

Eucalypts for Sawlogs

A promising new farm forestry option

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Introduction

Many farmers see commercial trees as having an important place in the long-term operation of their farm. They see trees and other perennial vegetation as a vital tool in protecting the resource base (soil and water) of farming. The question is not whether to plant trees but how to do it to obtain the multiple benefits being sought.

There is also growing recognition that for revegetation to occur at the scale required to have a significant impact on land degradation it must have a commercial basis to it. That is, farmers must be able to obtain commercial returns as well as conservation benefits from trees (Greening Australia (1996)). In this way commercial tree crops can help drive the integration of perennial woody plants with farming.

Presently there are only a few commercial tree crops available for operational use. In areas that receive more than 700 mm annual rainfall, bluegums for pulpwood is currently the most attractive option, although radiata pine can also be used. In the 700 to 400 mm annual rainfall zone Maritime pine is an option. Oil mallees are being developed for the Wheatbelt. To cater for the range of sites and farmer preferences a suite of commercial tree crops needs to be developed.

In the early 1980s CALM commenced a research program on growing eucalypts for sawlogs. Findings from this research, combined with the experience of some innovative farmers, indicate that this option has real promise. This paper draws together the results of research and practical experience, particularly on growing high grade sawlogs at wide-spacing with pruning. It presents information on a range of aspects, including market prospects for farmers, potential products, suitable species, tree management, costs and returns, economics, milling and seasoning techniques and timber quality. Finally it examines the major challenges facing the development of an industry based on growing eucalypts for sawlogs as part of farming in South West Western Australia.

Sawlogs – what are they?

Eucalypt sawlogs are logs suitable for milling into timber. Log size can vary but typically they are at least 50 cm in diameter at breast height over bark (DBHOB) and 2.5 to 6 m long (Reid and Stephen (1999). High-grade sawlogs, ie. logs capable of producing a high proportion of “appearance grade” timber, are free of defects such as bends and knots. Various milling studies of young eucalypt sawlogs both in Australia and overseas have shown that knots are the main cause of degrade in sawn hardwood timber (Brennan, G.B. et al., (1992), Washusen, R. (2000) and Maree, B. (2000)). The highest grade logs are those which have been pruned to produce a small knotty core surrounded by “knot-free” timber. The timber from such logs has a wide range of possible uses.

Products and markets

Many eucalypts produce fine timber, well suited to flooring, furniture, panelling and veneers (Klemarewski, 2000 and Davison, 2000). With declining supplies of high-grade hardwood logs from traditional sources, such as the tropical rainforests of South East Asia and our own karri and jarrah forests, there are opportunities for private growers in Western Australia to produce and sell eucalypt sawlogs. It is estimated that there is already more than 1000 ha of privately owned eucalypt plantings in WA being managed for sawlogs (Hingston, 2000), an indication of the high level of interest in this farm forestry option.

Species

Many species of eucalypts have been planted on farmland in the south west of Western Australia during the past two to three decades. These plantings indicate the most promising species for sawlog production, in terms of tree form, tree health and growth rate. Examples of species with potential are listed in Table 1 below.

Table 1. Examples of some species with sawlog potential in South West Western Australia. This assessment is based on performance in trial plantings dating from the early 1970s.

High Rainfall Zone (600+ mm/year)	Medium Rainfall Zone (450 to 600 mm/year)
<ul style="list-style-type: none">• <i>Eucalyptus globulus</i> (Tas. bluegum)• <i>E. saligna</i> (Sydney bluegum)• <i>E. grandis</i> (flooded or rose gum)• <i>E. botryoides</i> (bangalay)• <i>E. maculata</i> (spotted gum)	<ul style="list-style-type: none">• <i>E. cladocalyx</i> (sugar gum)• <i>E. tricarpa</i> (iron bark)• <i>E. maculata</i> (spotted gum)• <i>E. saligna</i> (moist sites, wet end of rainfall range)• <i>E. botryoides</i> (moist sites, wet end of rainfall range)

An assessment of site (soil and rainfall) is required to confirm which species are suitable for the particular site. It is important to match species to site to gain best results.

