real prices, of increasing scarcity of wood during the past 30 years. The FAO expects no long-term real price increases for wood because their supply and demand analysis suggested that forests and plantations together with other fibre sources would be sufficient to meet demand in the foreseeable future (FAO 1997, 1999). Sedjo and Lyons (1990) also found no evidence of increasing real prices for wood and concluded that increasing global wood consumption has been matched by an outward shift in the wood supply schedule.

**Discussion**

That the world is experiencing, or soon will experience, a wood shortage is a widely held view. It generates expectations of increasing real prices for wood. However, as has been shown here and elsewhere, there is no evidence of increasing real prices.

Both forest conservation and utilization advocates reinforce the expectation of increasing real wood prices in advancing their differing interests. Forest conservationists argue that over-consumption and unsustainable deforestation and logging are likely to increase wood prices (Greenpeace 1999). Increasing prices for wood are a desirable, but incomplete, correction mechanism. The native forest-logging industry argues that global wood shortages are imminent and that protecting more forest areas from logging to meet conservation objectives will increase wood prices (National Association of Forest Industries 1990, 1995). Promoters of plantation investment are encouraged by studies showing global wood shortages. Such studies create expectations of increasing wood prices which generate greater (false) confidence in investment.

Many factors, working on demand and supply, are averting a global wood shortage. There has been negligible growth in wood consumption in developed countries over the past three decades (Table 1). This is because sawn timber consumption has flattened as population levels and house building have stabilized and paper recycling has increased. Developed countries account for slightly over 70% of global wood consumption. Static, possibly in the near future declining, wood consumption in developed countries has helped to accommodate necessary consumption increases in developing countries without generating real price increases for wood.

Wood-saving technologies are increasing resource productivity, enabling the same volume of wood products to be manufactured but with less wood. As has been shown in this paper, global wood use in more recent years has been increasing at only half the rate of consumption growth in wood products. In 1990, 1.8 m³ of wood was used to make 1 m³ of wood products, but by 1998, wood-saving technologies reduced this to 1.6 m³ of wood to make 1 m³ of wood products (Fig 5). Paper recycling has been the most significant wood-saving technology adopted to date. Others include high yield pulping and substituting sawn timber with more resource-efficient wood-based panel products and timber-engineered products. Technological change is also increasing wood supply through the intensification of native forest management, logging cost reductions that widen the commercially viable wood catchment and productivity enhancement in plantations.

It would be incorrect to interpret the absence of a looming global wood shortage to mean that there is little to worry about from a conservation perspective. The outcome with respect to native forest conservation depends on what land base (forested land or already cleared agricultural land) will be used for the intensification technologies that enable ongoing wood cost reductions to be made through growing wood as an agricultural crop. It also depends on the extent to which native forest logging pressure is actually reduced as plantation-grown wood becomes available for processing.

Declining real prices for wood increases the risk that plantations will not be established on existing agricultural land with commercially-driven investment. Instead, the attraction of immediate cash flow from logging native forests on what is often subsidized public land means that plantation establishment is more likely to be focused on clearing native forests or intensively managing native forests. Intensification practices include reducing rotation periods, increasing wood yields using agricultural technology, and selecting non-indigenous tree species for replanting. Intensification of native forest management threatens biodiversity in natural ecosystems (Ehrlich 1996; Lindenmayer 1996; Norton 1996).

One option for addressing this biodiversity threat is to accredit industry players that source their wood from ecologically sustainable native forest logging. Accreditation may, for example, be based on the Montreal Process (Montreal Process Implementation Group 1998) or the principles established by the Forest Stewardship Council (World Wildlife Fund 1998). Accreditation, by not recognizing the commodity nature of the wood and wood products industry and the reality of global trade, will deliver a second-best ecological outcome. Accreditation will encourage commodity producers to relocate to regions where they can avoid wood growing and logging practices that add to their costs.

A long-lasting solution means accepting that commodity
and also increase its slope (Sw3) as wood supply became less ecologically (Fig. 7). It would shift the wood supply schedule up for forests from commodity wood supply has been shown theoretically (Fig. 7). With these uncertainties, it is prudent to consider approaches that encourage plantation investment on existing agriculture land using the price mechanism. Currently, much private sector plantation investment is based on price expectations derived from an incorrect view of an imminent global wood shortage. Withdrawing old-growth forests from commodity wood supply is likely to increase wood prices in line with widely held, though apparently false, expectations and also deliver an absolute best ecological outcome. Old-growth forests have dampened price increases when regional wood shortages have arisen because they contain large volumes of mature wood that can be quickly brought into production. The price effect of withdrawing old-growth forests from commodity wood supply has been shown theoretically (Fig. 7). It would shift the wood supply schedule up and also increase its slope (Ssw) as wood supply became less responsive to changes in price. The price for wood increases to point P*, (Fig.7).

