LOGGING INDUSTRY RESEARCH ORGANISATION
NEW ZEALAND

ISSN 1171-6932

REPORT

Vol. 20 No. 15 1995

EXTRACTION AND TRANSPORTATION OF EARLY THINNINGS FOR CHIP PRODUCTION

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Figure 1 *- Tractor and forwarder trailer*

Figure 2 *- Self-loading truck*

ABSTRACT

A system for extracting and transporting radiata pine first thinnings for chip wood was studied. The extraction and transportation system is described. Felling and trimming production was 2.6m³ per productive man hour. The extraction phase produced 6.2m³ per productive machine hour. Transport costs were estimated to be $0.18 per tonne kilometre. The system had minimal impact on the standing crop and would be a suitable method of extracting this material in other areas of New Zealand with forest on flat to rolling terrain and where chip wood demand and prices are high.

INTRODUCTION

There has been an increase in the number and size of Medium Density Fibreboard (MDF) plants in New Zealand in recent years, with a consequent substantial rise in demand for high quality chip wood. Combined with increased log exports, this has led to an increase in price for chip or pulp grade logs.

Traditionally, material from the first thinning of a stand has been left in the forest to rot as it has been uneconomic to extract it. The volume of this material is substantial, estimated at 960,000m³ per annum, based on age class figures (MOF, 1994). A system for extracting and transporting first thinnings material for chipping at an MDF plant was studied and is described here.

ACKNOWLEDGMENTS

LIRO acknowledges the assistance of the Selwyn Plantation Board Limited and contractor Gary O'Connor.

SYSTEM DESCRIPTION

The operation comprised three fallers who felled and delimbed the trees, to a small end diameter of 7.5 cm, removing all unpruned stems from the stand. The larger trees were cut into two pieces, with the faller manually placing the top log next to the butt to speed up extraction.

The trees were felled towards a centre lane from four rows, two each side. The tractor and forwarder-trailer then travelled along the centre lane between two rows of trees picking up logs from either side. The logs were taken to the roadside and stacked for pick up by self-loading trucks. The extraction unit would travel up to 800m along the road before turning into the stand. The load was then accumulated over distances within the stand of approximately 100m. The machine then travelled up to 200m through the stand before turning on to a firebreak or track to travel up to 400m to the unloading point.

The extraction machine was a 63 kW Lamborghini 4WD agricultural tractor, with some extra guarding. It towed a two-axle FMV forwarder-trailer fitted with a crane and grapple. The trailer hydraulics were powered by the tractor's PTO. The trailer had a system where some drive power could be applied to the trailer wheels by a movable hydraulic roller positioned between wheels on the trailer's two axles.

The trailer was rated at a five tonne load capacity. Overall, the tractor-trailer unit was 11.1 metres long. It was not very manoeuvrable and did not turn when inside the stand. It entered a row space from the road edge and travelled along it until it reached the other end, then used a track or row space to return to the road edge where the logs were unloaded.

The system was working on rolling terrain (0° to 15°), with the operator trying to avoid climbing the steeper slopes. The loaded unit was able to climb slopes of 8° to 10° depending on the ground conditions. Engaging the trailer wheel drive made a difference of 2° to 3° degrees in its ability to climb, with the upper limit being set by the trailer drive rollers losing traction on the wheels, rather than stalling due to a lack of power. The soil type was a clay loam and conditions were damp during the study.

METHODS

The stand was assessed prior to thinning using 1/25th hectare plots, to derive estimates of average stocking, height and DBH. The system was studied using time study techniques over three days. Logs were measured to derive an average piece size. The stand was assessed after thinning using area plots for estimates of stocking and damage to crop stems. Slash volumes after thinning were also sampled. The operating cost of the system was estimated (Riddle, 1994).

STAND DATA

Pre-thinning

Age - 10 years
Average stocking - 1175 stems per hectare
Average crop height - 11.2 m (range - 7.5 to 14.5 m)

Average DBH - 20 cm (range - 14 to 26 cm)

Mean merchantable tree size - 0.116 m^3
Mean extracted piece size - 0.110 m^3

The difference between tree and piece size estimates was due to fallers cutting the larger stems into two pieces for ease of handling during extraction.