Growth rates and time to produce sawlogs

Growth data from experimental sites established by CALM in the 1980s show that sawlogs can be produced within 15 to 20 years on fertile sites in high rainfall areas. To achieve these growth rates stands must be culled at a young age to about 125 trees per hectare and pruned. Twenty to 30 years is required to produce sawlogs in medium rainfall areas (450 to 600 mm annual

rainfall). To clarify the optimum age for milling young fast grown eucalypt sawlogs additional milling studies are required

Growth rate at 550 mm annual rainfall

A 12-year-old study site near Dinninup provides data on growth rates for wide-spaced *E. saligna*, *E. microcorys* and *E. maculata* in a medium rainfall area (550 mm per year average). Three provenances of each species were planted. The soil type is a gravelly loam 0.5 to 2.0 m deep over heavy clay or broken laterite. The trees were planted at a spacing of 15 m between rows and 2 m between trees in the rows (333 trees per hectare). The poorer formed trees were culled leaving the best 125 trees per hectare by 6 years of age. These were also pruned to 5 to 7 metres by this age. Growth data, presented in Table 2, shows that *E. saligna* is the most productive of the three species at the Dinninup site.

Table 2. Mean diameter at breast height over bark (DBHOB is measured 1.3 m above ground), height, basal area, volume per tree and volume per hectare for 12-year-old *E. saligna*, *E. microcorys* and *E. maculata* grown at 125 trees per hectare near Dinninup. Data is for the best performing provenance of each species.

Species	Diameter (DBHOB) (cm)	Height (m)	Basal area (m ² /ha)	Total vol/tree (m ³ /tree)	Total vol/ha (m ³ /ha)
<i>Eucalyptus saligna</i>	33	19.4	10.9	0.56	69.5
<i>E. microcorys</i>	30	15.5	9.0	0.36	45.7
<i>E. maculata</i>	27.3	14.9	7.5	0.29	36.1

Average annual increase in diameter (DBHOB) from age 10 to 12 years has been used to estimate mean DBHOB and volume of pruned logs at 20 years (see Table 3). The diameter of the pruned log at its mid-point has been estimated from the DBHOB, assuming taper is 1 mm per 100 mm of log length. Mean volume of the pruned log has been calculated using mean mid-log diameter and mean length of pruned log.

Table 3. Estimated diameter increment, diameter at 20 years, mid-log diameter and length and volume of pruned log for 20-year-old *E. saligna*, *E. microcorys* and *E. maculata* grown at 125 trees per hectare near Dinninup.

Species	Estimated diameter increment, year 12 to 20 (DHBOB) (cm/yr)	Mean diameter at 20 years (DHBOB) (cm)	Mean diameter at mid-log (cm)	Mean length of pruned log (m)	Mean volume of pruned log (m ³ /tree)
<i>Eucalyptus saligna</i>	2	49	46.8	7.0	1.2
<i>E. microcorys</i>	1.8	43.4	42.2	5.0	0.7
<i>E. maculata</i>	1.6	40.1	38.6	5.6	0.65

The data shows that by 20 years of age the mean diameter (DBHOB) of an *E. saligna* sawlog is estimated to be 49 cm, with the pruned log having a mean volume of 1.2 m³ per tree. The mean diameter of *E. microcorys* and *E. maculata* logs by 20 years is estimated to be 43cm and 40 cm respectively. This indicates that *E. microcorys* and *E. maculata* would need to be grown for a further 5 or 6 years to reach the target log diameter of 50 cm.

Growth rate at 900 mm annual rainfall

Table 4 presents growth data from 19-year-old trees at an experimental site near Busselton (Vasse plantation, compartment 2). The soil type is a sandy loam about 2 m deep over clay. Average rainfall is 900 mm per year. The stand was culled to 150 trees per hectare by 6 years of age and sawlog trees were pruned to 6 to 9 metres by 8 years.

Table 4. Mean diameter (DBHOB), height, basal area, volume per tree and volume per hectare for 19-year-old *E. globulus*, *E. diversicolor* and *E. maculata* grown at approximately 150 trees per hectare near Busselton.