Native forest logging levels will not automatically fall as increasing volumes of wood become available from maturing plantations. The Australian experience illustrates the significance of the point. Plantations now account for half of Australia’s wood base following a four-fold increase in plantation wood supply since the 1970s. Wood supply from native forests has remained unchanged over this 30-year period at around 10 million m³ per annum (Australian Bureau of Agricultural and Resource Economics 1998). Plantation products have displaced large volumes of native forest sawn timber (Australian Bureau of Agricultural and Resource Economics 1999 and earlier volumes), but new markets for native forest wood, principally the global chip market and more recently the expectations of major biomass use for ‘renewable’ electricity generation, are working to maintain logging levels in Australia’s native forests. Significant volumes of plantation wood have remained unused with large areas of plantations not thinned as scheduled and remaining unlogged despite reaching their clear-fell harvest age (Clark 1995a). Government policy settings skewed to the interests of the long-established native forest industry can undermine the emerging competing plantation processing industry (Clark 1995a).

Little is known about the global plantation estate, despite its strategic commercial importance. Unresolved operational definitions that distinguish a plantation from a native forest frustrate the compilation of comprehensive data on plantations. Developed countries account for most of the area data deficiencies. We do not know what plantations currently contribute to global wood supply (FAO 1999b) and comprehensive projections of global plantation wood supply are non-existent. Allocating more resources to address these information gaps is a timely task that would assist in developing appropriate industry policies and determining future plantation establishment rates.

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ANALYSIS

Forest policy for sustainable commodity wood production: an examination drawing on the Australian experience

Judy Clark*
Centre for Resource and Environmental Studies, Australian National University, Canberra, ACT 0200, Australia

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Abstract

This paper presents a policy framework aimed at sustainability in Australia’s wood-based industry. It commences with a historical overview to illuminate how culture and environment combined to fast-track Australia’s plantation establishment. This maturing estate is now generating new choices about meeting wood needs and the future for native forests. The essence of the forest problem lies in the nature of commodity production where cost reduction, essential for the firm’s survival, comes at the expense of native forest ecological integrity. The framework explicitly includes Australia’s plantation wood resource that, by definition, is excluded from the ‘multiple use’ approach to managing native forests for wood production. Three systems are identified—native forests as self-regenerating ecosystems, wood production systems to meet human material needs and rural socio-economic systems—and a dual strategy developed to enhance their persistence capacity. This strategy combines shifting commodity wood production from native forests to plantations and adding value by domestic processing. The strategy works in a complementary way across the three systems, meaning that trade-off is avoided at this level. Native forest ecosystems cease to be threatened by the intensification pressures inherent in commodity production and relatively labour-intensive wood products manufacturers enhance their competitiveness by processing agriculturally grown wood. A highly integrated regional industry can enhance the economic viability of wood growing that helps buffer agricultural land against the price-cost squeeze of commodity production. The policy framework may not be economically efficient if, after removing government subsidies and props to the older and less competitive native forest based sector, further measures are required to stimulate investment in plantation processing. Under these conditions, a specific wood industry policy can be argued on environment grounds. Trade-off is between market interventionist industry policy and general economic efficiency—fundamentally different to the native forest conservation versus industry trade-off commonly understood.

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Keywords: Forest policy; Wood industry policy; Commodity production; Wood processing; Plantations; Sustainability

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Tel.: +61 2 6125 4760; fax: +61 2 6125 0757.
E-mail address: jclark@cres.anu.edu.au.
1. Introduction

In Australia, plantation establishment commenced soon after European settlement. The new arrivals brought tools and building practices suited to the softwoods of their northern-hemisphere homeland. Australia, however, had a paucity of commercially viable native softwood trees. Culture and environment combined to pre-empt the shift to agricultural tree cropping where the depletion of wood stocks in old-growth forests normally stimulates investment in plantations (Sedjo, 1983, 1990). With decades of growing time, Australia’s relatively large and mature plantation estate enables a tangible, market-based study of the new plantation wood resource. Such investigation identifies outmoded government policy that undermines the economic and ecological sustainability of Australia’s wood-based industries.

This paper presents a policy framework aimed at sustainability in Australia’s wood-based industries. The paper commences with an overview of Australia’s early planting history. It then discusses the essence of Australia’s forest problem, namely commodity production where cost reduction, essential for the individual firm’s survival, comes at the expense of native forest ecological integrity. The nature of commodity production is explicitly addressed in the policy framework. Two key indicators emerge from the framework and are used to evaluate Australia’s forest and wood policy over the 1990s. Policy recommendations and a summary conclude the paper.

2. Australian forestry historical context

Environmental and cultural histories vary across the regions of the globe, making naive a ‘one size fits all’ global approach to forest and wood industry policy. For Australia, the key historical developments for the purposes of this paper are summarised below.

The federation of the Australian colonies in 1901 saw the states retain responsibility over Crown land and therefore over most forested land and its wood resources. By the mid-1920s, all states had established forest agencies giving them bureaucratic independence and making them directly accountable to parliament through a minister for forests (Carron, 1985).

The foresters staffing state forest agencies quickly adopted a European tree cropping approach to meet the nation’s wood requirements over the long-term (Frawley, 1999). How this was achieved defined 20th century Australian forestry.

