

MECHANISATION OF SMALLWOOD HARVESTING IN N.Z.

R.D.GORDON
Research Engineer,
LIRA.

INTRODUCTION

In 1977 Terlesk observed from overseas experience that "it seemed the path towards mechanisation was strewn with rusty machinery" (Ref 1). This quote accurately portrays the current 1980 position with respect to mechanisation of smallwood harvesting (i.e. machinery to fell and trim, excluding the chainsaw), in New Zealand. Why and will this continue is the subject of this paper, which attempts to identify on an industry wide basis the lessons learnt. As well, it aims to provide some meaningful guidelines on the future use of mechanised harvesting for smallwood operations in New Zealand.

If mechanised harvesting is going to be a viable logging method it gets the best opportunity to do so in smallwood. This is because of:

1. The comparative high cost of manual operations in smallwood with which it has to compete.
2. The ease of engineering the felling and trimming process for small trees rather than large trees.

DEVELOPMENTS UP TO 1978

It is pertinent to trace the introduction of the mechanised harvesting approach in N.Z. Very briefly the following table indicates the extent of activity at four points in time, from 1970 to 1978.

APPROXIMATE NUMBER OF UNITS IN SOME FORM OF PRODUCTIVE USE				
Date	Tree Shears	Feller-bunchers	Delimbers	Harvesters
1970/71	0	0	0	0
1973/74	3	0	2	0
1976/77	4	4	4	0
1978	4	7	5	0

The tree shears introduced were all hydraulic blade and fixed anvil type shears, mounted on crawler tractors. As well as for felling larger radiata pine they were also used in clearfelling small sized trees such as Ponderosa pine. Following the tree shears, feller-bunchers arrived with initially a rubber-tyred front-end loader based unit (Bobcat) and two excavator based units (Hitachi and Drott) introduced. These were later followed with further excavator based units (Hitachi) another rubber-tyred front-end loader based unit (Clark), and a locally produced crawler tractor based unit. All had hydraulic action

shear blades and some had the ability to accumulate stems. All essentially were applied primarily to clearfelling smaller trees, such as the unthrifty N.Z. Ponderosa pine crop, and a prominent reason for their introduction was poor labour availability for such work.

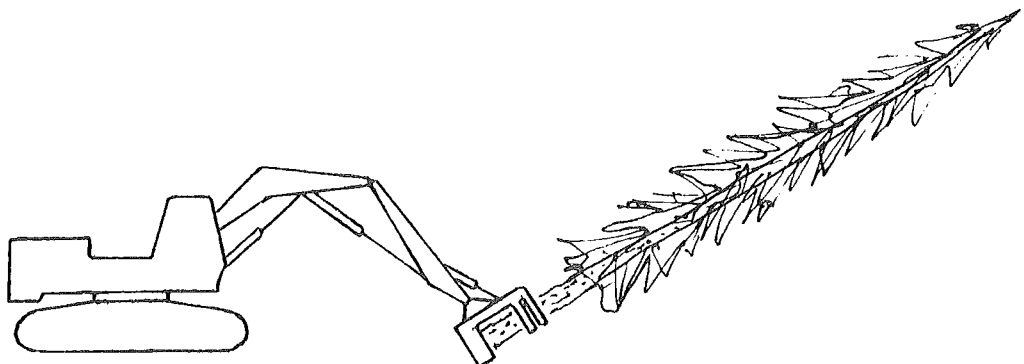
On the delimiting side, two processors (Cancar) were first introduced, although undoubtedly the use of a skidder blade to help remove limbs was tried. The processors delimited and cut single stems to length using wrap around knives and a hydraulic ram stem feed system. These were followed by skidder mounted chain flail delimiters of various layouts. During the above period there were also brief trials carried out with other devices that included partial delimiting of standing trees and dragging multiple stems through a mesh to break off branches. Again all these applications were essentially on unthrifty species such as Ponderosa pine, and labour availability was a prominent reason for their introduction.

The 1978 point is important because at this stage a number of things occurred, as follows:

1. The innovative loggers had by then dabbled in the mechanised approach and no doubt were more knowledgeable about its advantages and limitations.
2. Comprehensive studies of mechanised felling and mechanised delimiting had just been completed by LIRA and FRI, and the findings passed on to the industry through reports, talks, and a seminar.
3. This happened to be the point at which the total number of mechanised operations in N.Z. reached a peak. The number has since dropped.