Species	Diameter (cm)	Height (m)	Basal area (m ² /ha)	Total vol/tree (m ³ /tree)	Total vol/ha (m ³ /ha)
<i>Eucalyptus globulus</i>	57	25	34.8	2.3	297
<i>E. diversicolor</i>	52.9	30.4	28	2.3	286
<i>E. maculata</i>	38.5	22.4	21.5	0.92	163

Table 5 presents data on estimated size of pruned logs for 20-year-old trees at the Busselton site. Average annual increase in DBHOB from age 17 to 19 has been used to estimate DBHOB at 20 years. The diameter of the pruned log at its mid-point has been estimated from the DBHOB, assuming taper is 1 mm per 100 mm of log length. Mean volume of pruned logs has been calculated using mean mid-log diameter and mean length of pruned log.

Table 5. Estimated mean diameter (DHBOB), mid-log diameter, and length and volume of pruned log for 20-year-old *E. globulus*, *E. diversicolor* and *Corymbia maculata* grown at 150 trees per hectare near Busselton.

Species	Estimated diameter increment year 12 to 20 (DBHOB) (cm/yr)	Mean diameter at 20 years (DBHOB) (cm)	Mean diameter at mid-log (cm)	Mean length of pruned log (m)	Mean volume of pruned log (m ³ /tree)
<i>Eucalyptus globulus</i>	2.4	60.3	57.6	8.0	2.1
<i>E. diversicolor</i>	1.8	54.7	52.7	6.5	1.4
<i>E. maculata</i>	1.3	39.8	38.1	6.0	0.68

The data shows that the mean volume of a pruned *E. globulus* sawlog is estimated to be 2.1 m³ per tree by 20 years of age. The mean volume of pruned *E. diversicolor* and *C. maculata* logs is estimated to be 1.4 and 0.68 m³ per tree respectively.

The data shows that by 20 years the mean diameter (DBHOB) of an *E. globulus* sawlog is estimated to be 60 cm. The mean diameter of *E. diversicolor* and *C. maculata* logs by 20 years is estimated to be 54 cm and 40 cm respectively. This indicates that *C. maculata* would need to be grown for a further 8 years to reach the desired log diameter of 50 cm. The seedlings used in this trial were from unimproved stock and therefore growth rates may be conservative.

Growth rate at 1200 mm annual rainfall

A 10-year-old study site near Middlesex provides data on growth rates for wide-spaced *E. saligna*, *E. globulus* and *E. viminalis* in a high rainfall area (1200 mm per year average). The soil type is a deep karri loam. The stand was planted at a density of 333 trees per hectare and the poorer formed trees were culled leaving the best 125 trees per hectare by 6 years of age. These were pruned to 8 to 10 metres by 6 years. Growth data is presented in Table 6.

Table 6. Mean diameter (DBHOB), height, basal volume per tree and volume per hectare for 10-year-old *E. viminalis*, *E. globulus* and *E. saligna*, and grown at 125 trees per hectare near Middlesex. Data is for the best provenance

Species	Diameter (cm)	Height (m)	Basal area (m ² /ha)	Total vol/tree (m ³ /tree)	Total vol/ha (m ³ /ha)
<i>Eucalyptus viminalis</i>	45.1	34.8	20.5	1.84	230
<i>E. globulus</i>	43.3	30.6	18.9	1.5	187
<i>E. saligna</i>	41	28.6	16.8	1.26	157

Average annual increase in diameter (DBHOB) from age 8 to 10 years has been used to estimate diameter and volume of pruned logs at 20 years for each species (see Table 7). The diameter of the pruned log at its mid-point has been estimated from the diameter, assuming taper is 1 mm per 100 mm of log length. Mean volume of pruned log has been calculated using mean mid-log diameter and mean length of pruned log.

Table 7. Estimated mean diameter (DHBOB), mid-log diameter, and length and volume of pruned log for 20-year-old *E. saligna*, *E. globulus* and *E. viminalis* grown at 125 trees per hectare near Middlesex.

