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# Rowan's story

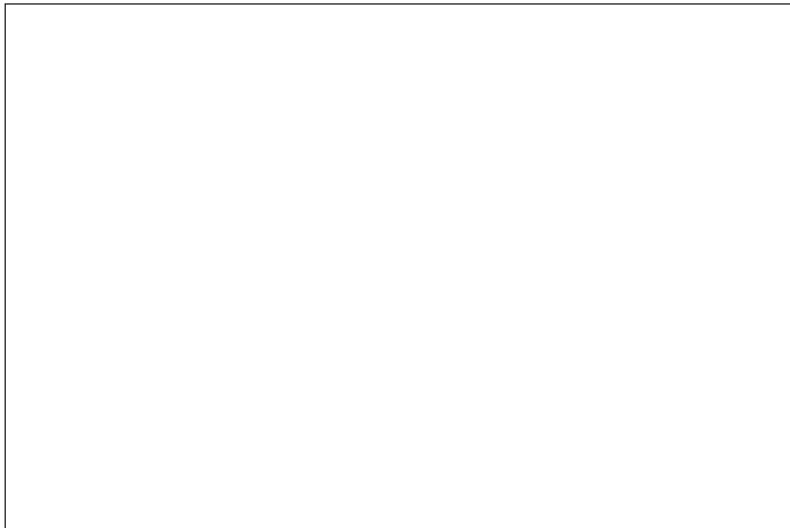
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## Bambra Agroforestry Farm

Bambra Agroforestry Farm is our private attempt at demonstrating how multipurpose forests can be integrated into a farming landscape. More than 40 commercial timber species have been incorporated into plantings for land degradation control, shelter, fire protection, shade, wildlife habitat and beautification. Set amongst an interlocking network of tall clean eucalypts with an understorey of Blackwood are a series of "rooms" that form an outdoor classroom. Since the first trees were planted in 1987 more than 4000 visitors from across Australia and overseas have taken our guided tour around the farm and witnessed demonstrations and debates about farm forestry.

The farm is nestled in a valley in the foothills of the Otway Ranges of southwest Victoria. The rainfall is approximately 800mm/yr. The indigenous vegetation along the valley floor was probably a tall (approximately 30m) forest of Manna Gum (*E. viminalis*) with Blackwood (*Acacia melanoxylon*). In addition to Manna Gum, there are remnant Swamp Gum (*E. ovata*), Messmate (*E. obliqua*) and Peppermint (*E. radiata*) on the slopes and elevated flats.

One of the most controversial farm forestry designs on the farm is the multipurpose buffer strip we planted along the eroded creek. Tall pruned eucalypts and Blackwoods now line the banks sheltering an understorey of native shrubs.



In 1987 the unfenced creek was actively eroding.

## THE FARMER'S FOREST



Eucalypts and blackwoods planted on the banks.



Rowan high pruning shining gum.



By age six the creek planting was providing good shelter, erosion control and an effective wildlife habitat.

When we purchased the farm, the fertile soils along the creek were actively eroding, fouled by stock and denuded of native vegetation. Willows were beginning to take root from trees upstream. We applied for, and received, land protection funding for fencing and tree planting - although there was concern about my open ambition to incorporate non-indigenous (although native) species and manage them for high value timber. Electric fencing was used to allow the planting to follow the meandering creek, with the width of the fence depending on the risk of bank erosion and rate of runoff.

The aim of the project was to produce quality timber within the constraints set by the primary needs of soil protection, enhanced water quality, wildlife habitat and landscape aesthetics. The species selected included local native understorey shrubs, regional selections of Blackwood (*A. melanoxylon*) for cabinet timber, and a number of eucalypts (primarily *E. regnans* and *E. globulus*) for sawlogs. Site preparation involved a spot application of herbicides (Glyphosate and Simazine) - there was no soil disturbance or watering and no fertilizer application. The first trees were planted by hand in spring 1987. The buffer planting was later interplanted with Shining Gum (*E. nitens*) seedlings in the spring of 1988, increasing the stocking to approximately 1000 eucalypt stems per hectare inside the fenced strip.

Over the subsequent years the better performing trees were pruned each winter using hand tools and ladders. All branches were removed from the bole of selected trees up to a stem diameter of about 10cm. I try to prune to a height of just over 6.5m to allow for a butt log of 6.1m although in practice pruned heights vary from about 5.5m to 7.5m. Poorly formed trees were thinned to waste.

