Growth in blue gum forest harvesting and haulage requirements in the Green Triangle region between 2008 and 2020

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Summary

The Green Triangle blue gum industry has a forecast sustainable yield of 3.7 million t y^{-1} that should be realised by 2013. We estimate that the industry will require between 166 and 249 harvest-related machines to achieve this yield, with a total capital value of between \$82 and \$107 million. Haulage needs of the emerging blue gum industry are likely to put significant pressure on Green Triangle roads, in particular at the Port of Portland where the bulk of this wood will be delivered. To handle this harvest we estimate that either 109 semi-trailers or 81 B-double units will be required. Use of larger units will reduce the traffic density but will require 'education' of other road users. The skill levels required by workers using alternative harvesting systems vary; in particular in-forest chipping with debarking at the forest edge is predicted to place the least demand on operator skills. Additional in-forest labour, estimated to be between 246 and 389 workers, will be needed. The greatest demand for training is likely to occur in 2011. This study has identified a clear need for the blue gum industry to undertake significant planning and preparation for harvesting and hauling the resource. This task includes liaison with road providers, development of loading and unloading infrastructure, and provision of operator and driver training. The expansion provides considerable opportunities in many sectors of the forest and related industries.

Keywords: plantations; planning; investment; harvesting; systems; labour; training; skills; transport

Introduction

The 'Green Triangle' region of South Australia and Victoria is the area of land roughly between Portland (Victoria), Millicent (South Australia, SA) and Penola (SA). The area, shown in Figure 1, contains 17% of Australia's plantation estate. The principal plantations in the region are radiata pine managed for solid-wood products and blue gum (*Eucalyptus globulus*) hardwood plantations managed to produce wood chips. The radiata pine industry has been established for over a century and has been relatively stable in area and wood production for many years. Plantations of blue gum were first established in 1988 under a scheme with Kimberley-Clark Australia, but then developed rapidly with the commencement of 'managed investment scheme' operations in 1997. Planning associated with this development involves a complex of government agencies and private companies, but is coordinated by the Green Triangle Regional Plantation Committee (John Kellas, Plantation Coordinator, *pers. comm.*, 2008).

This paper explores the machine and labour needs of the evolving blue gum wood chip industry. In particular, the paper addresses two questions

- given recent plantings, what is the likely yield over time of blue gum plantations?
- what labour force and capital investment in machine infrastructure will be necessary to handle this yield?

Several recent reports have made predictions on the increased wood flow in the Green Triangle. Lloyd (2005) made broad

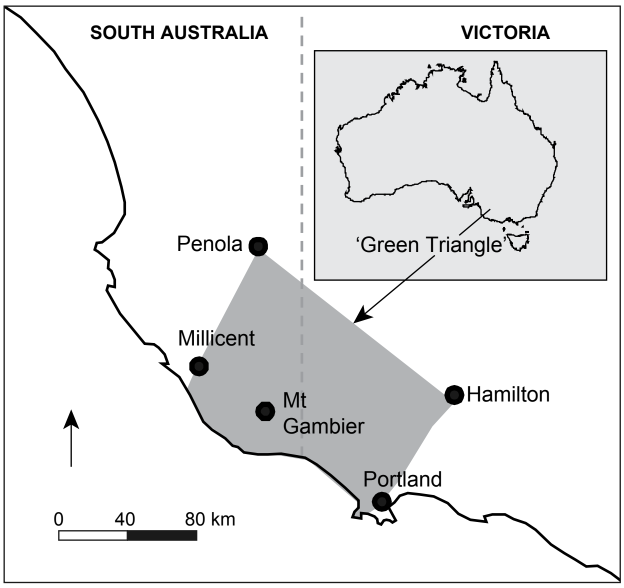

Figure 1. Location of the 'Green Triangle' region in Australia and major places referred to

long-term predictions of sustainable wood production in the region of 5–8 million t y^{-1} (hardwood and softwood) to 2039. The study by the Green Triangle Plantation Committee ('Forestry Industry in the Green Triangle', presentation to Plantation Forestry Seminar, DPI, Hamilton, Victoria, February 2006) indicated an annual harvest of more than 3.7 million t of blue gum wood chips between 2009 and 2014. A submission by the Port of Portland to the Federal House of Representatives in 2005 suggested a range of average annual yields and consequent truck deliveries of between 2.2 and 3.8 million tonnes per annum, to be exported through the Port of Portland[1].