Species	Estimated diameter increment year 12 to 20 (DBHOB) (cm/yr)	Mean diameter at 20 years (DBHOB) (cm)	Mean diameter at mid-log (cm)	Mean length of pruned log (m)	Mean volume of pruned log (m ³ /tree)
<i>Eucalyptus viminalis</i>	3.0	75.1	72	9	3.6
<i>E. saligna</i>	2.5	66	62	9	2.7
<i>E. globulus</i>	2.4	67.3	64	9	2.9

The data shows that the mean diameter of a 20-year-old pruned *E. viminalis* sawlog is estimated to be 75 cm, with a mean volume of 3.6 m³. The mean diameter of *E. saligna* and *E. globulus* logs by 20 years is estimated to be 66 cm and 67 cm respectively. This indicates that all 3 species will reach the target log diameter of 50 cm in less than 20 years.

Tree Management

There are various methods of managing eucalypts for sawlogs and the method can be tailored to suit the situation. If the grower wants to produce logs in as short a time as possible then it is recommended that the stand be thinned heavily at a young age to give the best 150 or so trees per hectare plenty of room to grow. At wide-spacing, growth of individual trees will be rapid but the total volume of wood produced per hectare will be less than if grown at the density of a conventional plantation (Reid and Stephen, 1999).

To produce high quality sawlogs at wide-spacing trees must be pruned (AGWEST/CALM, 1998 and Reid and Stephen 1999). This is because branches become large on wide-spaced trees and unless pruning is carried out, logs will have large knots, be of low quality and will probably be unsaleable.

As a rule most growers are interested in obtaining returns as early as possible. The wide-spaced approach is therefore likely to be commonly used. Two examples of wide-spaced regimes are outlined in Tables 8 and 9. The regime described in Table 8 involves planting as few seedlings per hectare as possible to keep costs down and to enable grazing to be carried out.

Table 8. An example of a wide-spaced regime of eucalypts for sawlogs. As few seedlings as possible are planted to minimize costs and to maximise grazing.

Age (yrs)	Operation
0	Plant 500 seedlings per ha (eg. 2 m between trees in rows 10 m apart)
4	Cull to 250 trees per ha (ie. cull 1 tree out of 2) Prune to ½ height (about 2.5m)
5	Culled to 125 trees per ha (ie. cull 1 tree out of 2) Prune to ½ height (about 4.5m)
6	Prune the 125 sawlog trees per hectare to ½ height (about 6.5m)
20	Harvest trees

The regime outlined in Table 9 involves planting a greater number of seedlings per hectare. This approach provides additional choice in selecting crop trees if poor tree form occurs due either to genetic characteristics or to damage from environmental factors such as parrots.

The risk of damage to young trees from “28 parrots” is high in many districts. Parrot control methods are being developed (Morgan and McNee, 1999) but until growers are confident they can control damage, planting extra seedlings ensures there is plenty of choice in choosing crop trees. This regime is also appropriate where there is no intention to graze, such as in narrow belts.

Table 9. Example No. 2 of a wide-spaced regime of eucalypts for sawlogs. To provide adequate choice in selecting sawlog trees, seedlings are planted at a density similar to that of a conventional plantation.

Age (yrs)	Operation
0	Plant 1000 seedlings per ha (eg. 2 m between trees in rows 5 m apart)
4	Cull to 250 trees per ha (ie. cull 3 tree out of 4) Prune to ½ height (about 2.5m)
5	Culled to 125 trees per ha (ie. cull 1 tree out of 2) Prune to ½ height (about 4.5m)
6	Prune the 125 sawlog trees per hectare to ½ height (about 6.5m)
20	Harvest trees

The details of management vary depending on grower's objectives, growth rate and species. For example, at slow growth rates trees can be pruned later and at high growth rates it may be an advantage to grow more than 125 trees per hectare.

It should be noted that planting layouts and management regimes are flexible. The optimum layout is likely to be a compromise to meet various objectives of the landowner; eg. maintaining income from agricultural activities, lowering water-tables, providing shelter and enhancing aesthetic values. However, what-ever the layout, wide-spaced regimes can be used for them all.