One of the advantages of planting a range of species in a mixture is that you are able to thin down to the best. Although the Shining Gum were a year younger than the other eucalypts it was soon clear they would outgrow the Mountain Ash varieties and had better form and lighter branches than Blue Gum. Research by CSIRO done after I had planted the belt suggested that young *E. regnans* was unlikely to produce clear grade timber even when pruned due to excessive kino (red sap). From a starting density of around 1000 eucalypts per hectare I have thinned down to less than 250. As a result, straight pruned Shining Gums now dominate the belt.

Sheep have been totally excluded from the riparian belt except for some opportunistic summer grazing for fire and weed control or the occasional rogues. The planted and naturally regenerating understorey is encouraged while any willows causing concern are controlled using a stem injection of herbicide. All debris from thinning and pruning are left to decompose on site.

If timber production from a multipurpose planting like this is to be feasible the quality of each tree must be high enough to ensure that it is viable to harvest and market in small lots. With this in mind our aim was always to produce high pruned sawlogs of about 60cm in diameter. Tree diameter growth has been regularly monitored using 7 circular plots located along the riparian belt. Although the better performing Shining Gum had reached diameters of over 40cm at breast height by age 10 years, annual growth data collected from the plot measurements suggested that diameter increments were declining due to increasing competition. The forest would clearly need further thinning so that the target tree size could be achieved within 20 years.

Rather than thin to waste again, we chose to undertake our first

experimental harvest and sawing trial of Shining Gum in cooperation with Russell Washusen of the CSIRO Division of Forest Products in Melbourne.

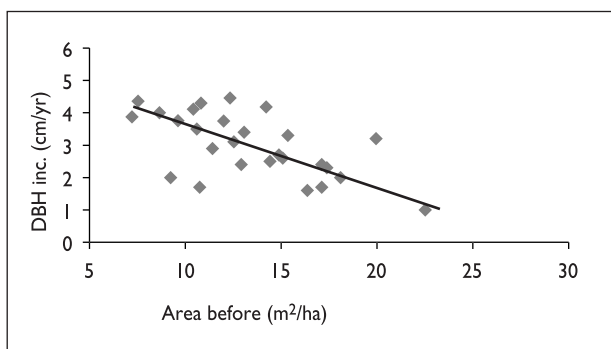


FIG 1. Relationship between plot Basal Area and subsequent annual Diameter Increment of selected plot trees between 1995 and 1998 showing how growth declines with competition.  $R^2 = 0.38$ .

## Harvest '99

Nine Shining Gum trees were selected for harvesting on the basis of form, size and proximity to other trees. The aim was to select individuals that were over 35cm in diameter at breast height (DBH), of good form, pruned to at least 5m, and close enough to other trees of good form to warrant thinning to reduce competition. The trees were all growing on alluvial soil within 10m of the creek bank. In most cases, harvesting simply required dropping of the electric wires from the fence posts and hand felling out into the adjacent cleared paddock.

Once on the ground, the full tree length was measured along with the residual stump to give a total tree height. The pruned section of the tree was then separated from the top and cut into two shorter logs (except for tree 2) and the log ends sealed with a proprietary brand sealer to reduce drying rates. Seed was collected from the canopies for sale to nurseries and other farmers.

The pruned logs were transported to a log pile using our farm tractor fitted with a front-end loader. The logs were stored under a water spray for two weeks before loading onto a tray truck for transporting to the mill at Creswick (approximately 100km) where they were watered for another 4 weeks prior to debarking and milling.

The logs were sawn using a conventional backsawing strategy before resawing to the final product dimensions (mostly 38mm by 100mm) on a conventional saw-bench. Russell immediately visually graded the freshly sawn timber using the CSIRO Appearance Grading Criteria. The timber with grading stickers was stacked out for air drying in a shed using a fan to force air through the stack.

A year later the timber was kiln-dried, reconditioned and dressed. Any boards graded as "select" or better when green were visually re-graded to assess the extent of degrade due to drying.

