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‘FibrePlus’ study:
Harvesting stemwood waste pieces in pine clearfall

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Introduction

With increased demand for forest products and decreased access to forest resource it is becoming more important to maximise the volume of wood recovered from every harvesting operation. One way to achieve this is to use existing harvesting machinery to extract tree tops and larger stemwood waste pieces that do not meet existing sawlog and pulpwood specifications and would otherwise be left in the forest. These waste pieces can be chipped for pulp or for biomass fuel.

This study aimed to investigate the productivity and cost impacts of extracting stemwood waste, also known as ‘FibrePlus’, during a typical cut-to-length clearfall harvesting operation in a thinned radiata pine plantation, and to assess the suitability of FibrePlus for papermaking.

Study description

Two 100-tree plots (each of approximately 0.5 ha) and two 2 ha sites were established in a 34-year-old radiata pine plantation (near Tumut, NSW) that had been thinned twice. Stand and site conditions were very good and uniform. The stand was relatively high-yielding with trees of good form and quality. The plantation was flat with no obstacles.

One plot and site were harvested and extracted incorporating FibrePlus (the FibrePlus plot and site); the other plot and site were harvested and extracted as normal (the control plot and site).

All trees in each plot were inventoried using ATLAS Cruiser methodology. Plot inventory showed that although the control plot had a slightly greater number of larger trees, tree size was similar enough for comparison across the plots.

Harvesting was carried out using a cut-to-length, two-machine system (a Timbco 475 harvester with a Rosin 997 head and a modified Timbco 820-D 8-wheel forwarder). Detailed time and motion studies were completed for harvesting of each plot, and for forwarding on each plot and site.

Products cut were recorded, measured, segregated and tracked across customer weighbridges to determine exact yields from each plot and site.

The retained biomass (or ‘left-slash’) on the FibrePlus site was measured four months after the harvest.

Results

Yields

Product yields from the FibrePlus plot and site (in green metric tonnes per hectare, GMt/ha) are shown in Figure 1. Overall yields from the site were high, which was not unexpected given the quality of the plantation. The control plot and site recorded similar yields and proportions by product. The FibrePlus plot and site yielded almost as much FibrePlus as pulpwood, which was a higher proportion than anticipated.

A substantial amount of biomass was retained on site, including branches and woody debris, fine branches and needles that play an important role in enhancing soil quality for future rotations. The spatial distribution of this retained biomass was highly variable, but the significant quantity of retained biomass is likely to provide protection from erosion and to enhance soil fertility for the next tree crop.

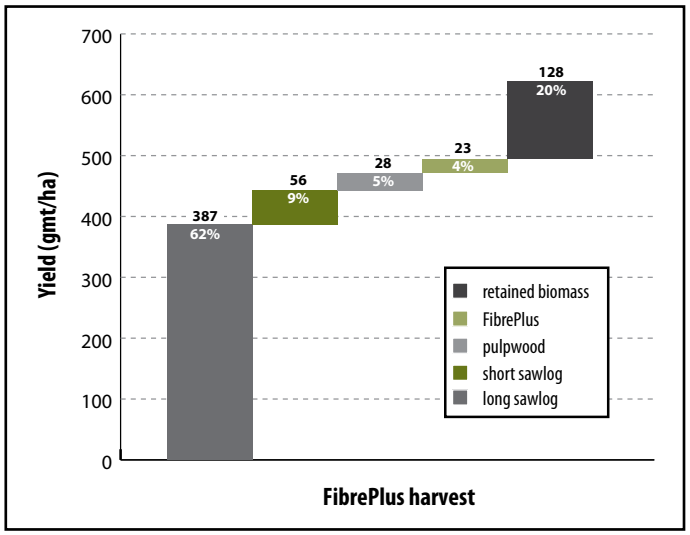

Figure 1 : Yields by product from the FibrePlus plot and site

Harvesting phase

Harvester productivity in the control plot was 91.9 GMt/PMH_0 and was 93.4 GMt/PHM_0 in the FibrePlus plot. This comparison indicates that integrating the FibrePlus product into the harvesting operation had a negligible impact on harvester productivity. A more detailed analysis showed no differences in harvester productivity across the range of tree sizes in the study. The harvester productivity model is shown in Figure 2.

