CRC for Forestry
Researching sustainable forest landscapes

Harvesting and Operations Programme
Research Bulletin

Bulletin #: 09-2008-001

# Impact of piece size and slope on productivity and costs of CTL harvesting equipment

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## Introduction

As more native forest stands are progressively removed from timber production, focus increases on intensifying management practices in forests that remain under active management. Throughout the working forests of southern New South Wales (NSW) and Tasmania, large areas of native forest regrowth of various qualities will become increasingly important to supply sawlogs, poles and fibre for industry.

Thinning practices in these stands are attracting considerable interest to enhance stand productivity and hence meet sawlog production targets. However, thinning is expensive, and variability in forest characteristics and stand conditions makes achieving desired silvicultural outcomes in an economical way a considerable challenge for operational managers and contractors.

In October 2007, the CRC for Forestry's Harvesting and Operations programme (Research Programme Three) conducted a trial in a forest near Eden, NSW to address some of these challenges. The trial investigated the impact of piece size and slope on the productivity of individual harvesting machines (comprising two harvesting systems: System 1 comprising a harvester working alone and System 2 comprising a feller buncher working with two processors) thinning native forest regrowth. In addition, the impact on productivity and costs of production of adding a feller buncher to a cut-to-length (CTL) harvesting system was investigated.

Importantly, while the results relate specifically to a particular harvesting operation studied under a particular set of conditions, they can be applied more broadly as an indicator of the impact of piece size and slope on harvesting machine productivity and hence, costs of production, in native forest and plantations alike.

## Harvesting machines studied

Tracked Timberjack 608S harvester with Waratah 622 head

Tracked Valmet 445 EXL feller buncher with Rosin CF750 head

## Impact of piece size and slope on productivity

Figure 1 shows the impact of piece size and slope on the productivity of the harvester working alone (System 1) expressed as tonnes/productive machine hour (PMH). In this case PMH is defined as excluding all delays.

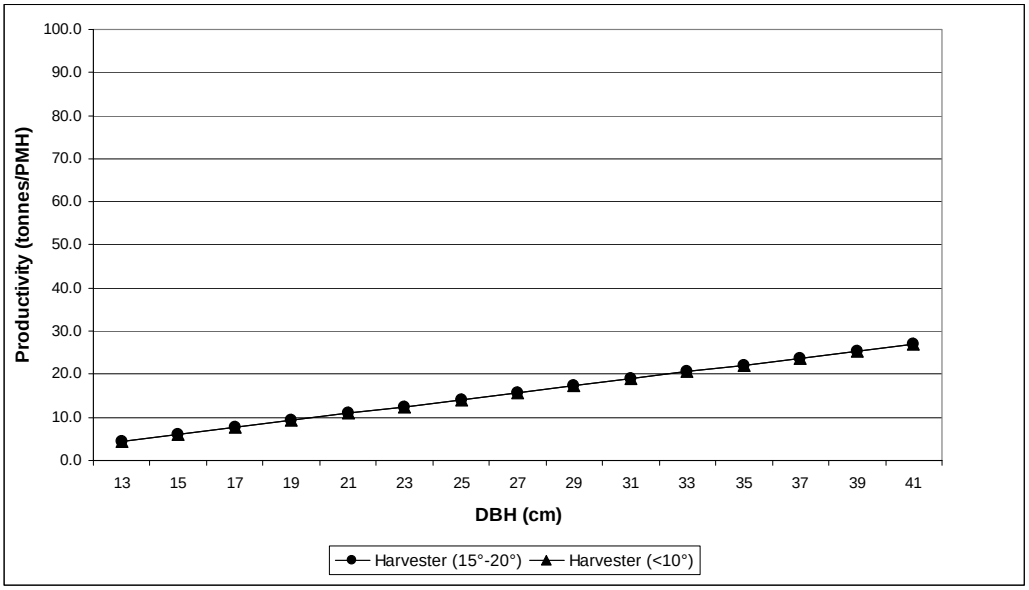


**Figure 1: Harvester productivity for a range of tree diameters and slopes**

The results indicate that the harvester is 5.5 times more productive when harvesting trees in the 41 cm diameter class than the 13 cm diameter class. The relationship between diameter at breast height and productivity is linear within the diameter range studied. Slope has no apparent impact on the productivity of the harvester within the slope range studied (from flat to moderately steep at 20 degrees).

Figure 2 shows the impact of piece size and slope on the productivity of the feller buncher and a processor when working together (part of System 2).