## Tree and log volumes

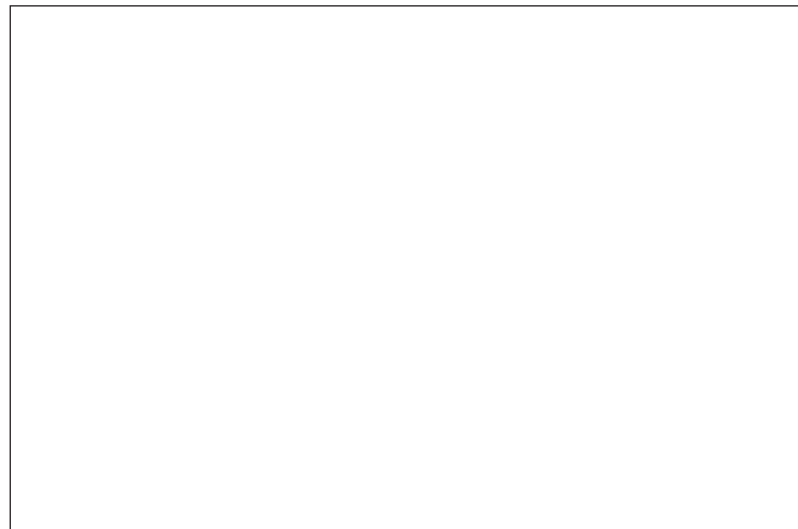
The standing volumes of the nine trees are shown in Table 1. The total volume was estimated at just under 10m<sup>3</sup> with 0.5m<sup>3</sup> of this remaining in the stump. Given that the over-bark volume of the pruned logs amounted to an



Selected trees were felled out into the adjacent paddock.

Tree No	Diameter at Breast Height (DBH) (cm)	Tree Height (m)	Pruned height (m)	Overbark volume of standing trees (m <sup>3</sup> )	Overbark sawlog volume (m <sup>3</sup> )
1	41.0	21.1	6.4	1.12	0.67
2	38.0	21.4	5.4	0.98	0.62
3	40.8	25.0	7.0	1.13	0.72
4	36.5	25.4	6.3	1.21	0.65
5	42.6	22.7	6.7	1.23	0.78
6	38.1	20.8	6.3	1.06	0.63
7	37.5	22.3	6.4	0.99	0.59
8	38.9	23.2	6.8	1.11	0.63
9	40.0	22.4	6.5	1.14	0.69
<b>MEAN</b>	<b>39.3</b>	<b>22.7</b>	<b>6.4</b>	<b>1.11</b>	<b>0.67</b>
<b>TOTAL</b>				<b>9.97</b>	<b>5.99</b>

estimated 6.0m<sup>3</sup> the pruned log volume represented more than 60% of the total volume on timber on the ground despite representing only 26% of the total tree height. The stump and unpruned section were left on site. Following debarking and log preparation a total of 4.7m<sup>3</sup> of sawlog was available for milling. Each tree, except tree 2 which was left as a 5m log, provided two pruned log sections of about 3m each.



Milling of the ten year old pruned logs produced timber clear of knots.

## Recovery of green timber

The CSIRO Appearance Grading Criteria has 9 grades suitable for different applications in the production of appearance products. The three highest grades (Polishing, Moulding and Select) are considered the most valuable appearance products.

These products are almost defect free on the graded faces and edges and are grouped as "select or better" in the analysis below. To achieve a select grade the product needed to be a minimum of 2.4 m in length and free of defect on one face and two edges. As the aim of pruning was to obtain high quality products, the recovery of products of select grade or better was considered

TABLE 2. The green sawn timber recoveries (Rec.) of Select and better (S&B) sawn timber grades

Log	Log Vol.	Total Sawn Rec.	Vol. S&B	Rec. S&B	% of Boards S&B
Bottom log	(m <sup>3</sup> )	(%)	(m <sup>3</sup> )	(%)	(%)
1A	0.31	42	0.10	32	77
3A	0.37	32	0.09	23	74
4A	0.32	42	0.04	12	29
5A	0.35	45	0.09	24	53
6A	0.29	38	0.07	23	60
7A	0.33	35	0.07	21	60
8A	0.25	48	0.08	33	70
9A	0.30	43	0.10	31	73
<b>TOTAL</b>	<b>2.52</b>		<b>.62</b>		
<b>MEAN</b>	<b>0.32</b>	<b>41</b>		<b>25</b>	<b>62</b>
Top log					
1B	0.23	44	0.02	10	23
3B	0.23	43	0.02	10	24
4B	0.24	36	0.01	5	14
5B	0.23	43	0.04	17	40
6B	0.19	48	0.02	8	17
7B	0.19	40	0.03	15	38
8B	0.18	36	0.02	11	29
9B	0.21	39	0.01	5	12
<b>TOTAL</b>	<b>1.71</b>		<b>0.17</b>		
<b>MEAN</b>	<b>0.21</b>	<b>41</b>		<b>10</b>	<b>25</b>
Tree 2	0.43	40	0.06	14	36
<b>TOTAL</b>	<b>4.66</b>		<b>0.86</b>		
<b>MEAN</b>		<b>41</b>		<b>18</b>	<b>44</b>

to be the critical. Table 2 gives the recovery of all green products and the recovery of select grade and better for each log.