Costs

Costs vary greatly depending on the type of management regime adopted (eg. dense or wide-spaced stands) and the equipment, skills and methods used to tend the trees. For the regime described in Table 8, the total of all establishment and management costs ranges from \$1073 to \$1290 per hectare (see Table 10). The average cost is based on contract rates for undertaking the work. Some costs (marked with "+"), such as planning, rabbit control and heaping debris, may not be incurred. Thus a range of possible costs is shown. If all the establishment and management costs are allocated to the best 125 trees per hectare the cost per sawlog tree is about \$10.

Table 10. Site preparation, establishment and management costs associated with growing eucalypts for sawlogs under the wide-spaced approach outlined in Table 8.

Age (yrs)	Operation	Average Cost (\$/ha)
-1	Planning	20 ⁺
	Fencing	67 ⁺
	Rabbit control	10 ⁺
	Ripping and mounding	75
	Sub-total	75-172
0	Weed control	50
	Seedling cost (\$0.30/seedling)	150
	Planting	80 ⁺
	Insect monitoring and control	30
	Parrot control	20
Sub-total	250-330	
1	Parrot control	10
	Sub-total	10
2	Parrot control	10
	Sub-total	10
4	1 st culling (from 500 to 250 trees/ha)	100
	1 st pruning (250 trees/ha @ \$0.60 each)	150
	Coppice control	20
	Heaping debris	15 ⁺
Sub-total	270-285	
5	2 nd culling (from 250 to 125 trees/ha)	56
	2 nd pruning (125 trees/ha @ \$1.50 each)	187
	Coppice control	15
	Heaping debris	20 ⁺
Sub-total	258-278	
6	3 rd pruning (125 trees/ha @ \$1.60 each)	200
	Heaping debris	5 ⁺
	Sub-total	200-205
	Total	\$1,073 to \$1,290

Note:

1. Costs marked with "+" may not be incurred in all situations. A range in costs is therefore shown.
2. The regime outlined in Table 9 would have extra costs associated with the additional seedlings.

Returns from wood

Returns from wood vary greatly depending on growth rate and therefore the size of the sawlog at harvest. For example, growth data for *E. saligna* near Dinninup (550 mm annual rainfall) indicates that the average volume of sawlog is likely to be 1.2 m³ per tree by 20 years, whereas the volume of *E. saligna* sawlogs at Middlesex (1200 mm annual rainfall) is expected to be 2.7 m³ per tree by the same age.

Returns will also vary depending on whether the grower sells sawlogs (for a stumpage) or adds value and sells the timber, dry, dressed and ready for use.

Returns from sawlogs

The price that can be expected for high-grade pruned eucalypt logs is uncertain but is likely to range between \$45 and \$90 per cubic metre for the standing tree (stumpage) under present economic conditions. The demand for, and the quality of, sawlogs will determine stumpage for sawlogs.

Using the above stumpage figures, returns for *E. saligna* sawlogs at Dinninup would therefore range from \$6,750 to \$13,500 per hectare at 20 years. On a per tree basis the range in returns is \$54 to \$108. The range in returns from sawlogs at the 3 different sites is presented in Table 10.

Table 10. Sawlog yields and returns from 20-year-old *E. saligna* and *E. globulus* growing at 125 trees per hectare on different sites for two stumpage prices.

Site	Species	Sawlog yield (m ³ /tree)	Sawlog yield (m ³ /ha)	Sawlog returns (\$/ha)	
				\$45/m ³ stumpage	\$90/m ³ stumpage
Dinninup (550 mm/yr)	<i>E. saligna</i>	1.2	150	\$6,750	\$13,500
Busselton (900 mm/yr)	<i>E. globulus</i>	2.1	262	\$11,812	\$23,625
Middlesex (1200 mm/yr)	<i>E. globulus</i>	2.9	362	\$16,290	\$32,580
Middlesex (1200 mm/yr)	<i>E. saligna</i>	2.7	337	\$15,187	\$30,375

It may be possible to obtain small additional returns by selling the unpruned portion of the tree for pulpwood. Brennan and Hingston (*in prep.*) found that 40% of total tree volume was pulpwood in 19-year-old *E. saligna* near Darkan (600 mm/year rainfall). Assuming a stumpage of \$8/m³ for pulpwood, this would be an additional return of \$100/ha. Returns from pulpwood would be greater in higher rainfall areas where a greater proportion of the tree is pulpwood and stumpages are higher.