Australia’s forests confused the British colonists. They were dominated by unfamiliar eucalypts (hardwood) and had continued their unique evolution with aboriginal societies having no need to manage them for orderly wood production. Pragmatically, converting Australia’s forests into tree crops required commercial thinning, but there was no large-scale market for low-grade logs from Australia’s hardwood forests—at the time the global paper industry relied on softwood for its wood resource. A further dilemma faced the foresters. Builders’ general preference for softwood timber over Australia’s native hardwoods, as demonstrated by high softwood imports (Gray, 1935), cast serious doubts over the value of Australia’s hardwood dominant forests even if converted to tree crops.

By the end of the 1920s, Australia’s foresters settled on globalising Australia’s wood-based industries to the softwood standard of the northern-hemisphere developed countries. Australia’s tree planting, instigated by environmental and cultural factors, preempted the shift to agricultural cropping where the depletion of wood stocks in old-growth forests usually stimulates plantation investment (Sedjo, 1983, 1990).

Softwood tree planting continued into the 1950s at unacceptably low rates for the foresters with their expectations of continuing strong consumer demand (Hanson, 1962). In their view, state governments were not providing sufficient funds for planting and so they looked to the Federal Government for assistance. By retaining its wartime power to impose income tax, the Federal Government fundamentally shifted financing power and was also actively seeking projects of national development. By the mid-1960s, the Federal Government overcame state government concerns about their interference in forestry by providing generous, highly subsidised financial assistance to the states to escalate their softwood planting (see Fairbairn (1967) for a clarification to Parliament of the subsidy). In so doing, it brought national homogeneity to softwood plantation establishment. All states enjoyed significant growth in softwood sawlog supply.
as the relatively large area of plantations established with Federal Government funding reached maturity by around 2000–2005 (Clark, 1995a).

As the softwood planting progressed, fundamental changes took place in the hardwood sector. Proven technology in eucalypt pulping combined with Japan’s resource hungry pulp and paper industry to provide a commercial market for the large volume of logs unsuitable for sawmilling. The decades-long market constraint frustrating the foresters’ endeavours to bring order to Australia’s eucalypt forests was finally overcome. By the 1970s, however, sawlog production was shifting to softwood plantations. Management of Australia’s native forests shifted from less intensive sawlog production to more intensive woodchip production. Native forest hardwood chip exports soared with exporters enjoying extraordinary profits (calculated from Harris-Daishowa (Australia) Pty. (2002) and earlier years). Most were established as regional monopolies buying logs substantially from government.

Eucalypt tree cropping in Australia remained relatively modest until the second half of the 1990s. It escalated with the concerted promotion by eucalypt plantation prospectus companies riding on the back of Australia’s rapidly growing mass-marketed tax-effective investment schemes (Senate Economics Reference Committee, 2001, p. 16) and federal and state government encouragement for plantation establishment. This private sector dominated planting is concentrated in three regions—southwest Western Australia, Tasmania and the Green Triangle that takes in southeast South Australia and southwest Victoria (Wood et al., 2001).

Australia’s eucalypt plantations are overwhelmingly targeted to the pulp market, which means that they are managed over rotations of approximately 10 to 15 years. Large areas will mature together with Australia’s maturing, longer rotation softwood plantations. Existing softwood and hardwood plantations covering 1.5 million ha (Wood et al., 2001) can now meet virtually all Australia’s wood requirements (Clark, 1995a) and, within a couple of years, can completely substitute for native forest hardwood chip exports (see Ferguson et al., 2002 for hardwood chiplog supply projections and Australian Bureau of Agricultural and Resource Economics, 2002 for woodchip exports). Today, Australia has a wide choice as to how its wood requirements are met and the future for native forests.

3. Commodity production

The essence of Australia’s forest problem lies in the nature of commodity production. Australia’s early foresters freely expressed the commodity producers’ need to reduce costs to maintain competitiveness against non-wood substitutes (Gray, 1928). With conservation then concerning the ‘wise-use’ of resources, the ecological implications of commodity production remained unexplored. By the 1960s, our deepening ecological consciousness (Robin, 1998) brought public demand for ecological values to be put on the agenda. The political response consolidated the ‘multiple use’ approach to managing native forests for wood production as Australia’s forest policy keystone. In application, however, ‘multiple use’ remained an inexplicit concept with practitioners sacrificing either ecological values or industry development.

Rarely is the nature of commodity production in competitive market economies and its implications for native forest ecosystems openly acknowledged in contemporary policy. Revisiting the nature of commodity production and clarifying its social and environmental implications is prudent. I take the view that commodity production will exist for a very long time. There is nothing on the horizon to indicate a fundamental shift in our price conscious behaviour and neither are there signs of serious challenge to our competitive, market-based production system.

Both commodity products and specialty products are sold in the market. Commodities differ from specialties: they are homogeneous products that usually meet established standards. Homogeneity leaves little, apart from price, on which commodity producers compete for the buyers’ dollar. To capture more sales or to protect market share, individual firms producing commodities focus on selling their products at attractive prices, thereby putting downward pressure on commodity prices over the long-term (Clark, 2001; Brain, 1999; Ruthven, 1995).