Methods

The basic methodology was one of estimating the annual harvest of blue gum, and then dividing this by the production rate of each potential harvesting system or worker to estimate the number of systems or workers required. The wood flow analysis was based on the existing inventory of blue gum resources, together with estimates of growth and yield derived by growth modelling and data from other consultancies. We found that predicting the blue gum wood flow for the Green Triangle was a complicated task given multiple ownership of the resource, uncertain market destinations and the lack of detailed growth data. To accommodate such complexities, some assumptions have been necessary and are described in the text.

The production rates of various harvesting systems were derived from a variety of industry models, the productivity of past operations, and experience. Again, many assumptions were necessary. A more comprehensive account of the methods and assumptions is given in Lambert and Quill (2006), available on request from author Bren.

[1] Submission by Green Triangle Regional Plantation Committee to the House of Representatives Inquiry into the Integration of Regional Rail and Road Freight Transport and their Interface with Ports, May 2005.

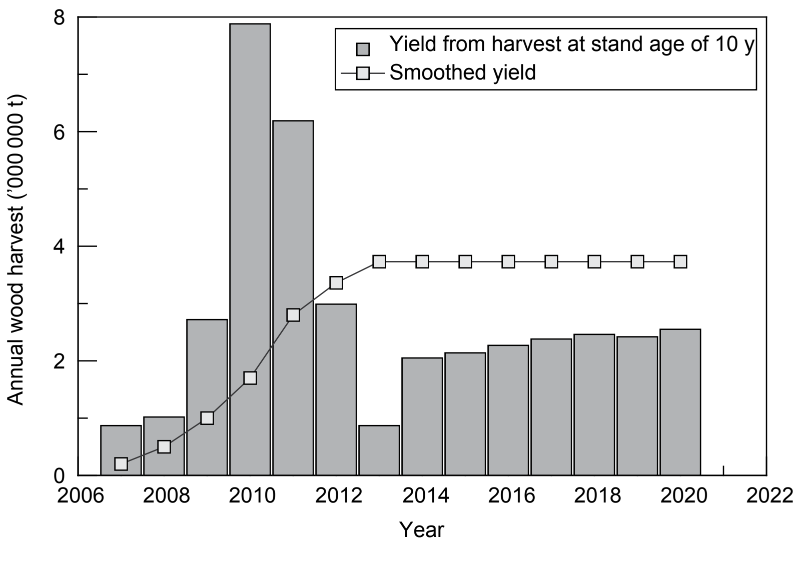

Figure 2. Annual yield of wood if (a) harvested at age 10 y, and (b) with smoothing

Table 1. Assumptions made in deriving the smoothed annual wood flow shown in Figure 2(b) (Source: 'Forsight' Forest Valuation Model, Nick Ping, Poyry Forest Industry, *pers. comm.*, 2006)

Discount rate: 9%
Harvest generally between ages 8 and 12 y
Existing Portland facility can export 500 000 t in 2008, and 1 million t in 2009
New pulpmill in region operational in 2011
New export facilities and domestic markets developed

Results

Figure 2(a) shows the estimated Green Triangle wood flow if it assumed that blue gum is harvested at exactly 10 y of age. It can be seen this would give a very substantial peak in 2010 and 2011 relative to the sustained yield. Using the assumptions of Table 1, a smoothed wood flow projection (Fig. 2b) has been derived by delaying harvesting of some wood. Such a smooth flow may be idealistic as it would require managed investment scheme companies to delay their harvest beyond stand ages set out in their prospectuses, and assumes that the multiplicity of landholders will work together to achieve efficiencies of scale. It is reasonable, however, to expect that market forces and shortages of harvesting capacity will combine to ensure that the yield is significantly smoothed. Recently, commentators have also noted the possible development of markets for biomass energy using chips and for various forms of carbon payments. These are so uncertain, however, that we have not factored such developments into the following estimates.

