SESSION 7
Paper (e)

THE FUTURE OF SMALLWOOD MECHANISATION IN NEW ZEALAND

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Introduction

In the 1960's many foresters throughout the world predicted wood demand doubling by the year 2000. In order to harvest this quantity of wood, using conventional harvesting techniques, a large labour force would be required. The forest industry had seen the success of complete mechanisation in the agricultural industry and felt that the same principles could apply. The push for mechanisation has been for many reasons, such as :

1. Increased wood fibre demand;
2. Scarcity of skilled labour;
3. Rapidly rising costs of labour;
4. To improve workers environment with respect to safety and climatic conditions;
5. To increase manday productivity with potential for reducing harvesting costs.

Mechanisation has had most success in small tree sizes (less than .35 m^3) where manual systems are very expensive. In New Zealand there will be an estimated two million m^3 of wood in this tree size range harvested annually. Of this approximately 70% is located on terrain suitable for mechanised systems. This paper looks at mechanisation in New Zealand: its past and future potentials.

Past Experience

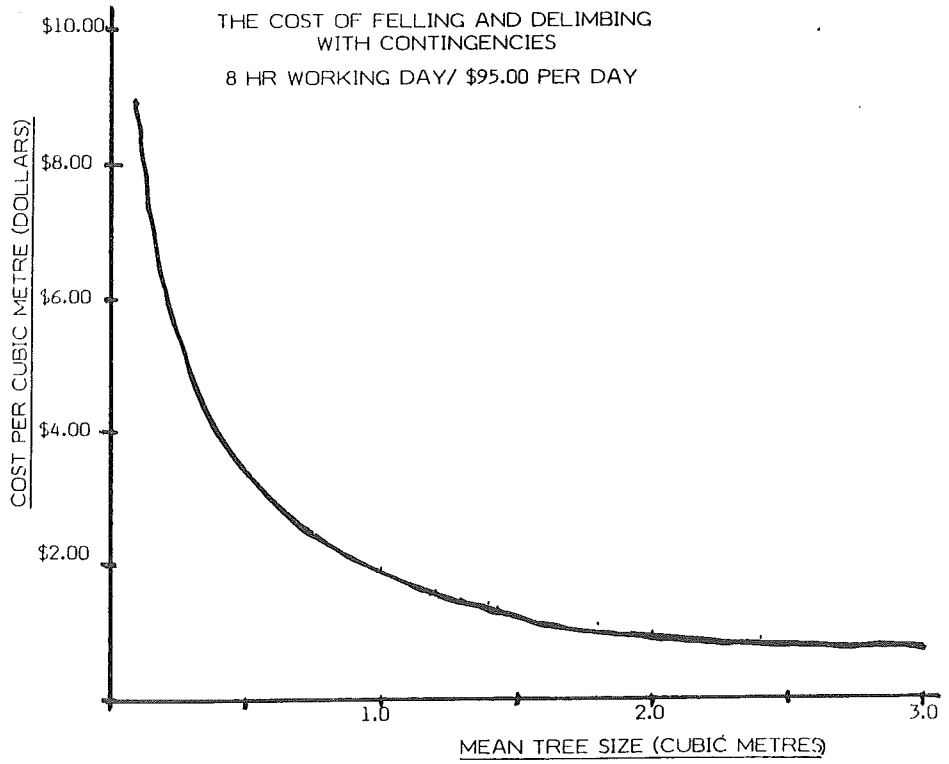
New Zealand's experience in mechanisation has been limited. Early attempts saw the introduction of directional felling machines and feller-bunchers. These units were safe, cost efficient, and highly productive, felling and bunching 100-120 trees per hour. Through low stumps and reduced breakage, increased wood volumes were recovered. Additional advantages from the low stumps were the reduced wear and tear on extraction machines and the lower site preparation costs. The main benefit to the harvesting system was through the bunching of trees for rapid accumulation of optimum payload for winch or grapple skidders.

Radiata pine and the minor species have large pliable branches which are difficult to remove using impact force to delimb. Consequently, the experience with mechanised delimbing was not as successful as mechanised felling. Single stem delimbers yielded good delimbing quality, but had low productivity and poor mechanical availability. Multi-stem delimbers were highly productive, but did not produce the delimbing quality required for most mills.

Lessons learnt indicated that mechanised felling was successful. However, delimbing systems must be matched to felling productivity. Manual delimbing of mechanically felled wood is physically demanding, monotonous and heart-breaking, thus, in order for mechanisation to be successful, a complete system is required. Therefore, the success of future mechanised systems will depend on a delimbing device that can efficiently deal with the minor species in the short-term and in longer terms, radiata pine thinnings.

Cost Competitiveness of Mechanisation

The costs of manual harvesting systems increases rapidly with decreasing tree size. The cost of felling and delimbing in .2 m^3 tree size is three times the cost of that in 1.0 m^3 tree size. The curve below illustrates this trend in felling and delimbing costs. Mechanisation has the highest potential for cost reduction in the small tree size range less than .35 m^3.