The average sawn recovery was 41% for both the bottom and top logs. Sixty-two percent of the boards sawn from the bottom logs were graded green as select or better representing 25% of the saw log volume. By comparison, only 25% of the boards from the smaller diameter top logs were of high grade representing just 10% of log volume.

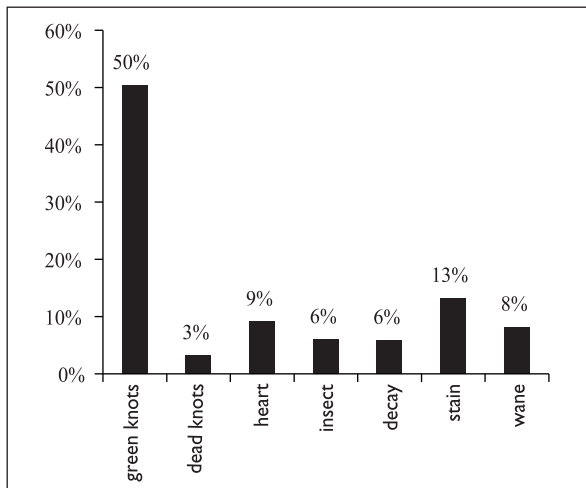


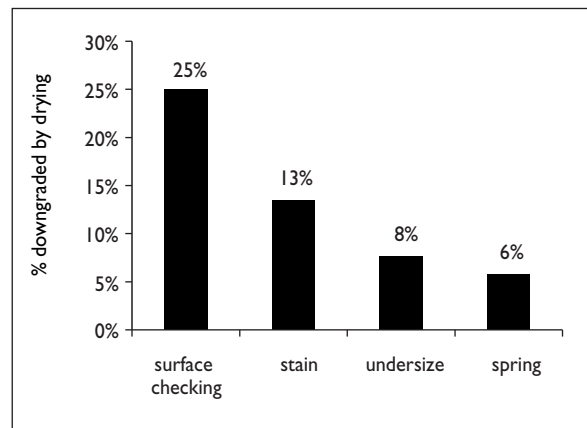
FIG 2. The causes of degrade of green boards.

The major grade-limiting defect, affecting 50% of the boards, was green knots (Figure 2). Since the logs were pruned the green knots were often associated with pruned stubs and mostly located on the back face of boards from the inner heartwood.

Decay was evident in some of the pruning stubs but was in itself only a minor (6%) grade-limiting defect. Decay was also associated with the damage caused by wood moths, in which case the decay was often located in the clearwood zone. Stain was noted as a grade-limiting defect (13%) and possibly an indication that decay might have become more prevalent in future years had the trees not been harvested.

### Drying degrade

All 38mm thick boards assessed as select grade or better when green were re-graded following drying and dressing. In all fifty-two 38mm-thick boards were regraded and of these 25 (or 48%) remained as select grade or better. The main drying related causes of downgrading were surface checking (25%), stain (13%), under sizing (8%) and spring (6%) (Figure 3).



**FIG 3.**  
The causes of drying degrade in a sample of 52, 38mm thick boards.

While pruning may be effective in increasing the recovery of high quality green products, this level of drying degrade would need to be reduced to maximise the return from pruning. Quartersawing may be a means of reducing drying degrade provided the trees are grown to a larger diameter. More sophisticated drying strategies involving careful early drying may also be effective in reducing, or even eliminating, surface checking.

### Financial considerations

The viability of timber production from riparian buffer strips will largely depend on the value of the individual standing trees. While the trees are performing a useful function, harvesting for timber is unlikely unless the farmer is assured of a reasonable return (such as \$50 per pruned tree).

The highest value sawn products, as a group, are the dried timbers of select grade and better. The production of dried undressed timber from relatively young eucalypt plantations might expect to attract a wholesale price of around \$1000/m<sup>3</sup>. Lesser grades might sell for half this price.

The nine trees milled in the trial produced a total of 1.90m<sup>3</sup> of sawn timber of which 0.86m<sup>3</sup> (45%) was graded (when green) as select grade or

better with 0.46m<sup>3</sup> (24%) graded as "standard", "utility" or "cover" grade (still suitable for appearance use or as structural components in furniture). The remaining 0.58m<sup>3</sup> (31%) was "case" grade or worse and might end up as woodchips at a value of around \$10/m<sup>3</sup>. Sawn recovery was 41% suggesting that at least 50% of the log volume (a total of 2.3m<sup>3</sup>) would also be chipped bringing the total volume of woodchips to 2.9m<sup>3</sup>.