Harvesting assumptions

Harvesting of blue-gum plantations commenced in the Green Triangle with deliveries of chip to Kimberley Clark in 1999. Initially these operations used single-grip harvesters and forwarders in a cut-to-length operation. More recently these operations have been replaced by in-forest chipping. Table 2 details the operational flow sequence implicit in each case; it can be seen that in-forest chipping does reduce the amount of raw wood handling. To model the productivity of each system for harvesting of plantation blue gum, estimates have been made of the productivity of machines involved in each flow sequence. Table 3 lists the productivity of the two alternative systems. Both harvesting approaches have advantages and disadvantages related to the complexity of the equipment, difficulty of relocating, quality control and material handling. We believe that both systems will co-exist.

To estimate the cost of harvesting the 'JobCost' model of the Logging Industry Research Organisation of New Zealand was used. This suggested that in-forest chipping operations can produce unscreened woodchip into a trailer at a cost per green metric tonne 1% lower than cut-to-length operations can produce unchipped wood.

Table 2. Sequence of operations of two alternative harvesting systems

Harvesting system	Operation	Machine
(a) Cut to length and chipped at mill	Harvesting and debarking	Single-grip harvester
	Extract	Forwarder
	Load	Forwarder or loader
	Haul	Skeletal trailer
	Unload and store	Radial crane or wheeled loader
	Unstack and feed	Radial crane or wheeled loader
	Chip	Static chipper
	Transport	Chip vans (road or rail)
(b) In-forest chipping	Harvesting and debarking	Single-grip harvester or feller-buncher
	Extract	Forwarder or skidder
	Chip and load	Mobile chipper
	Transport	Chip vans

Table 3. Comparison of blue gum harvesting systems

Attribute	Harvesting system			
	Cut to length		In-forest chipping	
	Debarking at stump	Debarking at forest edge	Debarking at stump	Debarking at forest edge
Output (t y^{-1})	60 000	90 000	100 000	90 000
Capital cost($ million)	1.7	2.4	2.9	2.1
Number of machines	4	6	5	4
End product	Chip logs		Unscreened chips	
Operator skill level	High	Medium	High	Medium
Output per operator (t y^{-1})	15 000	15 000	20 000	22 500

Table 4. Total number of machines and capital investment required to process 3.7 million t y^{-1} of blue gum chip. Costs are based on 2007 values.

Attribute	Harvesting system			
	Cut to length		In-forest chipping	
	Debarking at stump	Debarking at forest edge	Debarking at stump	Debarking at forest edge
No. of machines	249	207	187	166
Total cost ($ million)	106	82	106	88

Irrespective of the system or combination of systems used in the Green Triangle, significant capital investment will be required. Table 4 provides an estimate of the number of machines (harvesters, forwarders and chippers) and the capital cost required to produce 3.73 million t of blue gum chip per annum. The investment, by any standard, will be significant. To put this into perspective, a recent survey conducted by the Logging Investigation and Training Association (Email: lita@seol.net.au), based in Mount Gambier, revealed that the Green Triangle pine industry is currently using more than 180 pieces of specialised harvesting machinery. In addition, the pine industry uses 108 truck drivers and about 100 haulage trucks. Thus the size of the regional harvesting industry will effectively double. The existing industry, however, provides a very capable base for the needed expansion.

There exists the possibility of 'new technology' leading to substantial increases in productivity and reductions in cost, but we do not view this as likely within the timeframe of this study. This view is based on the lead time required for such technologies to replace existing machines, the fact that such technologies are not 'in view' at the moment, and that our analysis is based on 'modern' equipment.