The wood and wood products industry is highly commodified. Globally, commodities make up around
80% of the output volume of the wood products industry (Leslie, personal communication, 1992) and I estimate, using Australian Bureau of Agricultural and Resource Economics product classifications and production data, that commodities constitute around 95% of Australia’s production. Most sawntimber, structural beams and wood-based panels, much of veneer and plywood, pulp, and most paper are commodities. The wood used in their manufacture is highly commodified. Thus, most sawlogs and all chiplogs and woodchips are commodities.

To maintain profit levels in a market environment of real prices in long-term decline—or expectations of this trend—commodity producers constantly focus on cost reduction strategies. Technology change (new products or processes) enables reductions in both fixed and operating costs of production. For firms investing in new processing capacity, the task is to determine the appropriate processing technology and scale. With the plant installed and operating at maximum capacity, opportunities for reducing capital costs become limited and cost reduction focuses on the operating costs over the plant’s life. Wood is a major operating cost component for producers of sawntimber, wood-based panels (for example, particleboard and medium density fibreboard) and pulp. It comprises the price of merchantable wood in the standing tree (stumpage) and the cost of logging and cartage to the mill. The three components contribute roughly evenly to wood costs in the case of a chip export operation entailing 100 km of cartage (Australian Forest Growers, 1996). Stumpage becomes relatively more important for higher quality saw and veneer logs. Wood makes up about 60% of the operating costs for a softwood sawmill supplying the Australian domestic market; about 35% of the operating costs for a large export-oriented kraft pulpmill; and about 20% of the operating costs of modern mills producing wood-based panels and paper for the export market (Industry Commission, 1993; Simons and McLennan Magasanik Associates, 1990). The commodity production imperative, to lower wood costs to remain competitive either at an industry level against non-wood products (e.g. concrete, bricks and steel) or at an individual producer level against other wood products producers, takes us to the essence of the trade-off problem in forestry.

4. Effect on native forest ecosystems

Industry perceives old-growth native forests as large wood stocks: cost reduction therefore is initially focused on wood extraction and carting. Logging has generally concentrated on the highest quality and volume producing forests, that lie in close proximity to markets and on flat land. With these forests logged, industry has shifted to forests with progressively higher associated logging and cartage costs. These costs were ameliorated by capital intensive logging equipment combined with larger wood extractions made possible by the Japanese pulp and paper industry’s growing wood demand. By introducing clearfelling (the removal of all trees in a specified cutting area) in Australia’s native forests, logging contractors spread the cost of expensive machinery over the larger revenue from the increased cut, thereby reducing logging costs per unit of wood. Previously inaccessible and distant native forests became commercially viable, and native forest wood production intensified (Frawley, 1999).

Another cost-minimising strategy has been to keep stumpage prices low or stable. Debate continues—largely because of inadequate financial reporting—about the extent of subsidy on wood from public native forests (Byron and Douglas, 1981; Marsden Jacob Associates, 2001). Buckman (2002) analysed the 2000–2001 annual reports for each Australian state forest agency and found all to be financially under-performing. Those selling mainly native forest wood performed more poorly than plantation dominant operations. Consistently low financial returns indicate a subsidy to wood buyers that maintains wood production at levels higher than it otherwise would be.

Despite their capacity to substitute for most products made from native forests (Resource Assessment Commission, 1992, Appendix R), plantations may actually intensify native forest logging. As more plantation wood comes onto the market, the native forest-based industry may lobby for intensification of native forest management to enjoy the same commercial advantages as their agriculture competitors. Opportunities to use intensification technologies are greatest when old-growth forests are clearfelled and shift into a regrowth phase. Through logging and fire, most of Australia’s wood-producing native forests are
now in this regrowth phase. Intensification practices, which include reducing rotation lengths, increasing wood yields using agricultural technology, and selecting non-indigenous/endemic tree species for replanting, threaten biodiversity in native forest ecosystems (Ehrlich, 1996; Norton, 1996; Mackey et al., 2002).

Plantation wood growing is a forestry cost reduction strategy. Its aim is rapid growth of relatively large and uniform volumes of wood in close proximity to mills. It offers cost reduction by economising on time, land, logging and transport as well as scale economies and processing efficiencies (Sedjo, 1983; Clark, 1995a). The potential for on-going cost reduction, through research and development in tree breeding and plantation management, sustains industry interest in agricultural wood-growing regimes. As agricultural production systems, plantations enjoy less stringent standards for ecological sustainability than self-regenerating ecosystems like native forests. Plantation growers, however, cannot escape the price-cost squeeze of commodity production. Ultimately cost-cutting passes down the line, ending at the environment. The attraction of commodity wood supplied from agricultural land is that the requirements for ecological sustainability are less stringent than those for self-regenerating native forest ecosystems. Nevertheless, commodity producer resistance to cost add-ons, irrespective of the wood growing regime employed, must still be addressed in policy making.

