

THE EVOLUTION OF HARVESTING METHODS TO THIN PINE PLANTATIONS IN N.S.W.

C. HUMPHREYS

Australian

Newsprint Mills Ltd

I have been asked to outline the changes in the logging methods used in harvesting pine thinnings in New South Wales over the last 40 years. These changes have been simple and straight forward and are summarised in Table 1. For each basic element in the harvesting operation, changes have been listed at the approximate date of their occurrence.

For the remainder of this paper I will discuss the changes, and the reason I believe they occurred.

But before we proceed, I am sure you will agree, that the selection of the most suitable logging system is specific for each individual task. The selection is strongly influenced by the technology and cost structure of the industry being supplied, the design of individual factories and the forest's silviculture. Environmental constraints, which legitimately vary from forest to forest, are increasingly relevant influences. Finally, a very important variable, which strongly influences the method used to harvest a forest, is the society in which the industry is set.

1. CHARACTER OF THE N.S.W. PINE MANUFACTURING INDUSTRY

The methods used to thin N.S.W. pine plantations over their forty year history, have undergone considerable change. To understand this change a knowledge of the changes in the forest manufacturing industries which use the thinnings, is necessary.

The initial pine plantings of the 1920's were thinned in N.S.W. to supply small sawmills in 1940's. These mills cut packaging material for the fruit industry as well as for secondary manufacturing factories. They were located close to pine plantations and were simple in their technology, using 2000 to 3000 m³ of logs per annum.

As the diameter of logs became larger from second and third thinnings, boards for strip flooring, furniture and weatherboards were cut necessitating the installation of kilns. To achieve economies of scale the small case mills amalgamated into fewer larger sawmills.

In the early 1960's the particle board industry was established. In its early years this industry was dependent on small thinning logs, without any supplement from chipped sawmill residues which are now available.

The thinnings for particle board resulted in sawlogs growing more rapidly, and this, together with increased planting areas, enabled sawmills to increase log input, so that some now cut in excess of 100,000 m³ per annum.

At the start of the 1980's pulp industries are being established in N.S.W. Their raw material comes from the expanded planting program financed by the Commonwealth Government in the 1960's and early 1970's. When this expansion is completed over the next 3 to 5 years, an annual commercial thinning yield for the State in excess of 1,000,000 tonnes will be in operation.

2. FALLING

The introduction of the chainsaws, in lieu of the axe, for falling trees in the large Australian Eucalypt forests was truly a revolution. However, for the small logs in pine thinning, chainsaws were slower to become used because the development of smaller saws was a prerequisite.

Further, in the initial stages the chainsaw was not used in delimiting stems, which consumes about half of the log cutter's work effort.

However, now in 1980's, we are seeing the felling shear getting ready to cut half the N.S.W. thinning yield.

When considering felling shears, it is important to realise that the chainsaw is still the cheapest method of falling radiata thinnings in N.S.W. plantations, and is likely to remain so for some time. A cost ratio of 1:1.25 probably reflects the current difference between the chainsaw and the shear.

The compelling reason for the movement into felling shears in thinning is a social one, i.e. the lack of suitable people willing to become log cutters in N.S.W. The rise in early thinning logging in N.S.W. will be about seven fold in the next 3 to 5 years, and the industry cannot see that it can attract the 500 to 600 new cutters necessary for the task. The manpower difficulties over the last 10 years, even when unemployment has been up to 6% indicate that the only realistic approach is to assume cutters in sufficient numbers would not be forthcoming. Additionally, the accident record resulting from the introduction of 500 to 600 rookie log cutters over such a short period, is sickening to contemplate.

3. LIMBING AND CROSS-CUTTING

The replacement of the axe by the chain saw in delimiting pine took about 10 years longer than it did for falling. It had to await further weight reductions in saws and the development of efficient and safe chainsaw limbing techniques by the Scandinavians. These new techniques were introduced into N.S.W. in the early 1970's.

Processors for delimiting and cross-cutting radiata logs were first used in N.S.W. in 1975 in the form of the Twigg. This machine, which is a delimitter fitted to a Volvo forwarder undercarriage, aligns the delimitter at 90° to the extraction track. Thus it took logs from the stand on one side of the track, delimited them and deposited them amongst the retained stems on the opposite side. It thereby cramps its operation by not making use of the space in the track.

The Windsor Harvester, the John Deere Harvester and the Logma Processor all align their stems parallel with the extraction track thus utilising that space.