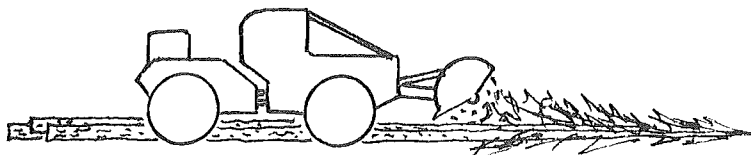
During 1978 the LIRA studies and seminar (Ref 2), at which considerable local experience was exchanged, identified the potential and limitations of mechanised harvesting in N.Z. Desirable directions for future development were also highlighted. The main findings, or conclusions emanating, were:

1. Shears and feller-bunchers were considered to be cost competitive with manual chainsaw felling in small clearfelling operations. (e.g. clearfelling of unthrifty crops such as Ponderosa pine). In the N.Z. logging scene it was desirable to make use of a standard base machine that was common to the logging industry. Machines in this category included crawler tractors, rubber-tyred front-end loaders, skidders, and excavators. All had characteristics which made them individually suited to a wide range of applications.



Example of a feller-buncher

2. Mechanised delimiting was also considered to be cost competitive with manual chainsaw trimming, but a particular form of mechanised delimiting showed up as offering significant cost savings if operable. This was basically the low capital cost multi-stem delimitter attachment that could operate with base machines common to N.Z., doing a partial trim only.

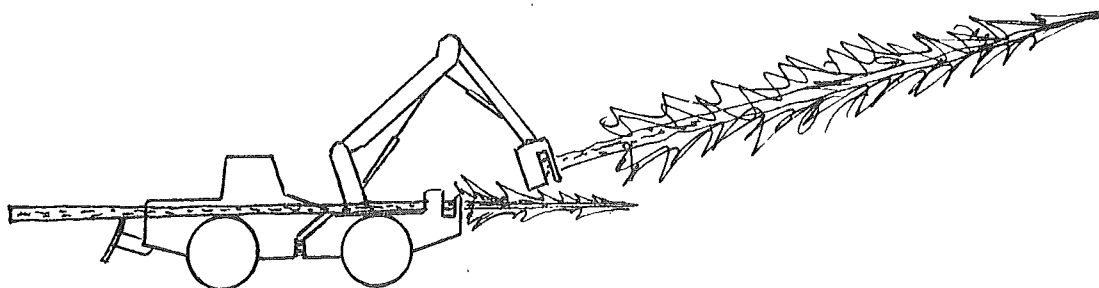


Example of a multi-stem delimitter

3. Multi-function machines such as feller-delimitters (harvesters) that were available had a marginal potential to be cost competitive with the manual chainsaw system. They could reduce costs if everything ran in their favour, such as ideal tree sizes and form, good operation management and labour, good machine maintenance and servicing etc. A modelled costing done by LIRA in 1977 resulted in the following comparative costs for felling and trimming stems of volume 0.2 to 0.3 cubic metres, in a clearfelling situation:

- 1977 manual chainsaw felling and trimming, approx.
\$2.50/tonne (labour \$4.50/hr)
- 1977 harvester machine felling and trimming, approx.
\$2.00/tonne (machine \$150,000)

As the harvester costing is much more sensitive to variations in factors like machine life, utilisation, repairs cost, residual value, and production rate, this difference was only considered marginal.



Example of a harvester machine

Also identified during 1978 (Ref 2) were the following:

4. The immediate future for mechanised harvesting lay in clearfelling unthrifty species on the Kaingaroa Plains, however, once this was completed a greater challenge was mechanisation in radiata pine thinning.

5. Mechanisation does not necessarily get over the problem of labour shortages, as you need better system management, and labour prepared to work on shift, where more expensive machinery is used.
6. The relative value of labour (as well as labour availability) to machine costs, and the movement of their relativity would dictate the swing to and from mechanised harvesting.

SUBSEQUENT DEVELOPMENTS 1978-1980

Over the period 1978-1980 further industry trials and developments occurred. This included the use of one or two home built feller-bunchers on crawler tractors, the trial of multi-stem delimiters on radiata pine thinnings, and the local development of a harvester for thinning radiata pine. Hence the swing to consideration of mechanised harvesting in small radiata pine and thus of necessity in thinning operations. During this period there was a marked change in the trend pattern which is shown below, updated to 1980.

APPROX. NUMBER OF UNITS IN SOME FORM OF PRODUCTIVE USE				
Date	Tree Shears	Feller-bunchers	Delimiters	Harvesters
1970/71	0	0	0	0
1973/74	3	0	2	0
1976/77	4	4	4	0
1978	4	7	5	0
1979/80	1	3	0	3

No new tree shears, feller-bunchers, or delimiters were introduced and as well, the number of units in productive use dropped markedly (Ref 3, 5). It is often said that the proof of the pudding is in the eating. It seems N.Z. loggers have had a taste of mechanised harvesting and have spat it out again. Against this trend however, we saw the first introduction of harvesters (Hitachi) being used to delimb and fell in radiata pine thinnings.