Haulage needs

Most logs hauled in the Green Triangle Region are carried on B-double units. Many of these are constructed so that the second trailer is carried on the back of the first trailer when empty, and then folded down for loading and haulage of material. This

Table 5. Transport requirements for 3.73 million t of blue gum chips

Attribute	Transport system		
	Semi-trailer	B-double	Road-train
Log trucks needed	109	79	63
Chip trucks needed	109	81	61
Chip truck trips per year	138 000	93 000	69 000
Chip trucks trips per day	553	373	276
Chip trucks trips per hour	50	34	25

reduces wear on axles and facilitates return trips. In some cases semi-trailers are used where access at some point in the transport route is limited or product volumes smaller. The B-doubles require better road construction to allow the vehicle to start moving. The region is generally flat and there is a ready access to materials suitable for secondary road construction. Our analysis concluded that roading costs in this area are cheaper than in any comparable area in Australia. Table 5 shows the investment and number of truck trips required by various forms of transport to carry 3.7 million t y^{-1} of blue gum chips. A further possibility is the use of road-trains, the use of which has traditionally been associated with populations of very low density. Such a configuration allows more wood to be carried per truck, thereby helping to reduce the frequency of log-truck journeys. It is unlikely, however, that road-trains would be acceptable to local residents.

A major concern is the concentration of truck movements around Portland. This port will need to handle around 90 000 truck visits per year, so the development of plantation harvesting will place stress on the road network and other facilities around the port. Use of larger B-double or road train units will reduce the number of trucks, but is probably not favoured by the public because of perceptions of vehicle size and safety. It is likely that a major aspect of the development of chip exports will be the mitigation of traffic in the vicinity of major towns. If pulp mills planned for the Heywood–Penola region are built (although their status is uncertain at this time) there would be perhaps a 30% reduction in the Portland traffic. Initial studies of transport have indicated that seasonal impacts will be more pronounced than in the existing softwood industry. This is because the blue gum plantings are often on clay soils rather than the freely-draining sandy soils found under pines where winter rainfall has a minimal affect on forest operations.

Our analysis examined the possible retrofitting of a number of old railway lines in the region. These include the broad gauge lines between Mt Gambier and Wolsely (183 km), Mt Gambier and Millicent (50 km), and Mt Gambier and Portland (55 km). All would require a large investment in rebuilding and standardisation of gauges. Estimated costs of rebuilding the Mt Gambier to Portland line have been of the order of \$40–\$60 million, and much of the resource is not well-sited for this line. Because of the double handling of wood and the relatively short haulage distances to Portland for much of the resource, these projects have doubtful utility. Thus we conclude that these will not have any role in the foreseeable future. Fuel price rises in 2008 have again highlighted the inherent energy savings of railways, so it is possible that these lines may yet play an economic role in future decades — but not the coming one.

Although we do not believe that log trucks are inherently more prone to mishaps than any other form of transport, experience in Tasmania indicates that the public perceive this to be the case (Sean Riley, Forest Industries Council of Tasmania, *pers. comm.*, 2006). A number of factors will require careful management to mitigate this perception. These includes driver education, careful routing of trucks, dealing with the 'small slippery log' problem, and capital investment to avoid long queues of trucks waiting to load and unload. 'Public education' would be crucial if a decision was made to use B-doubles or road trains because of the negative perception of these by other road users. They do, however, substantially reduce the number of truck passages past a given point.

Transport costs

To estimate transport costs a model developed by Parsons (Lew Parsons, Forestry SA, *pers. comm.*, 2006) was used and updated with 2007 costs for each of the trucking systems. Table 6 summarises the transport costs derived using a weighted average lead haul distance of 120 km.

As expected, modelling showed considerable sensitivity of wood haulage costs per kilometre to haulage distance for all systems, with short-haul costs (10 km) being about \$0.60 t km^{-1}, decreasing to around \$0.15 t km^{-1} for long hauls. The analysis suggested a very large impact of loading equipment at either end on haulage costs. This handling overhead makes the rejuvenation of old railway lines unlikely. The provision of wood-handling infrastructure will be a very necessary but costly part of the development of the region.

Table 6. Average hauling cost for blue gum wood on a lead-haul distance of 120 km

Haulage type	Rate (\$ t^{-1})
Semi-trailer hauling chips	15.57
Semi-trailer hauling pulpwood	16.41
B-double hauling chip	13.01
B-double hauling pulp logs	13.81
Double road train hauling chip	10.59
Double road train hauling pulp logs	11.81

Table 7. Labour productivity of alternative harvesting systems

Harvesting system	Output ($t\ y^{-1}$)	Operators per team	Output per operator ($t\ y^{-1}$)
Cut-to-length with debarking at stump	60000	4	15000
Cut-to-length with debarking at forest edge	90000	5	18000
In-forest chipping with debarking at stump	100000	5	20000
In-forest chipping with debarking at forest edge	90000	4	22500

Harvesting labour and skill requirements

Foregoing work has shown that the harvesting of blue gum in the region, and consequently the demand for labour, will expand dramatically in the next few years.