Again, as with falling, there is a cost disadvantage in replacing the chainsaw with the mechanical delimitter, something in the order of 20 to 40%. There may also be a delimiting quality reduction depending on the machine used.

However, it should not be overlooked that with the expansion of the logging of pulpwood in N.S.W., there will still be an increase in chainsaw falling because of the slope limitations imposed on machines. Up to 20% of thinnings will be felled by chainsaws, in conjunction with mechanical felling, in N.S.W.

4. BUNCHING

The greatest single act loggers of small wood can do in order to overcome "the tyranny of small piece size", is to bunch logs as soon as possible in the logging system. Thus feller/bunchers with accumulators have a bright future.

However, in radiata thinning, this hope is considerably dampened by the lack of a processor which can delimb several stems, simultaneously, to a satisfactory standard. Thus in brittle limbed species, such as slash pine, accumulators and multi-stemmed delimiters give considerable cost advantages over radiata, in commercial thinnings.

Initially in N.S.W., man and horse bunched for many years until the sledge mounted small bunching winch was introduced into Tumut, in the 1950's.

At Bathurst, at the commencement of logging in 1960's, the particle board industry used iron pallets, which were manually loaded with logs in 2.4 m lengths, and pulled from the forest with horses and small agricultural tractors.

Finally, in the 1980's, feller/bunchers are being introduced and these give considerable flexibility in placing bunches where required by the processor, in the appropriate bunch size, alignment and indexation.

5. EXTRACTION

In N.S.W., extraction refers to the transport of logs from the stump to the plantation roadside.

For many years horses and men shared the burden of log extraction, assisted by the four wheel-drive truck which was so commonly available after the war. The trucks entered the stand along extraction tracks at 40 m spacing, where logs which had been dumped at 90° to the track were then loaded manually onto the truck.

Rubber tyred skidders were introduced via Timberjack, in the mid 1960's. The full tree length system was quickly replaced by a ten metre maximum log length, in order to reduce the excessive damage being inflicted on retained stems.

With the introduction of chainsaws and skidders, it was becoming clear that thinning pine plantations need not be dependent on the sweat of horse and man, nor the agony of the ruined spine. The possibility of complete mechanisation of commercial thinning was becoming apparent to everyone in the industry.

Forwarders were introduced, via Volvo, and along with "Nordfor" cutting systems, a new motor manual stage was reached.

The forwarder offered several advantages. Firstly it gave industry clean wood. This is a factor which is very important to many industries. For example, factories dependent on boilers often have their annual maintenance shut down period determined by how long it takes to clean boiler tubes. Thus every day saved by using clean fuel can account for several hundred thousand dollars.

Another important advantage was, that by transporting and loading short wood of consistent length, forwarders materially added the introduction of the bogey semi-trailer for the transportation of pine thinnings. It enabled the economic loading of these larger trucks within the legal length, total weight and axle weight, applying in N.S.W. As log haul distances were increasing, this was an important consideration.

A third advantage is the performance of the forwarder in wet weather relative to skidders. By concentrating limbs and debris on extraction tracks, forwarders create ruts in tracks less readily in wet weather, thus reducing damage to root systems of the retained stems and to forest soils generally.

The advantages forwarders gave to the loading element of the thinning operation is discussed under loading.

6. SPACING OF EXTRACTION TRACKS

With each change in harvesting system, it has been necessary to change the spacing of extraction tracks. With increasing mechanisation track spacing has been reduced by the N.S.W. Forestry Commission from 88 m down to 12 m. The boom mounted felling shears are limited to cutting only five rows at a time - a row out plus selection of two rows from either side. This will soon become the most common extraction pattern.

The reduction in row spacing does reduce stem selection for future crop trees, but concern that it reduces total wood volume growth of the plantation has not been verified from measurements taken so far.

7. LOADING

About 1960, the back breaking chore of manually loading wood onto the back of trucks was replaced by manually loading steel pallets (2m x 1m x 1m). These were winched over the back of trucks by winches set behind the drivers cab. The trucks were 4 x 4 vehicles which were driven along the extraction track to be loaded. This system, of course, gave very expensive road transport costs because of the low travel speed of these trucks.