The factors causing this trend reversal (noted as early as Nov. 1977 by Terlesk in Ref. 1) for shears, feller-bunchers, and delimiters, are many and varied, but such factors that stand out most include:

1. There was a favourable change in labour availability for chainsaw operations in those areas using mechanised logging.
2. There was a significant increase in equipment costs, particularly machine purchase costs and fuel costs.
3. There are problems in making mechanised delimiting operable. Single stem delimiters are restricted by lineal throughput to production rates not high enough to easily justify high cost machines. Multistem delimiters are at a low stage of development and their output quality can have difficulty meeting mill requirements.
4. The economics of mechanised operations are very sensitive to system availability. Low availability of machines and systems was being experienced. The introduction of unskilled workers to mechanised operations and the lack of trained servicemen and managers was undoubtedly a contributing factor to this.

5. The operating conditions of tree size and terrain were less than ideal for economical mechanised harvesting.

Against this adverse mechanisation trend for felling machines and delimiting machines, we now have the emergence of harvesters. The lack of available experienced labour has been stated as a major reason for their introduction (Ref. 4). Time will undoubtedly tell whether they are here to stay or not. My limited knowledge of the operation involving these harvesters confirms some of the earlier conclusions about harvesters, in that their economics are undoubtedly sensitive to:

1. Ideal tree size and form as well as terrain.
2. Good operational on-the-job management.
3. Good machine design, maintenance and servicing.

The over-riding factor as to whether any harvesters are justified comes back to the consideration of labour availability and cost, compared to the manual alternative.

If one updates the 1977 LIRA comparative cost example for felling and trimming in 0.2 to 0.3 cubic metre stems, we get:

- 1980 manual chainsaw felling and trimming, approx.
\$3.50/tonne (labour \$6.00/hr)
- 1980 harvester machine felling and trimming, approx.
\$3.00/tonne (machine \$200,000)

A similar cost comparison for felling and trimming in 0.1 to 0.2 cubic metre stems results in a cost of \$6.00/tonne for both manual and mechanised (\$125,000 machine on double shift) approaches. Hence the present situation is similar to that in 1977 with the difference considered to be only marginal.

LESSONS LEARNT

The main points arising from this look at the N.Z. experience with mechanised harvesting in smallwood operations, are as follows:

1. While mechanised felling can be economically applied, using equipment of the type introduced in the past, a major difficulty arises in having a suitable delimiting operation that can keep up with the higher felling production rate.
2. There is money to be made by an equipment supplier or innovative logger if they can come up with a good low cost delimiting attachment for a machine common to logging. (A multistem delimitter offers most potential.)
3. There is a need for better skilled labour in operators, managers, and servicing, if mechanised operations are going to be used.
4. For harvester machines (that fell and trim) we should continually watch the relativity of labour cost to machine cost, as a significant movement may economically justify the use of harvesters. Where they are currently used on the basis of labour shortages or otherwise, the operation can benefit significantly by top notch management and ideal operating conditions. We can undoubtedly afford to watch closely, the Australian's current use of such equipment.

THE FUTURE

In attempting to gauge the future for mechanised smallwood harvesting I don't see the relativity of labour costs verses machine costs changing markedly towards encouraging mechanisation over the next five years. Equipment costs will continue to rise primarily through the influence of the energy crisis and the factor of New Zealand's location. I also do not foresee any overall labour shortages or political happenings that will drastically increase our labour costs, although there may be initial acute labour shortages in some of the newer areas to be harvested. From 1985-90 and onwards however, when the logging industry size is expected to increase significantly, there will undoubtedly be labour shortages that encourage mechanisation.

I doubt also whether N.Z. (being the size and in the location it is) can afford to get involved in an expensive form of machinery development unless the export of such machines arises. For the more sophisticated machinery then (such as harvesters) we should thus leave development to the overseas countries who are in a better position to efficiently support such. We should concentrate on monitoring and checking the relevance (through co-operative N.Z. trials of such machines, if need be) of overseas machines that look to have potential. As well we should attempt to make a better use of the excellent general engineering facilities we have in N.Z. With guidance they could readily produce lower cost attachments that could make mechanised harvesting a competitive means for smallwood harvesting.

REFERENCES AND SUGGESTED READING

1. "Mechanised Harvesting In and Out of New Zealand"
By Cedric Terlesk, F.R.I.
Forest Industries Review Journal - November 1977
2. "LIRA Seminar - Mechanised Harvesting and Delimiting"
By Peter Hill
Forest Industries Review Journal - May 1978
3. "Panpac's Mechanised Unit Gets the Push"
Logging Magazine - April 1979
4. "The Taupo Tree Harvesters"
Logging Magazine - August 1979
5. "Mechanised Felling - Loggers Who Have Lived With It"
Forest Industries Review Journal - December 1979