Table 7 shows the labour productivity of various harvesting systems as developed by companies operating in the Green Triangle.

A cross-classification analysis of skill requirements is necessary for such systems because the availability of suitably skilled labour is as important as the inherent productivity of a system — if a person is not available to operate a machine there can be no productivity. The report of Bull (2006) makes it clear that availability of trained forest labour resources will be a major limiting factor in the future. The spectrum of skills required is:

- **Skill level A:** Highest level skill. Experienced machine operator, with understanding of computer systems, product types, trouble-shooting, leadership, communication, initiative, motivation and high productivity coupled with excellent eye-hand coordination.
- **Skill level B:** Forwarder or loader operator with many of the skills of Category A but concentrated on a single task.
- **Skill level C:** Base or entry level in demonstrated skills (e.g. grapple skidders or excavator-loaders). The machines are less complex, the tasks repetitive and less challenging.

A recent survey by the Logging Investigation and Training Association of Mt Gambier examined job categories in 177 softwood harvesting operations in the Green Triangle. Of these, 42% of jobs were in category A, 37% in category B and 21% in category C. Category A workers cannot be developed by training alone — Nicholls et al. (2004) showed that these require high levels of coordination. Such skills are perhaps similar to sporting skills in that at least some of the necessary ability is inherent. As an example of the likely growth in labour requirements, Figure 3 shows the estimated average number of workers with A and C skills required for in-forest chipping with debarking at stump systems for the period from 2007—2012; other systems have similarly expanded requirements for labour. Table 8 shows the estimated number of workers needed in each category for each system to move 3.7 million t of wood per year (i.e. the 2013–2020 harvest). Readers should refer to Lambert and Quill (2006) for more details.

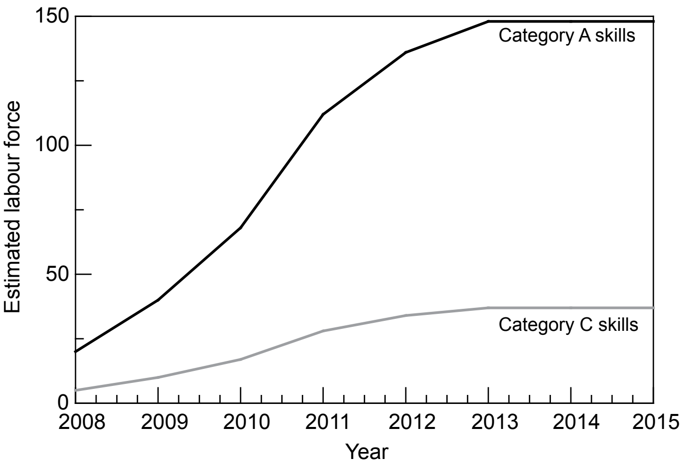

Figure 3. The labour force necessary to process the anticipated Green Triangle blue gum harvest using 'in-forest chipping with debarking at stump'. This system does not use category B workers.

Hauling labour and truck skill requirements

Table 9 shows estimated productivity rates for three truck configurations.

Using these statistics we can derive the following labour requirements to move 3.7 million t of blue gum wood per annum by alternative transport systems:

- Road trains: 66 drivers

Table 8. Estimated labour force required by alternative harvesting systems to meet harvesting requirements after 2013, by skill category

Harvesting system	Category A 'High skill'	Category B 'Less skill'	Category C 'Basic skill'	Total
Cut-to-length with debarking at stump	186	62	0	248
Cut-to-length with debarking at forest edge	123	82	41	246
In-forest chipping with debarking at stump	148	0	37	185
In-forest chipping with debarking at forest edge	41	41	82	164

- B-doubles: 86 drivers
- Semi-trailers: 119 drivers

Currently the softwood plantations in the Green Triangle employ 108 truck drivers (Andy Cusack, Logging Investigation and Training Unit, Mt Gambier, *pers. comm.*, 2006). Operators are already struggling to find appropriate numbers of employees to maintain this base, and TAFESA (2006) expressed concern regarding the aging of the work force in this industry. Thus the availability of drivers is likely to be of increasing concern to the industry.