5. Policy framework

With this understanding of Australia’s early planting history, and the commodity nature of the wood and wood products industry, we can now proceed to develop a framework for Australian forest and wood industry policy. The framework presented in this paper applies the sustainability concepts and definitions developed by Costanza and Patten (1995). Systems such as the environment, the economy, an organisation, a culture and a species are hierarchically interconnected over a range of time and space scales. A sustainable system, argue Costanza and Patten (1995), is one that attains its full expected life span within the nested hierarchy of systems. Processes that threaten to cut short the system’s expected life span undermine sustainability.

Sutton (2001) argues that as the applied pursuit of sustainability has progressed its meaning has shifted to one of integration, with a resignation to making trade-offs between social, economic and environmental goals. This later approach characterises the ‘multiple use’ approach to native forest management for wood production. Sutton (2001) observes that this changed understanding of sustainability is due to confusion about means and ends. The objective of sustainability is maintenance while the means to this end might be (among many other things) an integrated grappling with issues in the social, economic and environmental arenas, without major trade-off. Minimising, preferably eliminating, trade-off is the policy challenge.

The first task in developing a policy framework for sustainability is to identify the systems that society would like to survive or persist for a designated time. In this context—forests and wood production—I select three systems. They are:

1. native forests as self-regenerating ecosystems,
2. wood production systems designed to meet human needs for shelter, communication, packaging, etc., and
3. rural socio-economic systems.

This selection is based on my assessment of the Australian public’s desire to protect native forests; meet its requirements for shelter, packaging, and communication; and also maintain rural economies and employment. The analysis can be readily extended to include other systems, for example, the atmosphere.

We note, for later discussion, that the second goal (meeting human needs for shelter, etc.) is nested within the larger economic system. This system aims for efficient use of resources through freely operating markets to optimise consumer well-being and enhance national productivity and living standards. Can wood production systems intended to meet human needs for shelter be both sustainable and economically efficient? As discussed later, this is the essence of the trade-off problem in Australian forest and wood industry policy. It is fundamentally different to the native forest conservation versus industry trade-off commonly understood.
A dual strategy designed to maintain the persistence capacity of the three systems is proposed, namely:

1. shifting commodity wood production from native forests to an agricultural system, and
2. adding value by domestic processing.

On the basis of the earlier discussion, I argue that shifting commodity wood production from self-regenerating native forest ecosystems to plantations will have the combined effect of enhancing the persistence capacity of native forest ecosystems and also the economic viability of the wood and wood products industry (Fig. 1). Native forest ecosystems cease to be threatened by the intensification pressures inherent in commodity production and wood products manufacturers enhance their competitiveness by processing agriculturally grown wood.

The complementary second strategy emphasises domestic processing rather than the export of wood unprocessed as logs or chips. Processing increases income (value added, i.e. the difference between the total value of an industry’s or firm’s production and the cost of all the purchased material inputs and services that it uses) and employment per unit of wood used. Processing sawlogs domestically into sawn timber, rather than exporting them unprocessed, boosts regional income per m³ of wood used sevenfold (Fig. 2). Income per unit of wood used increases further if processing sawmill residues into wood-based panels is included in the calculation. The income returns per m³ of wood used by the Australian paper industry are even greater (Fig. 2). This is because the Australian paper industry’s high utilisation of recycled paper has significantly increased its resource productivity (output per unit of raw material input). Significantly higher levels of income per m³ of wood input are realised when commodity sawn timber, panels and paper are further processed into wooden components, roof trusses, door frames, paper containers, and so forth.

An industry that integrates plantation wood growing and processing generates more regional/national income per unit of wood grown than an industry that

![Fig. 1. Framework for forest and wood industry policy.](image-url)

**Strategies to enhance system capacity to persist**

- **Commodity wood production shifted from native forests to agriculture**
  - Enhances self-regenerating capacity of native forests
  - Enhances industry competitiveness
  - Enhances economic viability of wood growing
  - Enhances wealth and employment

**Systems**

- Native forest ecosystems
- Wood production systems to meet human needs for shelter, packaging, communication etc.
- Rural Australia socio-economic systems

Strategies enhancing more than one system’s capacity to persist increase policy coherence.
exports most of its wood unprocessed as logs or chips (Fig. 2). High domestic-industry integration is appealing from an ecological sustainability policy perspective because the regional industry as a whole has a higher income potential and more items to factor into its cost reducing strategies. Government policy can be framed to encourage revenue and cost sharing arrangements between growers, processors and distributors to buffer growers from cost-cutting as it inevitably passes down the line, ending at the environment. I argue that such environmentally focussed revenue and cost sharing arrangements are less likely to be achieved where growers export most of their wood as unprocessed logs and chips.

Domestic integration in wood growing and processing becomes a more attractive policy as the relative market power of wood growers diminishes. Price competition has become more intense in the global market for unprocessed logs relative to processed wood products. Over the last trough to trough economic cycle covering the period 1994 to 2001, real (inflation adjusted) prices for global exports of industrial roundwood (logs) nearly halved (Fig. 3). Real prices for global exports of all processed wood products also fell over this seven year period, but by significantly smaller amounts. Real export prices for wood pulp (pulp made from wood) and all paper grades fared better—from the producers’ perspective—than real export prices for the unprocessed chips used in their manufacture (Fig. 3).