Disregarding, for the moment, the degrade associated with drying, the 0.86m<sup>3</sup> of high grade timber produced from the 9 trees might be worth in the order of \$860 (at \$1000/m<sup>3</sup>), the lower grade timber worth \$230 (at \$500/m<sup>3</sup>) and the residual products \$29 (at \$10/m<sup>3</sup>). This suggests that a total product value might be in the order of \$1120.

If it is assumed that the total harvesting and transporting costs for 5m<sup>3</sup> of sawlog is \$250 (or \$50/m<sup>3</sup> of log) and that the processing costs (including drying) for 2m<sup>3</sup> of sawn timber is \$934 (\$237/m<sup>3</sup> of sawn timber for milling and \$230/m<sup>3</sup> for drying) then the total harvesting and processing costs come to \$1184. This suggests there is little value in harvesting logs of this size, even if the drying degrade could be avoided.

To be viable, under these assumptions, the recovery of appearance grade timber would need to represent more than 20% of log volume or 50% of the sawn product. Because the main grade-limiting factor was green knots, the recovery of appearance grade products from pruned trees is expected to increase with log diameter. Over the range of logs milled in this trial, the recovery of select or better timber did increase with diameter. Figure 4 shows the real recovery of select and better timber per metre of log length against log diameter.

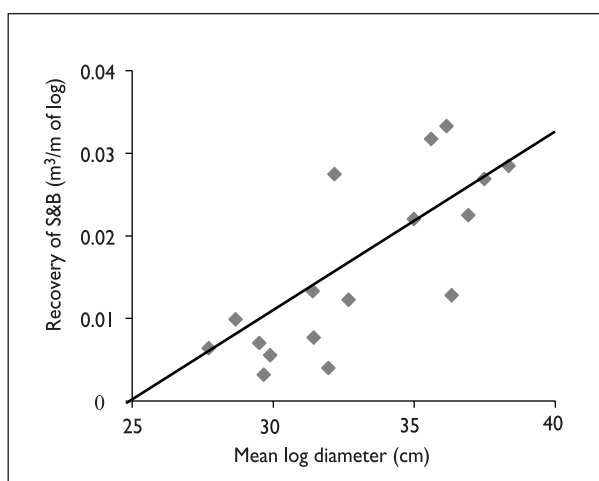
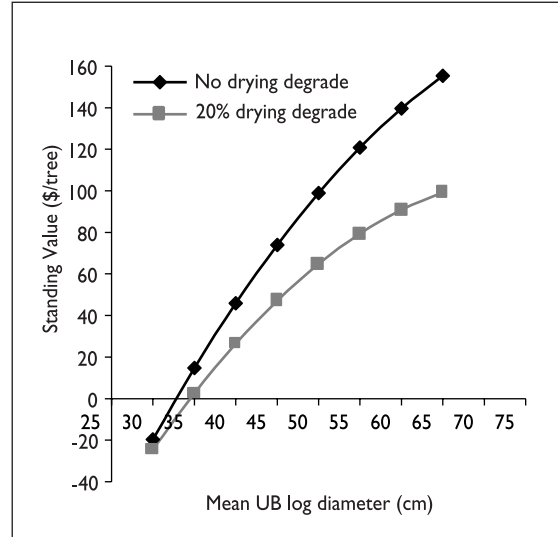


FIG 4. Volume of select grade or better boards per meter of log length from logs of different average underbark diameters.  $Y=0.0024x-0.064$ ,  $R^2=0.61$ .

If the same trees were grown to a diameter of 65cm DBH the 6.5m pruned section might provide two logs with a total underbark volume of 1.45m<sup>3</sup> (assuming a mean diameter underbark of 55cm and length of 6.1m). From the regression shown in Figure 4 this would provide 0.068m<sup>3</sup> of select and better timber per meter of log or 0.415m<sup>3</sup> in total (28% of log volume). At \$1000/m<sup>3</sup> this would represent \$268 of value. Given a sawn timber recovery of 40% and a balance between lower grade and waste there might also be \$43.50 worth of low grade sawn timber and a total of \$8.85 of chip. This suggests a total product value of 467 for a total cost of \$343 (\$72.50

harvesting and \$270 milling and drying): a return to the grower of \$123.64 for the tree or around \$85/m<sup>3</sup> of standing sawlog.