Total work force and training requirements

The foregoing results are summarised in Table 10, showing the estimated labour force requirements.

Clearly this will be a large additional labour force requirement. Although the use of the most efficient systems will reduce the requirement for labour, the additional skills needed for these systems will restrict the savings that can be realised. No matter how one views the situation, the provision of labour to service the forest industries will provide opportunities and challenges for the coming decade.

There is some variation in training requirements between Victoria and South Australia, and also between public and private land. In general, however, certificates of competency will be required to operate advanced machines. In the Green Triangle region, current training is a mixture of formal on-the-job training and informal on-the-job learning. Experience from Western Australia suggests that even operators who undertake a full 10–12 week training course at the Forestry Training Centre facility still require a component of on-the-job training. Andy Cusack (Logging Industry Training Association, Mt Gambier, *pers. comm.*, 2006) suggests that, including loss of production, the cost of training an operator of a single-grip harvester is of the order of \$35 000–\$50 000. This cost is incurred over three months, after which time the average operator is cost-neutral to the harvesting company. A further six–nine months are then required for peak operator efficiency.

Table 9. Haulage requirements and productivity rates (averaged across various harvesting systems)

Truck configuration	Operator skill level	Average load (t)	Output per driver per day (t)	Output per driver per year (t)
Semi-trailer	Low	27	136	31 000
B-double	Medium	40	187	43 000
Road train	High	54	240	55 000

Table 10. Estimates of the total labour force required to harvest 3.7 million t y^{-1} of blue gum using alternative harvesting and transport systems

Transport system	Harvesting system			
	Cut to length		In-forest chipping	
	Debarking at stump	Debarking at forest edge	Debarking at stump	Debarking at forest edge
Semi-trailer	389	344	322	299
B-double	356	311	290	268
Road train	339	294	269	246

Table 11. Estimated training cost to provide labour to meet wood flow requirements (\$'000)

Year	Harvesting system			
	Cut to length		In-forest chipping	
	Debarking at stump	Debarking at forest edge	Debarking at stump	Debarking at forest edge
2008	774	603	551	254
2009	1291	1006	551	253
2010	1807	1409	1286	592
2011	2839	2214	2021	930
2012	1446	1127	1029	474
2013	955	745	701	313
2014 on	458	357	326	150

Although there is some variation in the costs of training for the different systems, we can provide an approximate estimate of the likely training costs (Table 11). It can be seen that in-forest chipping with debarking at forest edge is by far the cheapest harvesting system alternative in terms of training, reflecting the reduced skills required.

Poor training management and competition between contractors can lead to 'pilfering' of competent operators and subsequent disruption to the company that has borne the cost of training the operator.

In contrast to harvesting operators, truck-driver skills are less expensive to acquire, although gaining of experience cannot be fast-tracked. Thus our estimates of the direct cost of training operators are about \$2000 for semi-trailer drivers, \$3000 for B-doubles and \$4000 for road-trains. These training costs are usually borne by the individual involved. Attracting the required number of skilled drivers to the region, however, will be an issue.

Conclusions

The foreseeable yields of blue gum to be harvested in the Green Triangle region will lead to a great expansion of the harvesting industry. This will place considerable pressure on roads, the labour force, training organisations and capital investment. The magnitude of the investments and the number of companies and agencies involved will add challenges to the task. At the same time this presents excellent business opportunities for venture capital to provide facilities for both wood-handling and training. A major issue will be the recruitment of workers with suitable skills and retaining these workers despite 'pilfering' from other local companies, other regions and other industries. Effectively the blue-gum harvesting will double the size of the existing (and substantial) wood-harvesting capacity in the region. There is some lead time to develop the necessary infrastructure. In particular, work is needed to identify and address issues associated with the increased frequency of trucks movements related to the industry.

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