Front end loaders were introduced with the longer ten metre wood snigged to the log landings by wheeled skidders. The front end loaders provided a cost efficient method of loading. However, they encountered trouble when drainage from the log landings was seen to add to the turbidity of creeks. Following the hydrological controversies of the mid 1970's, the design and location of landing suitable for front end loaders became restricted, as did their use during wet periods. Also, the odd stone that front end loaders embedded into logs when used on gravel landings, gave rise to some colourful language from chipper room staff - and rightly so.

In contrast to the mire of mud, dirty water supplies and profanity arising from front end loader usage, the loading of logs by the knuckle boom cranes of forwarders in adjacent logging operations were indeed elegant. In addition, loading could be carried out in a large number of situations, thus reducing the need for prepared landings. The more flexible loading situations also reduced the distance to be travelled from stump to roadside.

Labour with the skills necessary to use knuckle boom cranes has changed from being scarce, when forwarders were first introduced, to reasonably easy to obtain. Knuckle boom operator jobs are now popular, after ten years of forwarder use.

It soon became clear that specialised knuckle boom loaders had advantages over forwarders, because they can be placed on retired trucks and they can lift greater loads. In short, for half the capital outlay, they can load trucks twice as quickly as forwarders.

In order to load a semi-trailer, the initial breed of knuckle boom loader loaded over the side of the truck. It therefore has to align itself parallel to the side of the truck thus consuming a total width of at least six metres - and space is a scarce commodity in a pine plantation during

first thinning. Extensions can be made to knuckle boom loaders which will enable loading over the back of semi-trailers. These are being introduced to save space and to ensure loaders and trucks stay on compacted gravel surfaces of roads during wet weather.

8. TRUCKS

Road haulage distances have increased since thinnings started in N.S.W. 40 years ago. This is a result of forest industry becoming concentrated into larger and larger units and thus needing to go further for log supplies.

When each new industry establishes, there is a large immediate increase in yield and the forests are stressed to supply the required volumes. However, as the plantation estate expands each year, so too does the volume available and the average road haulage distance tends to diminish. This continues until the next new industrial expansion when the haulage distances expands once more and the cycle tends to repeat itself.

Also pulpwood industries are fairly complex. In siting them, considerations other than log transportation costs also have to be considered. Factors such as social and associated industrial infra-structure, energy sources, and transport to market are just some of the other factors which are relevant. In total, it is often found that the best location of the pulpmill will not be that which gives minimal log transportation costs. Increasingly large trucks have been used for log haulage to minimize costs. From the 4 x 4 ex-Army trucks, we have evolved to the use of tri-axle skeletal trailers and the logging industry trucks run on N.S.W. highways as elegantly as those associated with other industries.

Despite popular hysteria generated as liquid fuel prices rise toward their real value, I see an expanding future for truck haulage. This will come by improved efficiency of truck design, more care in selecting engines with appropriate power, more highly trained drivers, by the continual improvement of roads, and by the use of larger trucks. On the subject of larger trucks, the bogie-bogie trailer configuration, which allows three five metre packs of logs to be loaded on the truck and the trailer, is standard practice in Scandinavia. If used in N.S.W. these would enable 50% increase in truck loads without increasing axle loadings. This system would lead to significantly reduced fuel consumption per tonne, and a strong case can be made for the use of this truck configuration in N.S.W.

9. ADMINISTRATION OF HARVESTING

Initially commercial pine thinning was administered by the Forestry Commission of N.S.W., who employed cutters with horses on piece work rates. When the uncertain small sawmills suffered a downturn in the market, many of the cutters would be offered maintenance and planting work in the pine forests.

With the advent of mechanisation, the Forestry Commission stepped out of logging administration because it felt private industry could more reasonably carry out this task. Also, larger industry would not agree to the administration of logging being outside their direct control.

Presently in N.S.W., each radiata firm is responsible for the administration of logging operations for the predominant part of their log purchases.

All logging is done via contractors. The reason the N.S.W. industry uses contractors, rather than company or Forestry Commission logging, is that the contractor system keeps the work group sufficiently small to enable forest workers to relate to a manager - the contractor. Further, because contractors are deeply committed both financially and emotionally to their logging operation, their field supervision is superior.

Contractors also broaden the managerial base of expertise in the logging systems, thus giving a greater input of ideas and innovation.

The contractor system is self cleansing because the Darwinian process of natural selection applies. In short, inadequate contractors cannot survive to the extent that is possible in the salaried structure of some companies and many bureaucracies. Over the last ten years the number of contractors has diminished in N.S.W. despite the increase in forest yields. At the same time the quality of those contractors who have survived has increased significantly.