Returns from dry dressed timber

Adding value to sawlogs by sawing, drying and dressing timber can greatly increase returns to the grower. David Jenkins, Bridgetown, increased his net returns ten fold by selling his timber as dry dressed panelling. Colin Campbell, of Appadene Forest Products, Manjimup, processed David's 12-year-old *E. saligna* logs. The costs and returns of this value-adding exercise are set out in Table 11 below (David Jenkins and Colin Campbell, *pers. comm.*).

Table 11. Volumes, recoveries, returns and costs of processing twenty 12-year-old *E. saligna* logs grown by David Jenkins and processed by Colin Campbell.

	Parameter	Value
Volumes & recoveries	• Total volume of the 20 logs ("in the round")	4.7 m ³
	• Total volume of green sawn timber (510 pieces @ 100 mm x 18 mm x 2650 mm boards)	2.43 m ³
	• Recovery of green sawn timber	51.7%
	• Volume of dry dressed timber (500 pieces @ 80 mm x 10 mm x 2650 mm panelling)	1.06 m ³
	• Recovery of dry dressed timber	22.5%
	• Volume of dry dressed timber after removing 10% down-grade (450 pieces at 80 mm x 10 mm x 2650 mm panelling)	0.954 m ³
	• Recovery of dry dressed timber after removing 10% down-grade	20.3%
Returns	• Area of dry dressed panelling (450 pieces @ 80 mm x 10 mm x 2650 mm)	95.4 m ²
	• Value of dry dressed panelling (95.4 m ² x \$40/m ²)	\$3816
	Total returns	\$3816
Costs	• Falling, extracting and cartage (4.7 m ³ x \$24/m ³)	\$112.80
	• Milling costs including strip stacking (2.43 m ³ x \$300/m ³)	\$729
	• Dipping and drying costs (2.43 m ³ x \$200/m ³)	\$486
	• Machining costs (\$0.50/lineal meter x 1325 lineal meters)	\$662.50
	Total costs	\$1990.30
Net returns	• Total returns minus total costs for 4.7 m ³ of sawlog (\$3816 - \$1990.30)	\$1825.70
	• Net return per m³ of log (\$1825.70 divided by 4.7 m ³)	\$388/m³

The price paid for sawlogs (stumpage) was assumed to be \$35/m³, considering the young age and small size of the logs. The net returns for dry dressed panelling, converted to net return per m³ of log, is \$388/m³. This is more than a 10-fold increase compared with returns for sawlogs.

Economics

The economics of growing *E. saligna* for sawlogs has been assessed using data from the study site at Dinninup (McElwee *et al.*, *in prep.*). The assessment included returns from grazing which can be substantial during the first half of the 20 year growing cycle if trees are grown at wide-spacing. The assessment showed that net present value[†] (NPV) of the project was \$521/ha, assuming that stumpage was \$45/m³, total costs were \$1290/ha and discount rate was 7%. The annuity equivalent* for the combined returns from wood and grazing was \$118/ha/year, compared with \$65/ha/year for grazing alone. Profitability would be greater in areas with higher rainfall where growth rates are higher.

The assessment also showed that profitability was markedly sensitive to sawlog stumpage. A modest increase in stumpage from \$45/m³ to \$60/m³ increased annuity equivalent from \$118/ha/year to \$168/ha/year.

Trees may provide additional benefits to the farm beyond returns from wood and grazing. For example, trees can lower water-tables thereby helping to combat salination. Trees can also provide shelter for stock and crops and control wind erosion. These benefits are likely to impact positively on farm profitability and sustainability, particularly in the long term and may cause some farmers to evaluate the value of agroforestry in ways other than conventional economics.

Additional economic assessments using data presented in this paper are being documented in a separate paper by McElwee *et al.* (*in prep.*).