A combination of demand and supply factors explains this trend in relative prices and the diminishing market power of growers relative to processors. Increasing resource productivity in the wood products industry is dampening the demand for wood relative to processed wood products (Clark, 2001, p. 57). On the supply side, there is no evidence of a looming global wood shortage (Clark, 2001). Globally, large areas of undisturbed native forests remain available for wood production (FAO, 1999). Furthermore, as old-growth forests are logged and the supply of larger logs diminishes, attention has focused on new product development suited to using smaller logs from forests managed over shorter rotations (for example, wood-based panels made from small logs and particles of wood that substitute for sawntimber and veneer made...
from larger logs). This synchronised change in the nature of the raw material and processed products works to avert wood shortages and the associated increases in wood prices.

In addition to the above ecological sustainability argument, industry structure has significant socio-economic implications for rural communities in close proximity to plantations. Processing wood into sawn timber, panels and paper generates around 15 times more jobs than exporting the equivalent log volume unprocessed (Fig. 2). Industry policy that supports domestic processing of agricultural raw materials should be a high priority for those seeking higher employment levels and increased economic wealth in rural Australia.

The dual strategy works in a complementary way across the three systems (Fig. 1), meaning that trade-off at this level is avoided. But is this policy framework compatible with the broader economic efficiency goal? For the first strategy, I argue yes. The shift to plantations will occur in freely operating, well-informed markets because a plantation grown resource enhances competitiveness in manufacturing commodity wood products. The Australian experience indicates, however, that wood markets are not freely operating, largely because of historically based government subsidies to the native forest-based sector (discussed below). The removal of these subsidies will advantage native forest ecosystems, wood and wood products industry competitiveness and overall economic efficiency.

The trade-off issue becomes more complex for the second strategy. How domestic integration in the wood and wood products industry is achieved has different implications for general economic efficiency. Many economists argue against industry-specific policies on economic efficiency grounds. This is well illustrated by state and federal government wood industry policy shaped over decades of cost-conscious commodity industry lobbying. Native forests were then industry’s primary wood source. The subsidies the native forest-based sector continues to enjoy disadvantage the younger, more competitive plantation-based sector. The recent Regional Forest Agreement process, aimed at developing internationally competitive forest-based industries that maximise

Fig. 3. Real price index for global exports of wood and wood products 2001. Source: FAOSTAT (2002).
value-adding opportunities, and efficient use of resources as well as protecting forest biodiversity, is estimated to have cost the Australian public $0.5 billion (Mobbs, 2000). It left the plantation processing sector out of the policy framework and the public consultation process (Clark, 1999a,b). Some of the funds were used to support the less efficient native forest sawmill industry. For example, 75% ($6 million) of the cost of reopening a native forest sawmill in the Eden region of New South Wales was financed by grants from the Regional Forest Agreement structural adjustment package (Phillips, 1999, p. 73). In northern New South Wales, 50% ($22.5 million) of the expenditure by Boral on native forest sawmill upgrades was funded through the same facility (Boral, 2001). Other states have provided similar assistance to their native forest-based sawmillers (see for example, Minister for Environment and Conservation, 2001).

These government actions are barriers that make it harder for firms to exit the native forest sector. Low native forest wood stumpage prices, tradable log licences and the facilitation of sawmill diversification into woodchip production are other examples of government instigated exit barriers for the native forest-based sector. The removal of these barriers is likely to encourage investment in plantation processing and therefore a more highly integrated industry structure. Maybe trade-off between sustainability in wood production systems and economic efficiency can be avoided. If, after removing government based market distortions, significant plantation processing investment is not realised, a specific wood and wood products industry policy can be argued on environment grounds.

Buffering the less-powerful plantation wood growers from the price-cost squeeze of commodity production allows higher environmental standards in agricultural land use. Under these conditions, we can justify trading-off economic efficiency with an industry-specific industry policy. The Government roles envisaged in this industry policy framework is to jointly encourage commercially viable investment in plantation processing and to reduce the long-term pressure on growers to lower wood prices. It requires careful crafting because, from the plantation processors’ perspective, the second task may result in them paying higher prices for wood. The package would entail removing subsidies to the competing native forest sector and, depending on the plantation processing industry’s response, providing specific one-off assistance to boost processing investment while encouraging cost and revenue sharing arrangements between plantation growers and processors that relieve the competitive pressure on wood growers.

6. Evaluation

The foregoing discussion presented two key strategies aimed at enhancing the sustainability of the three identified systems. From the framework emerge two key indicators for policy evaluation, namely:

1. the shift in commodity wood sourcing from native forests to plantations, and
2. the domestic integration in plantation wood growing and processing.