10. CHOICE OF MECHANISED LOGGING SYSTEM BY A.N.M.

In the light of the history outlined above, together with A.N.M's experience with John Deere Harvesters and forwarders in Tasmania, the company, in consultation with the Forestry Commission of N.S.W., chose its basic logging system to log at Albury in October, 1979.

Five assumptions were basic to this choice:

1. All wood is to come from thinnings from land less than 20° slope.
2. Labour in sufficient numbers of adequate quality, would not be available for a motor-manual logging system at Albury.
3. The system must accommodate the Forestry Commission's reasonable constraints regarding stand damage, hydrology and fire.
4. Sawlogs must be produced along with pulplogs.
5. Clean logs have a significant premium to the Albury plant.
6. Machines should be oriented to operator comfort.

In summary, the choice of logging system was based on the following rationale

The trucks used will be bogey drive with tri-axle skeletal trailers. Because of the long weighted average road haul of 132 km, the choice of the longest legal rig was necessary in order to contain costs.

To load these trucks legally for axle weight, and keep within legal length limits, two short wood packs of 5.4 m will be necessary.

In the N.S.W. forests, forwarder extraction and knuckle boom loading of 5 m long wood from thinnings has been found to be more efficient than skidders plus chainsaw cross-cut at landing.

Specialised knuckle boom loaders are more efficient than forwarders in loading trucks. By loading over the back of trucks rather than over the side economies in space utilisation will be achieved.

No harvester which satisfactorily produces bunched 5 m wood parallel to the extraction track was available for selection thinning in 1979. A feller/buncher plus processor system was therefore chosen.

The only processor, which satisfactorily delimits radiata to sawlog standard, is Kockums's Logma (85 - 41).

To enable a larger market for training, parts and maintenance, Kockums feller/buncher (880) and forwarder (850), which compare very favourably with their competitors, were chosen to match the Kockum processor.

Land less than 20°, but too steep for the mechanised system, would be chainsaw felled and bunched by a crawler tractor on skidder. Depending on circumstances, it will be delimbed by the processor or by the chainsaw. Similarly, the tractor will snig logs to the processor or to the forwarder or to the roadside, as best suits each situation.

A.N.M. has offered to clear fall land over 20° slope using cables. In Australia, A.N.M. has been the only company to operate these systems on a continuous basis since 1940 and currently have three systems (expanding to 4) operative in Tasmanian Eucalypts. Concerted efforts in Australia to thin steep country using cables have not been economically viable.

To operate this system 40 machine operators will be trained over a three month period by a team of seven instructors. This school is being organised by Kockums, as part of their machinery sale package to A.N.M.

Presently N.S.W. shares in the Australian movement of radiata industry management commitment to increasing mechanisation. These systems will be administered by skilled contractors.

Until recently, the introduction of mechanised harvesting has been at some increase in costs. However, this disparity is decreasing each year, and several systems are now already in a position to claim that they are cheaper than motor manual operations.

The 1980's will, I believe, see in N.S.W., the introduction of mechanised thinning harvesting in a wide variety of forms each designed to best serve the different logging task each forest and industry throws up.

TABLE 1. SUMMARY OF DEVELOPMENT OF LOGGING PINE THINNINGS IN N.S.W.

Year	Industry Development	Felling	Delimiting	Track Spacing	Bunching	Extraction	Loading	Trucks	Administration
1940	Small Sawmills: 2000m ³ Log/annum	Axe	Axe	88 m	Manual and Horse	Horse and Man	Man	Rigid 2 wheel drive	Forestry Commission piece workers
1945						4 x 4 Trucks		4 x 4 Military trucks	
1950									
1955	Larger Sawmills with kilns 15 000m ³ /annum				Bunching Winch	Agric. Tractors			
1960	Particle Board Industry ³ 100 000m ³ to 150 000m ³ /annum	Chain saw		44 m	Pallets	Pallets	Pallets & Truck Winch	Single Axle Semi & Truck	Industry via Contractors
1965				16 m		Skidders	Front End Loaders		
1970	Sawmills to 100 000m ³ /annum		Chain Saw			Forwarders	Forwarders	Dual Axle Semi	
1975									
1980	Pulp & Paper Industry ³ 450 000m ³ /annum	Felling Shear	Processors	12 m	Feller - Buncher		Knuckle Boom Truck Mounted Loaders	Tri-axle Trailer 6 x 4 truck	