New Zealand currently enjoys a plentiful supply of labour and a labour to machine cost relationship which favours manual systems. However, labour shortages could develop as the forest industry expands and alternative industries, particularly horticulture, increase their demand on the same labour pool. Logging is also a dangerous and physically demanding job. In order to compete for labour with alternative industries, forestry may have to provide an improved working environment. This will entail shifting the work place from the ground to a more controlled environment of a machine cab. Also, within the forest industry the expansion of large tree clearfelling operations, which are generally preferred to small tree bush work, could further drain the potential workforce.

Mill Requirements

Mill delimbing acceptance standards can have a controlling influence on the success of mechanised systems. There are four main problem areas :

1. Mill conveying systems : Stubs and limbs can get jammed in wood conveying systems, requiring stoppage and physical clearing.

2. Drum debarking : While tumble drum debarkers are capable of removing most limbs and stubs, long length parallel type debarkers may not be able to match this capability.

3. Stone groundwood pulping : This pulping process requires a high standard of delimbing because stubs can cause overheating and damage to the stones.

4. Chip quality : If limbs get through to the chipper, long sliver chips are often produced, which cause clogging of the chip screening systems.

Mill handling systems are expensive, if not impossible to modify to suit logging systems. Logging systems must be designed to conform to current mill requirements. New mills or new expansion must consider that future log supply may include wood from mechanised systems and should be designed to handle this type of wood source.

System Options

Mechanised systems revolve around the delimbing device. While felling must always be done at the stump, delimbing can be done in four main locations.

1. Standing tree : Delimbing a tree prior to felling, i.e. Waratah DFB, or Beloit harvester.

2. Stump : Delimbing after the tree has been felled, generally a single stem delimbing device, i.e. Kockums Logma, or John Deere 743.

3. Intermediate location : Delimbing generally during extraction phase, involving a multiple stem delimber, i.e. the chain flail or gate.

4. Roadside : Delimbing following extraction, often used on steep country and generally a single stem delimber, i.e. Harricanna or Hahn processor (slash accumulation may be a problem with this option).

Recommendations

Considering harvesting costs and physical design limitations of machinery, mechanisation should be aimed for tree sizes between .1 and .35 m^3. Machines should be able to handle 45 cm L.E.D. and work on slopes up to 30%. Delimbing machines are either single or multiple stem. Multiple stem devices have the highest potential for cost reduction therefore requiring major emphasis and should meet the following requirements :

1. A simple mechanism that is easily maintained.

2. Preferrably an attachment device to a common carrier.

3. Aim for 85% delimbing standard to be completed by a man with a chainsaw, if required.

4. Minimise stem damage.

Possible options requiring further investigation are :

1. Double drum chain flail.

2. Gate delimbing.

Single stem delimbers are more common and yield a higher quality of delimbing. Ideally they should have the following requirements :

1. Attachment device to a common carrier.

2. Simple design with high mechanical availability.

3. Capable of sustaining high productivity (trees per hour).

4. Be able to delimb multiple leaders and forks.

5. Achieve 95% delimbing quality and easily allow for multiple pass through the knives without greatly reducing productivity.

6. Wood presentation suitable for later extraction.

Possible options include :

1. Step-feed or stroking device : moving knives.

   (a) Straight boom
   (b) Knuckle boom.

2. Linear feed device : fixed knives.

   (a) Rubber-tyred rollers;
   (b) Spiked steel rollers.

Conclusions

The shortfall of mechanised systems in New Zealand was with delimbing. Mechanical felling was successful and gave added benefits of improved safety, wood utilisation, reduced site preparation costs and improved extraction productivity. The key to mechanised systems is a successful delimbing device. Mechanisation is most suited to small trees (less than .35 m^3) where it can be cost competitive to labour. Mill planning and co-operation with logging managers should reduce mill constraints placed on the harvesting operation. Mechanisation will require detailed harvest planning and good on-ground management to maintain high productivity.

The future of mechanised smallwood harvesting lies in the thinning of radiata pine. The time for experimentation is now, in the remaining minor species on the southern plains of Kaingaroa. New Zealand's wood resource will be rapidly expanding in the next decade. This is likely to lead to shortages of suitable skilled labour. Labour demands with regard to wages and working environment will be increasing. Mechanisation may be a tool to meeting these demands. Overseas, machinery developments must be monitored. However, overseas machines are not designed to handle Pinus radiata and it is up to New Zealand to develop or adapt a machine to do the job.

Proposed action to be taken :

1. LIRA reintroduce mechanisation working group with emphasis on mechanised delimbing.

2. Evaluation of overseas delimbing machines to determine best options for development or importation.

3. Financial commitment by the industry for the development or importation of :

   (a) Multiple stem delimber
   (b) Attachment single stem delimber
   (c) Purpose-built single stem delimber if considered necessary.