If drying problems downgraded 20% of the better grades the product value per tree would drop to \$403.20 leaving \$60/tree for the grower. Based on similar assumptions, Figure 5 shows the influence of mean log diameter and drying degrade on the predicted standing value of a 6.1m pruned log.



**FIG 5.** Predicted standing value per tree against mean underbark log diameter assuming a 40% sawn timber recovery and 6.1m log length.

In a riparian buffer strip established and maintained for multiple values the only additional costs associated with the production of high value sawlogs will be pruning and thinning. I have estimated that the time required to produce one final crop tree from a group of four is less than 30 minutes, or around \$10 depending on how you value labour.

Wider tree spacings also increase the return on pruning costs due to increased diameter increments. Assuming a total cost of pruning and thinning of \$10 per harvested tree a return of, say, \$80/tree in 20 years represents an Internal Rate of Return of over 20%.

## Confidence is up

These trees were the first pruned eucalypt logs milled by CSIRO as part of a sawing trial. Since then Russell Washusen has continued his research and is confident that quartersawing will dramatically reduce the extent of drying degrade in these susceptible species.

This suggests that we should be aiming for a target tree of around 65 or 70cm DBH. Although individual *E. nitens* trees growing on this site have now reached more than 60cm DBH (underbark mean log diameter of approximately 50cm) by age 13 years it may be realistic to expect an average rotation of 20 years on this site.

The real market value of young eucalypt timber will remain uncertain until large volumes are made available. We know the wood density of young eucalypts is 20 or 30 percent lower than that from mature forests. Although this may have a negative bearing on product performance in some markets, initial results suggest that there may also be advantages for cabinetmakers

and joiners who prefer less dense timbers - mature eucalypts are inherently denser than many of the highly valued cabinet species such as Oak, Blackwood or Black Walnut.

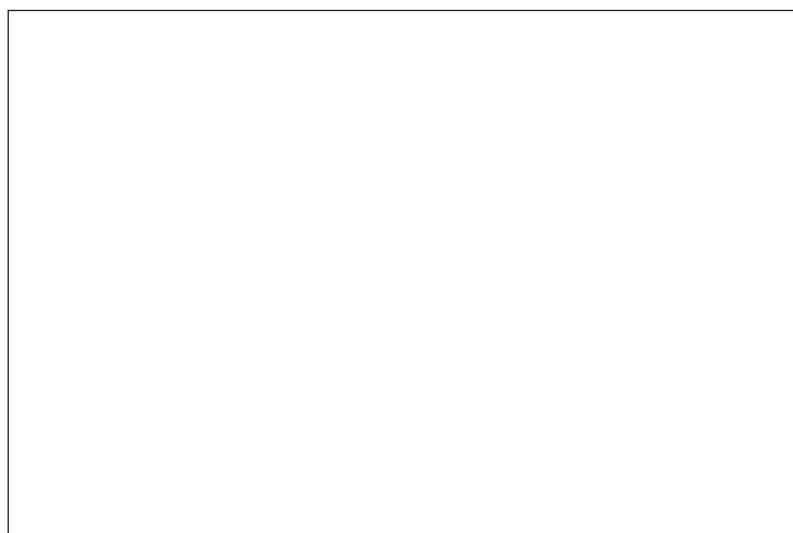
For me, the harvesting and sawing trial reinforced the importance of growing large clean sawlogs. Without pruning and thinning during the early years commercial production could never be considered a viable option. By doing the work I can ensure that the option is always there to harvest the trees should we wish to.

Forestry has added an additional dimension to our farm making it more attractive, challenging and, I hope, more valuable. Most visitors agree that we have increased the farm's capital value and ensured that future generations will not have to wait a full rotation in order to enjoy the full benefits of owning a productive forest. I have also had the satisfaction of growing, harvesting, milling and drying my own timber and making a piece of furniture. Something most foresters never experience.

*I would like to acknowledge the contribution made by Russell Washusen of CSIRO, Josquin Tibbets (Faller), Peter Stephen (Harvesting assistance), BWD Hydraulic Seeding (Cartage), Jim Minster of the Victorian Timber Industry Training Centre (Sawyer), and Phillip Blakemore, Richard Northway and Gary Waugh of CSIRO during the trial.*



Hall table from 10 year old tree.



Changing landscapes: Bamba Agroforestry Farm after 13 years of tree growing.

## THE FARMER'S FOREST

After 13 years the largest shining gums along the creek are over 55cm in diameter