Milling and timber quality

Mill studies of Tasmanian bluegum sawlogs by CALM's Timber Technology Centre show that it is feasible to mill and season timber from pruned, fast-grown eucalypts. Moore *et al.* (1996) reported the results of milling 13-year-old Tasmanian bluegum grown near Busselton. Mean log diameter was 33 cm and total recovery of green sawn timber was 34.7 per cent. The percentages of appearance grade for 25 mm and 38 mm boards were 63 per cent and 60 per cent respectively.

Brennan and Hingston (*in prep.*) reported recoveries and grades for 17-year-old Tasmanian bluegum logs from the same site. Log diameter (small end diameter under bark – SEDUB) ranged from 34.2 to 51.8 cm. Logs were cut to 2.5 m length and sawn on site into 25, 38 and 50 mm thick flitches using a back-sawing pattern with a "Woodmizer" portable bandsaw. Flitches were re-sawn with a "Jonsereds" bandsaw. Mean recovery of green sawn timber was 48.8 per cent.

The strip-stacked timber was dried in solar-assisted kilns using drying schedules developed for marri (*Eucalyptus calophylla*). Some of the 50 mm boards showed signs of cell collapse, which was recovered by re-conditioning the boards with steaming treatment. The overall recovery into appearance grade products, was 30 per cent based on log volume and 84 per cent based on dry-dressed volume (Brennan and Hingston, *in prep.*).

[†] **Net present value** is defined as "the difference between revenues and costs, when these are discounted to present values at a specified rate."

* **Annuity equivalent** is defined as "the annual payment that would give the same NPV as the agroforestry project, at the specified discount rate."

As mentioned previously, Colin Campbell of Appadene Forest Products, Manjimup, has also milled young Tasmanian and Sydney bluegum sawlogs. The 12-year-old logs were grown by David Jenkins, Bridgetown and had mid-log diameters of 33 cm. They were milled with a "Woodmizer" bandsaw, using a back-sawing cutting pattern and rotating the logs to minimise the effects of growth stresses. The recovery of green sawn timber was 51.7 per cent of the log volume. Approximately 90 per cent of the timber produced was appearance grade (David Jenkins, *pers. comm.*). Colin Campbell considers that providing logs are at least 450 mm in diameter (preferably 60 cm +) it is feasible to mill and season young bluegums.

Portable bandsaws, such as the Woodmizer, are likely to have an important role in the early stages of the industry before large-scale processing facilities have been established. They provide a means for the pioneer growers to process and sell their wood.

Sawn timber produced from bluegum sawlogs has been successfully put to use in range of ways, including book-shelves, door panels and kitchen bench-tops.

Current challenges

The evidence to date suggests that it should be possible to develop an industry based on eucalypt sawlogs. However there are some significant challenges. Two stand out in particular. Firstly there is a need to develop products and to establish markets. Suitable logs are available for this development work. It is important that potential timber processors be involved in this aspect of development.

The second major challenge is to build a resource of sawlogs to attract investment in processing facilities. There will be a reluctance to invest, until industry can see that there is a timber resource of suitable size and quality. If growers could work together to market their resource as a whole, the development of an industry would be assisted. Perhaps there is a role for a timber cooperative to amalgamate the many small plantings into one large resource.

Other aspects that require development, include:

- Assessing the economics of sawlog production in greater detail.
- Carrying out further milling and seasoning studies.
- Collecting data on wood yields for a wider range of sites and species, including slower growing species, such as *Eucalyptus maculata* and *E. cladocalyx*, in the 400 to 600 mm annual rainfall zone.
- Identifying superior provenances of target species and making these available for nursery growers.
- Investigating the price that industry might pay for high-grade hardwood sawlogs.
- Developing funding mechanisms such as joint venture schemes to assist growers with this long term crop.
- Providing growers with a farm forestry service, initially a government pilot scheme with private industry then taking over, that assists in planning, establishment, management, monitoring and harvesting.

The opportunity exists for potential growers, buyers, processors and investors to take up these challenges together to help develop eucalypts for sawlogs as a viable farm forestry option for farmers.

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