Neither the Australian Bureau of Statistics (ABS) nor the Australian Bureau of Agricultural and Resource Economics (ABARE) provides data that enable the indicators to be measured directly. This is because wood supply is not comprehensively reported by growing regime and the industrial classification for wood products is also not related to the growing regime. To fill this critical information gap, I estimated Australia’s production of wood and wood products disaggregated by wood source for 1999–2000 and, to enable a time-based comparison, for 1989–1990 (Table 1).

6.1. Shift in commodity wood production from native forests to plantations

Over the decade ending in 2000, Australia’s wood products industry (producers of sawn timber, wood panels, pulp and paper) substantially increased its dependence on plantation wood. By 1999–2000, plantations provided the wood for approximately 75% of Australia’s production of wood products—native forests for 25%. Of significance was the 20 percentage point increase in the plantation share of Australia’s sawn timber and wood panels production over the period.
Despite the displacement of native forest wood in domestic processing, there has been no decline in native forest wood production over the decade ending June 2000. It has remained constant at approximately 11 million m$^3$ per annum: this maintenance was achieved by increased woodchip exports. Native forest wood production remained unchanged even though plantation supplies nearly doubled. This means that Australia is dismissing opportunities to reduce the commodity wood production threat to native forest ecological integrity.

These lost opportunities are not spread evenly across Australia. The Queensland and Western Australian Governments have recently implemented policies to shift their wood-based industries into plantations and reap the economic and native forest conservation benefits (Clark, 2003). That native forest wood production Australia wide has not declined is due to increased logging in other states for chip exports, particularly from Tasmania and Victoria.

6.2. Domestic integration in plantation wood growing and processing

The Australian plantation sector has become less domestically integrated over the decade ending 2000. At the start of the 1990s, virtually all the plantation resource was processed domestically. At the end of the decade, one-third was exported unprocessed as chips or whole logs (Table 2). Over the 1990s, three-quarters of Australia’s increased plantation wood supply was exported unprocessed (Table 2).

The softwood sector, which dominated plantation wood supply during the 1990s, accounts for most of the increase in the proportion of wood exported unprocessed. Softwood chip exports increased significantly during the first half of the 1990s (Table 3). The second half of the 1990s saw growth in chip exports leveling and a rapid increase in softwood plantation sawlog exports (Table 3). Again, the trend is not evenly dispersed across the Australian states. Victoria, South Australia and Queensland accounted for 97% of Australia’s exports of softwood chips in 1999–2000 (Australian Bureau of Agricultural and Resource Economics, 2001, p. 57) with roughly equal shares. Victoria, South Australia, New South Wales and Tasmania dominate the exporting of softwood

Table 1

<table>
<thead>
<tr>
<th>Plantation</th>
<th>Native forest</th>
<th>% plantation</th>
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<tbody>
<tr>
<td>Wood production</td>
<td>6.7</td>
<td>13.0</td>
</tr>
<tr>
<td>Sawntimber and wood panels production</td>
<td>2.3</td>
<td>4.3</td>
</tr>
<tr>
<td>Wood used for Australian pulp production</td>
<td>2.1</td>
<td>2.0</td>
</tr>
<tr>
<td>Other wood products production (poles, posts, etc.)</td>
<td>0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Unprocessed wood exports (chips and logs)</td>
<td>0.3</td>
<td>4.3</td>
</tr>
</tbody>
</table>

Figures in bold are percentages. All other figures are million m$^3$ (differences due to rounding). Sawntimber and wood panels production is reported as the finished product volume. All other production is reported as the roundwood equivalent volume. Source: Clark (2002).

Table 2

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Wood production</td>
<td>6.7</td>
<td>13.0</td>
<td>94.0</td>
</tr>
<tr>
<td>Sawntimber</td>
<td>2.3</td>
<td>4.3</td>
<td>86.9</td>
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<tr>
<td>and wood panels</td>
<td></td>
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<tr>
<td>Sawntimber</td>
<td>1.3</td>
<td>2.5</td>
<td>99.7</td>
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<tr>
<td>Plywood</td>
<td>0.1</td>
<td>0.2</td>
<td>52.3</td>
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<tr>
<td>Wood-based panels</td>
<td>0.9</td>
<td>1.6</td>
<td>73.3</td>
</tr>
<tr>
<td>Wood used in Australian pulp production</td>
<td>2.1</td>
<td>2.0</td>
<td>-5.0*</td>
</tr>
<tr>
<td>Other wood products</td>
<td>0.3</td>
<td>0.5</td>
<td>44.9</td>
</tr>
<tr>
<td>(poles, posts, etc.)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Log exports</td>
<td>0.0</td>
<td>1.0</td>
<td>34 300</td>
</tr>
<tr>
<td>Chip exports</td>
<td>0.3</td>
<td>3.2</td>
<td>1 060</td>
</tr>
<tr>
<td>% wood exported unprocessed</td>
<td>4.0</td>
<td>33.0</td>
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</table>

