

## Effect of Logmaking on Production of Stem Wood Residue at Landings

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*Figure 1 - Stem wood discarded from log making operations*

### Abstract

Data on the volume and piece size distribution of stem wood residue were collected from logging operations using three different log making systems; manual, computer optimised, and mechanised processing.

Mechanised log processing systems created more residue and more pieces of residue per stem than manual or computer optimised systems.

The pieces produced by the computer optimised, and the mechanised processing systems, were on average longer than those created by the

manual log-making, but there were no differences in average piece diameter.

The mechanised system produced a greater proportion of pieces in sections longer than 1.2 m.

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# Introduction

There are a number of changes taking place in the New Zealand logging industry, amongst which are changes to harvesting systems. Two significant changes are the introduction of mechanised log processing, and the recent arrival of a computer based log-making optimisation tool.

The objective of this study was to assess the effects of both these developments on stem residue production from log making operations in comparison to conventional manual log-making.

Due to the value maximisation focus of log making operations in New Zealand, all log making operations produce sections of stem-wood which are discarded as residue. The proportion of the extracted volume that ends up as residue varies from operation to operation and is affected by the crop, the cutting plan, the individual log-maker (Parker, Cossens and Strang, 1993) and the nature of the harvesting system (Hall, 1994). Past studies of logging operations using traditional manual log making found that, on average, stem residue volumes were 2.5 % of the total extracted volume in ground-based operations and 4.7 % in hauler operations, (Hall, 1994).

With the increased focus on value recovery and environmental issues, it was considered worthwhile to determine what effects these system changes have had on both the volume of residue and the dimensions of the residue pieces as there is potential to recover some of the residue as very short (>1.2m) chip logs. This could result in increased value recovery and a reduction in the size of residue piles at landings

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# Methods

Logging operations were sampled where the three different log making systems were being used operationally.

1. For manual log-making systems, data was collected by:
  - measuring a sample of the extracted stems to determine the average stem volume
  - counting the number of extracted stems
  - estimating total extracted volume
  - measuring all sections of stem residue for length and diameter.
2. Mechanised systems were sampled using a similar system in some cases and in others by down-loading from the data-logger of the log processor.
3. For the computer optimisation samples, stem and residue volumes and residue piece size data were derived from operational data files from Timber Tech log optimisation tools being used in logging operations.

Each sample aimed to collect residue data from 75 stems. However, some were more than this and some slightly less. Stem and residue volumes were calculated using a three dimensional log volume equation (Ellis 1982). Stems were measured in sections of less than 15m and the section volumes were then totalled.

The information was summarised by log making system. Data from 56 studies were available, comprising; manual operations (33), computer optimisation (10) and mechanised processing (6). The studies were conducted in 12 forests at 47 different sites and logging crews.

# Results and Discussion

	Units	Manual (ML)		Computer (CO)		Mechanised (MP)	
		Average	95 % cl	Average	95 % cl	Average	95 % cl
Extracted piece size	m <sup>3</sup>	<b>1.58 a</b>	0.12	<b>1.68 a</b>	0.12	<b>1.78 a</b>	0.18
No. residue pieces per stem		<b>1.68 a</b>	0.14	<b>1.54 a</b>	0.07	<b>2.04 b</b>	0.19
Length of residue	m	<b>0.9 a</b>	0.12	<b>1.3 b</b>	0.16	<b>1.4 b</b>	0.25
Diameter of residue	cm	<b>32 a</b>	1.3	<b>33 a</b>	2.1	<b>30 a</b>	2.9
Volume of residue	m <sup>3</sup>	<b>0.041 a</b>	0.004	<b>0.074 a</b>	0.005	<b>0.050 a</b>	0.1
Residue to extracted volume	%	<b>4.2 a</b>	0.48	<b>4.6 a</b>	0.41	<b>6.2 b</b>	0.52
% of pieces >1.2 m length	%	<b>24 a</b>	3.7	<b>28 ab</b>	5.0	<b>37 b</b>	6.8
% of volume >1.2 m length	%	<b>48 a</b>	5.5	<b>57 a</b>	5.1	<b>52 a</b>	5.9
No of stems	(n=)	<b>2277</b>		<b>648</b>		<b>1638</b>	

Table 1 – Stem wood residue variation by log-making system (95% confidence limit)

Note: results in a row followed by a different letter are significantly different (P<0.05), results followed by the same letter are not.

A summary of the results is presented in Table 1;

- the mechanised processors (MP) created a greater proportion of residue (6.2%) than the other systems, manual log-making (ML, 4.2%) and computer optimised (CO, 4.6%).

- the CO and MP systems produced residue pieces that were longer (1.3m and 1.4m respectively) than the manual system (0.9m).

- the MP system produced more pieces of residue per stem (2.04) than the CO system (1.54) and ML (1.68).

- the CO and MP systems both had a greater proportion of the pieces and total residue volume in sections longer than 1.2 m than the ML system, although the MP volume was not significantly greater than the ML.

Of the residue produced by all three systems, a substantial proportion is in pieces greater than 1.2 m in length. These pieces are suitable for pulp chip. The amount of material that could potentially be recovered as very short pulp logs is presented in Table 2. These figures are based on an assumed extracted volume of 600 m<sup>3</sup>/ha.

The amount of stem residue produced in any log making system depends on the cutting pattern, log prices, crop type and individual log maker differences. The wide range of conditions covered in the samples collected and the large number of stems means the results presented here are an industry average and are not site specific.