Post-thinning

Average stocking - 600 stems per hectare
Average crop height - 12 m (range - 9 to 14 m)
Average DBH - 23 cm (range - 20 to 26 cm)
Damage to crop trees - 0.5% (bark removal on four trees in 1.3 hectares, 780 crop trees)
Removals - 575 stems ha at 0.116 m^3 per stem = 66.7 m^3 per hectare

Slash volume remaining in stand:
Branch material = 50.6 m^3 per hectare
Stem material = 17.2 m^3 per hectare
Total = 67.8 m^3 per hectare

RESULTS

Production Estimate

For felling and trimming, a delay-free average cycle time of 2.7 minutes per tree was observed. Based on an eight hour day, with 405 productive minutes, production would be approximately 150 trees per day per man. With a tree size of 0.116m^3, the daily volume produced by three fallers would be 52m^3. This was the productivity observed, but could be described as the upper limit for a highly skilled, fit and motivated worker. A long term average production level would possibly be lower, in the order of 135 to 140 trees per day per man. The daily volume for three fallers would then be 47 to 49m^3.

Over an average haul distance of 340m, an average extraction cycle time of 55 minutes was observed, allowing eight cycles to be completed in an eight hour day with 440 productive minutes. The average load on the trailer was 52 logs at a piece size 0.110m^3, giving a load volume of 5.7m^3 and a daily production rate of approximately 45m^3. The machine utilisation observed in this short study was high (92%). Over a longer term, it is likely to be lower, 80% to 85%. Using the lower figures, the daily production rate of the extraction phase would be 40 to 42m^3.

Logging Costs

A gang-day cost for the system including four men, five chainsaws, tractor, forwarder-trailer, transport and overheads was calculated based on new equipment. This gave a cost of $1,580 per day. Based on the estimated production of 45m^3 per day, this gave a cost of $35.10 per m^3. However, if the lower utilisation figures suggested above are used, the logging cost rises to $37.60 per m^3 and $39.50 per m^3 for 40 and 42m^3 per day respectively.

Transportation Costs

The logs were picked up and transported by a self-loading 8 x 4 truck with a 4-axle trailer over a lead distance of 80 kilometres. Average payloads were approximately 23 tonnes (weighbridge figures). This was costed at $0.18 per tonne kilometre, or $14.40 per tonne delivered to the MDF plant.

DISCUSSION

The stand in the forest where the study took place had the crop established in straight, well defined rows which allowed the tractor-trailer unit to travel along the row space (4m wide) without any difficulty. The unit did little manoeuvering in the stand, and the operator was very careful not to hit trees with the crane, or logs when loading, so crop damage levels were low.

There was some improvement to be gained in the system as it was observed, by improved presentation of the wood for extraction. The logs had to be 100% trimmed, approximately five metres in length and free of major malformation. A small degree of manual bunching of the logs also helped speed up the loading of the trailer. There were a number of instances when the tractor operator had to retrim or recut the logs, which affected the performance of the extraction unit. These times were deducted from the cycle time and the figures presented in this report represent an estimate of the system working at its best.

The level of damage to the crop trees was low and removal of nutrients from the stand was minimised by delimbing at the stump. Soil compaction was minimised by the extraction unit running on slash beds.

The piece size of first thinnings being extracted is likely to vary from stand to stand. Using the times from the study and substituting both smaller and larger average extracted piece sizes, the following rates of production and cost were derived (Table 1).

Table 1 - Effect of piece size on production and cost

Piece size m^3	Daily production m^3	Cost per m^3
0.090	41	$38.54
0.110	45	$35.11
0.125	49	$32.24

CONCLUSIONS

Extraction of first thinnings for chip wood can be achieved at a cost of approximately $30 to $40 per m^3. Transportation of this wood can be completed for a cost of approximately $0.18 per tonne kilometre.

Small purpose-built forwarders are likely to be slightly more productive, having better ability to climb slopes and being shorter in overall length, leading to greater manoeuvrability. However, the capital investment required would be higher.

The system described in this report could have a wide application throughout New Zealand, especially in areas where there are forests planted on flat to rolling terrain.

REFERENCES

Ministry Of Forestry (1994) : "A National Exotic Forest Description; as at 1 April 1993".

Riddle A. R. (1994) : "Business Management for Logging". LIRO Handbook.

The costs stated in this report were derived using the procedures shown in the LIRO Handbook, Business Management For Logging. They are indicative only and do not necessarily represent the actual costs of the operations.

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