Figures in bold are percentages. All other figures are million m$^3$ (differences due to rounding). Sawntimber and wood panels production is reported as the finished product volume. All other production is reported as the roundwood equivalent volume. The commissioning of the Visy Industries pulp and paper mill in Tumut, New South Wales, which will process 0.8 million tonnes of softwood plantation wood per annum (Visy Industries, 2000) will reverse the downward trend in Australia’s plantation-based pulp production. Source: Clark (2002).
In addition to sawlog exports, the buildup of a softwood plantation sawlog stockpile (sawlogs in standing plantations past their commercial clearfell harvest age) has further separated processing capacity from plantation sawlog availability. The stockpile results from insufficient investment in sawntimber processing and cautious public plantation management Clark (1995b). A 60% increase in Australia’s softwood plantation sawntimber processing capacity is required for full domestic processing of available softwood plantation sawlog supply (calculated by comparing projected softwood plantation sawlog availability (Ferguson et al., 2002) with current sawtimber output converted to sawlog equivalent units).

Increased domestic processing of pulp and wood-based panels (e.g. particleboard and medium density fibreboard) is currently the main alternative to exporting unprocessed plantation chips and small logs. Australia’s production of wood-based panels increased strongly over the 1990s (Table 2); Australia is now a net exporter of these products. Pulp and paper industry rationalisation and wood-saving technologies have reduced wood input for Australia pulp production over the 1990s (Table 2). The commissioning of the Visy Industries pulp and paper mill in Tumut, New South Wales (Visy Industries, 2000) will reverse the downward trend in Australia’s pulp production. In the absence of significant additional investment in plantation processing capacity (e.g. pulp and paper mills, wood panel plants and new products), much of Australia’s increasing (softwood and hardwood) plantation wood supply will be exported unprocessed and industry integration will continue to deteriorate.

In total, Australia’s plantation processing capacity needs to increase by 100% to provide a market outlet sufficient to absorb Australia’s softwood and hardwood plantation saw, veneer and chiplog supply in 2001–2004 and by 170% to absorb all the plantation resource coming on stream over 2005–2009 (calculated by comparing projected softwood and hardwood plantation wood availability (Ferguson et al., 2002) with Australia’s current level of plantation processing (Table 2).

### 7. Summary and recommendations

This paper presents a policy framework aimed at sustainability in Australia’s wood-based industries.
The essence of the forest problem lies in the nature of commodity production where cost reduction, essential for the individual firm’s survival, comes at the expense of native forest ecological integrity. Hence, the many proposals in more recent years to plant trees on agricultural land to provide an alternative to native forest logging. Agriculture for wood production—a cost reduction strategy in its own right—developed relatively early in Australia with its particular environmental and cultural makeup. Plantation wood is now well established in the market after decades of tree growing.

The Australian experience indicates that a significantly increased supply of substitutable and economically efficient plantation wood does not automatically reduce native forest logging. Rather, the new competition it brings may intensify native forest wood production. Reaping the native forest conservation and economic efficiency benefits of plantation supplies requires fundamental government policy and institutional change.

Shifting wood production from native forests to plantations does not eliminate the price-cost squeeze of commodity production: it transfers to plantation wood growers and agricultural land that has less demanding requirements for ecological sustainability than native forest ecosystems. Nevertheless, the capacity for wood growers to bear cost add-ons (for example, to meet ecological sustainability requirements) is low relative to the processing arm of the industry. Furthermore, the market power of wood growers has fallen with wood prices declining relative to prices for processed wood products in global wood markets over recent years.

This is the current context for forest and wood industry policy making in Australia. In building an appropriate policy framework, this paper identifies three goals aimed at maintaining:

- native forests as self-regenerating ecosystems,
- wood production systems to meet human needs for shelter, communication, packaging, etc., and
- rural socio-economic systems,

and proposes a dual strategy to:

- shift commodity wood production from native forests to an agricultural system, and
- add value by domestic processing.

The first strategy has the combined effect of enhancing the sustainability of native forest ecosystems and also the economic viability of the wood and wood products industry. The second strategy—adding value through processing—means that regional wood growing and processing is highly integrated. This provides more scope for revenue and cost sharing to buffer the increasingly less powerful wood growers and agricultural land from the price-cost squeeze of commodity production. Adding value through domestic processing boosts regional income and employment relative to exporting wood unprocessed.

The dual strategy works in a complementary way across the three systems, meaning that trade-off is avoided at this level. It contrasts with ‘multiple use’ management of native forests, where agriculturally grown wood is ignored and trade-off between commodity wood production and native forest ecosystems is inevitable.

The policy framework presented in this paper reveals a potential ‘new’ trade-off: between a market interventionist wood industry policy and general economic efficiency. If, after removing government subsidies to the competing native forest sector, significant plantation processing investment is not realised, a specific wood and wood products industry policy can be argued on environment grounds.

Two key policy recommendations emerge from this analysis, namely:

1. That commodity wood production in Australia (estimated 95% of wood production) be quickly shifted from native forests to plantations.
2. That a wood industry policy be developed to encourage investment in plantation processing, and cost and revenue sharing arrangements between growers and processors to buffer wood growing from intensifying price competition.

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