	Manual	Computer	Mechanised
Residue volume in sections >1.2m long	12 m <sup>3</sup> /ha	17 m <sup>3</sup> /ha	19 m <sup>3</sup> /ha

Table 2 – Potential volume (per hectare) of short pulp logs

Figure 2 shows the percent frequency distribution of stem residue lengths and Figure 3 the percent frequency distribution of stem residue piece volumes. Figures 2 and 3 indicate that the trends are very similar for all 3 systems, with the bulk of the number of pieces produced being less than 1.0 m in length, and less than 0.1 m<sup>3</sup> in volume.



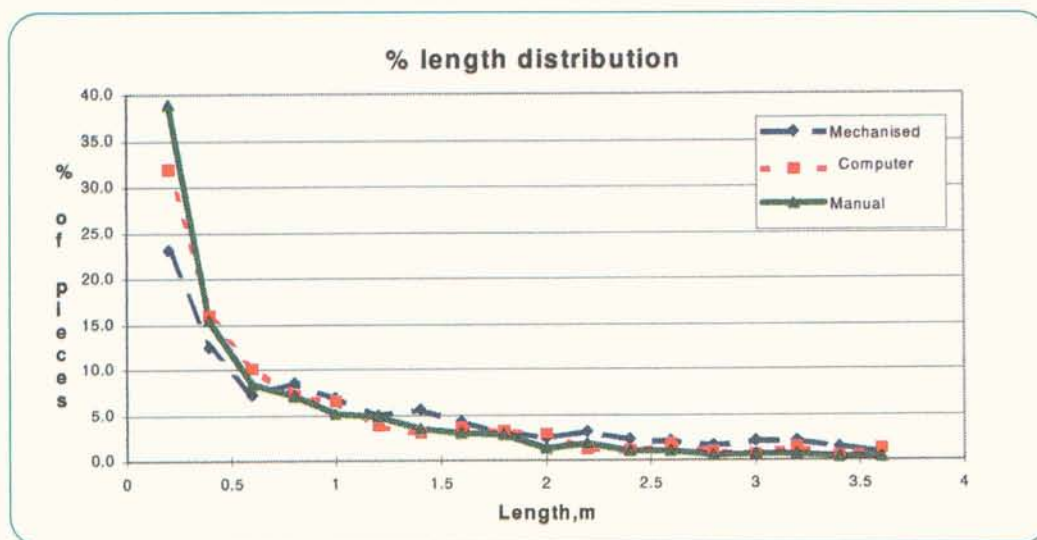


Figure 2 - Frequency distribution of lengths of residue pieces

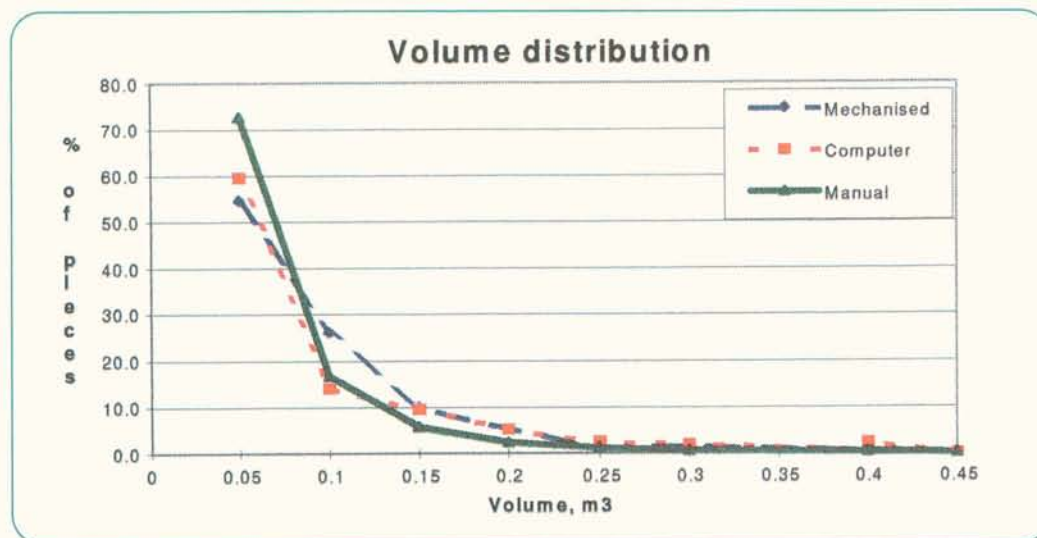


Figure 3 - Frequency distribution of volumes of residue pieces

The trends are very similar for all systems, with the bulk of the number of stem residue pieces being less than 1.0 m in length, and less than 0.1 m<sup>3</sup> in volume. The manual log making system tends to produce a greater proportion of small volume pieces.

## Conclusions

The mechanised log processors were producing more stem residue than the manual or computer optimised systems for the same volume processed. Residue pieces tended to be longer than those in the manual system, with more residue pieces per stem.

The computer optimised systems also tended to produce longer and larger volume pieces of residue than the manual system.

Manual log makers produced the least residue with the smallest average length and piece size.

In all systems, a substantial proportion of the volume of the residue (48% to 57%) was in sections longer than 1.2 m. This

material, which represents approximately 2% of the extracted volume could potentially be recovered as pulp chip.

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