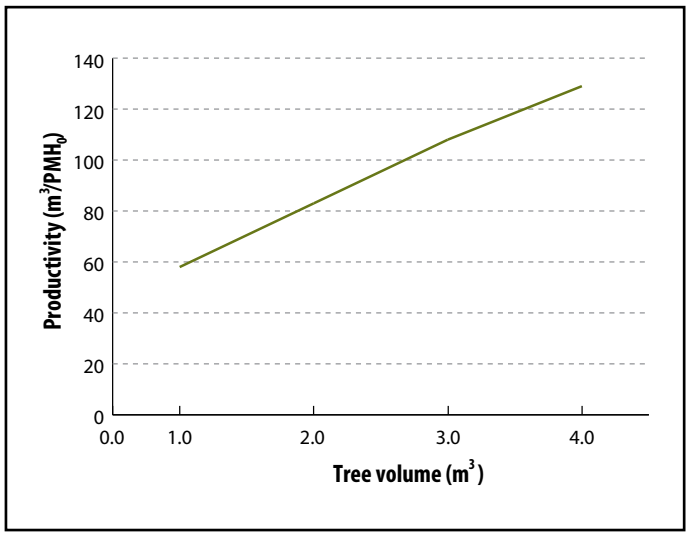

Figure 2: Harvester productivity model

Forwarding phase

Forwarding of the harvested log products was conducted by roadside log sort. The 6.1 m sawlogs were forwarded first; then mixed loads of 4.9 m and 3.7 m sawlogs; and lastly mixed loads of pulpwood and FibrePlus products from the FibrePlus plot and site, and pulpwood-only loads from the control plot and site.

Forwarder productivity in the control plot and site was 92.6 GMt/PMH_0 but extracting the FibrePlus product reduced forwarder productivity by 14% to 79.4 GMt/PHM_0 in the FibrePlus plot and site. The forwarding time elements indicated some slight differences between the control and FibrePlus plots and sites but did not explain the total difference in productivity.

Further investigation revealed that the productivity of the forwarder when extracting sawlogs from the two study plots and sites was similar, whereas the productivity of extracting pulpwood alone was greater than for extracting mixed loads of pulpwood and FibrePlus (Table 1). This was because the loaded density of FibrePlus was much lower than the other products due to the smaller piece size, so the forwarder was unable to load enough weight of product when extracting FibrePlus, and had to extract more loads per unit area, sharply reducing productivity.

Table 1: Comparison of forwarder productivity (GMt/PMH_0) between the two study plots and sites by product extracted

Product	Control	FibrePlus
6.1 m sawlogs	113.4	109.4
4.9 m and 3.7 m sawlogs	56.2	58.0
Pulpwood	41.1	N/A
Mixed pulpwood and FibrePlus	N/A	30.5

Cost impact[1]

Integrating FibrePlus into the existing harvesting operation is estimated to increase overall costs of harvesting, extraction and loading by 12.1%. The increased cost is due to the decreased productivity of the forwarder, and because the harvester has to reduce its productivity to maintain balance in the system.

The system could be balanced without slowing the harvester either in a cold-deck operation using an alternative means of loading trucks (truck-mounted loader); or by extending the shift of the forwarder

1 Cost information provided in this bulletin is indicative only, and is based on a costing model. Operational constraints and/or costs that are difficult to foresee or quantify may emerge, and actual costs may vary from the model on a case-by-case basis.

in the existing operation. For these alternatives, the estimated increased cost of integrating FibrePlus into the operation falls to between 2.7% and 6.0% (depending on assumptions related to machine and labour costs and machine life).

A sensitivity analysis showed that the percentage increase in costs was not substantially affected by reducing the productivity of the harvester and forwarder by 33%, or by reducing the utilisation rate of the forwarder by 10%, or by doing both.

Quality of woodchips produced from FibrePlus

The FibrePlus was chipped at the roadside and weighed at the customer's weighbridge. Testing by the customer indicated that FibrePlus chips were suitable for mixing with debarked roundwood chips for papermaking. Alternatively, the FibrePlus chips would be suitable as biomass fuel.

Take-home messages

- Extracting FibrePlus during pine plantation harvesting had no impact on the harvesting phase but reduced forwarding productivity by 14% in this study. Reduction in forwarding productivity due to extraction of FibrePlus could increase in-field costs by between 2.7% and 12.1%. By adjusting operations to achieve lower-cost solutions, it's possible to improve net value recovery by harvesting FibrePlus where there are markets for the material.
- FibrePlus added an additional 23 GMt / ha or 4% to the total yield in this study, and the FibrePlus woodchips were of sufficient quality for papermaking when mixed as a small proportion of the total pulp chip supply.
- A substantial quantity of biomass was retained on the site despite extraction of FibrePlus, contributing to ongoing soil protection and site fertility.

Organisations supporting this research

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More information

CRC for Forestry website:
http://www.crcforestry.com.au/research/programme-three/index.html

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