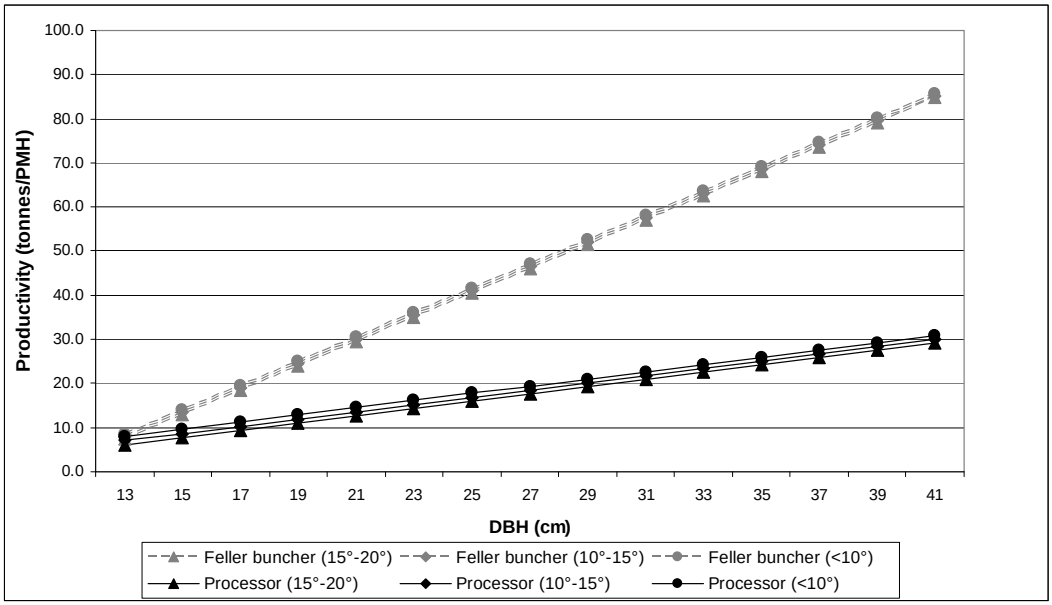


**Figure 2: Feller buncher and processor productivity for a range of tree diameters and slopes**

The pattern of productivity displayed for the processor is very similar to that obtained for the harvester when working alone (see Figure 1), whereas the feller buncher is ten times more productive when harvesting trees in the 41 cm diameter class than the 13 cm diameter class. Again, the diameter–productivity relationship is linear. The pronounced rise in productivity is due to the feller buncher being able to maintain a consistent rate of felling regardless of tree size. Hence, the benefits of increasing tree volume are not diluted. The productivity of both the harvester and the processor is limited by their inability to maintain a consistent felling and/or processing rate as tree size increases and this dilutes the impact of increasing volume with diameter.

In the case of the feller buncher and processor working together, slope had a statistically significant impact on the productivity of both machines but the overall impact of changes in slope within the slope range studied was negligible compared with the impact of piece size.

## Production costs: does the feller buncher pay its way?

Using generic costs, Figure 3 shows the impact of piece size and slope on the production costs (at stump) of the two harvesting systems (i.e. the harvester working alone compared with the feller buncher working with two processors).

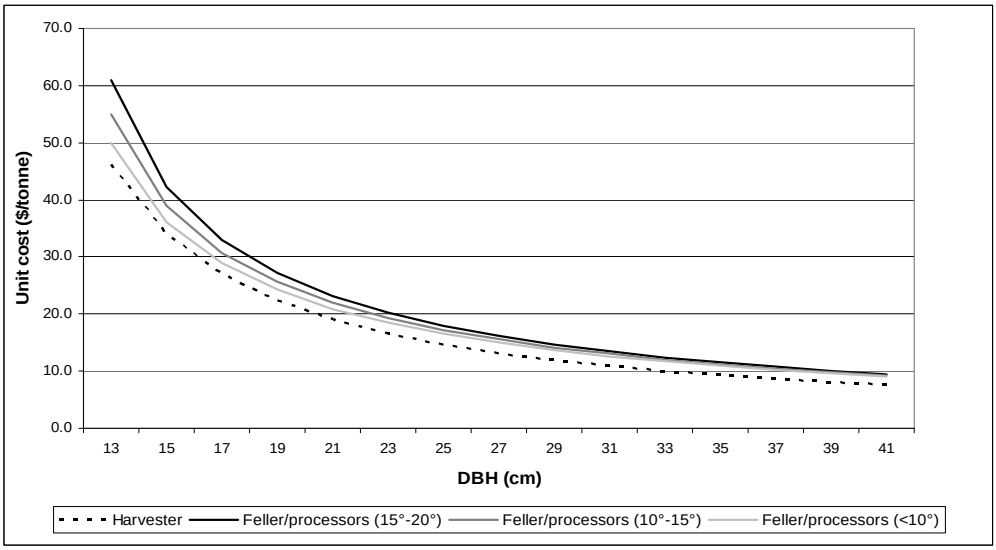


**Figure 3: Harvesting system costs of production for a range of tree diameters and slopes**

Although the feller buncher always improved the productivity of the processors, the feller buncher and processor combination resulted in higher costs of production than the harvester working alone, regardless of piece size or slope class. The difference ranges from less than $2 per tonne with the largest piece sizes studied, where slope has less impact, to between $4 and $14 per tonne with the smaller piece sizes where the impact of slope is more pronounced. The steeper the slope, the greater the difference.

## Take-home messages

- Diameter at breast height (piece size) explained more than 85 per cent of the variation in productivity of the machines and therefore is the main driver of productivity, and hence costs, under the prevailing conditions studied. Slope (to 20 degrees) explained less than 5 per cent of the variation in productivity.
- Although adding a feller buncher to the cut-to-length system did enhance productivity, the resulting higher cost per tonne outweighed the productivity gain. Using a feller buncher is not recommended on the basis of cost alone in the forest conditions studied (moderately steep terrain and/or small tree diameter). It is acknowledged that other forest conditions (e.g. downers, heavy understorey) may warrant the use of a feller buncher.
- Harvesting costs per tonne recovered increased exponentially when the diameter at breast height of the harvested trees fell below 20 cm. This relationship is likely to be replicated elsewhere and its economic implications for all harvesting operations—thinning or clearfell—must be noted.

**Organisations supporting this science:** South East Fibre Exports Pty Ltd (SEFE), contractor Stephen Pope and Forests NSW provided in-kind support to enable this research. This research project was supported by all contributors to Programme Three (Harvesting and Operations).

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