Harvesting and transport of small-diameter wood

Background

Approximately one fifth of Finnish primary energy is produced from wood based energy sources. One of the significant and under utilized sources of wood based energy is small-diameter wood from harvesting of young stands. In order to find out the most cost effective ways to harvest and transport wood from young stands, it is important to study the competitiveness of various supply and logging systems. This fact sheet presents recent study results from harvesting of young stands for fuel in Finland.

Mechanised logging beats manual in pre-commercial thinnings

When comparing the most common logging systems that are used in pre-commercial thinnings in Finland – the manual and the mechanised cutting of whole-trees and forwarding by a forwarder; and logging of whole-trees by a harwarder – the two-machine system was found to be the most cost competitive logging system thanks to both efficient cutting and, especially, forwarding work. In the manual worker based logging, the costs of felling bunching were at the same level as in the mechanised system, whereas in forwarding the costs were almost double. Using a harwarder system, the logging costs were found to be the highest, but in the larger tree volumes and removals the costs were almost equal to the manual worker based logging. To reach the cost competitiveness of the harwarder systems it calls for improvements to the logging machine and devices as well to the working techniques of the harwarder.

Fig. 1. Mechanised cutting with a harvester (left) or manual cutting by a logger (2nd on the left) is combined with mechanised forwarding (2nd on the right), whereas a harwarder (right) performs both harvesting and forwarding simultaneously.

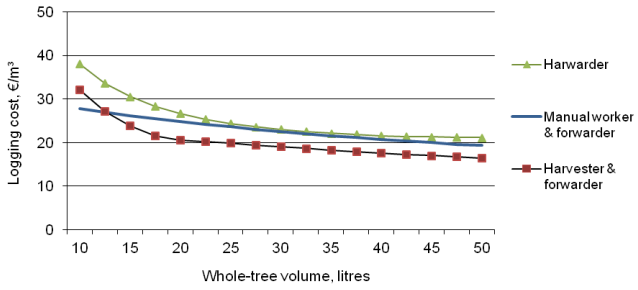


Fig. 2. Logging cost (€/m³), when the removal was 60 m³/ha, the tree volume 10-50 litres and the forwarding distance 200 metres.

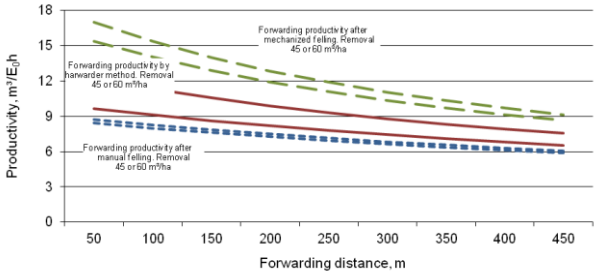


Fig. 3. Productivity (E_0h) of forwarding as a function of forwarding distance after mechanized and manual felling bunching and by harwarder system. The removal of whole-trees were 45 or 60 m³/ha.

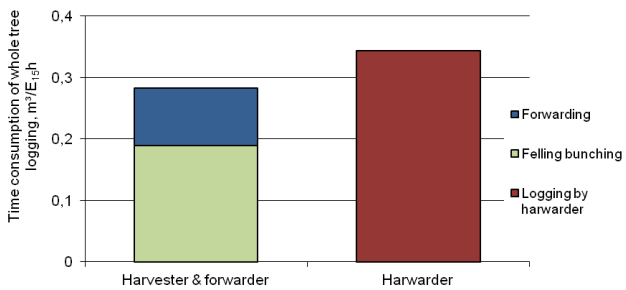


Fig.4. Logging time ($E_{15}h$) consumption per solid whole-tree cubic meter (m³) by the two-machine system and by harwarder, when the removal was 60 m³/ha, tree volume 30 litres and forwarding distance 200 metres.

Delimbed longwood cost efficient in transportation

In a study evaluating the competitiveness of various supply systems of small-diameter wood harvested from young stands for fuel, trees were harvested for the cost comparison either as (i) delimbed longwood or (ii) as whole-trees or (iii) trees were bundled using Fixteri bundle harvester.


Fig. 5. The cutting of whole-trees and delimbed longwood was carried out using a conventional harvester head equipped with multi-tree-handling accessories (left). Bundle harvesting was carried out using the newly-developed Fixteri bundle harvester (right).

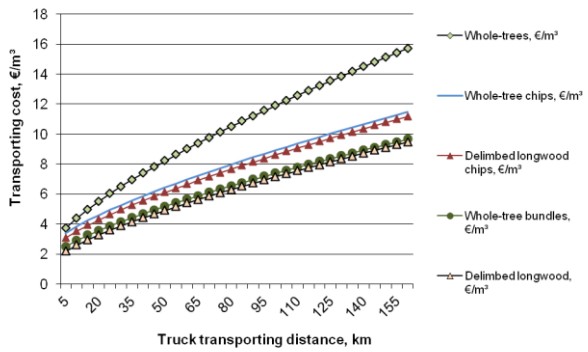

Fig. 6. The harvested wood was chipped either at a roadside landing (left) or at a terminal using a trailer-mounted drum chipper (right).

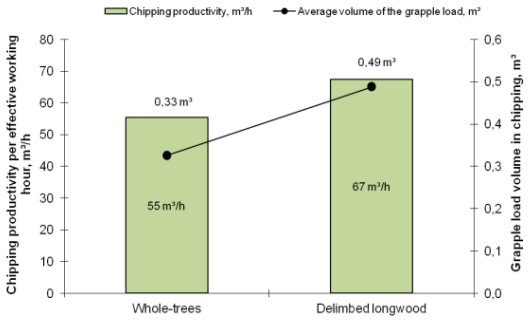


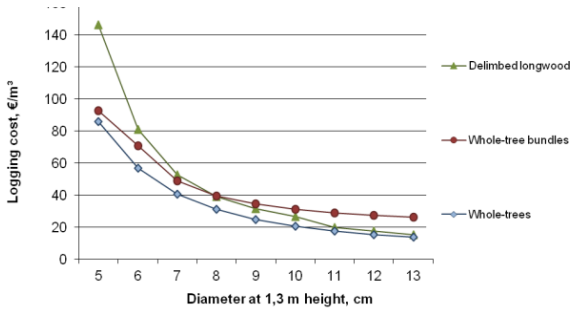
Fig. 7. Delimbed longwood and whole-tree bundles were transported to the terminal using a conventional timber truck (left) and whole-trees were transported using a biomass truck equipped with solid side panels and bottom. The chips from the roadside landing and from the terminal were transported using a standard chip truck (right).

The comparison of procurement costs was done at stand level as a function of breast height diameter (5-13 cm) and on-road transportation distance (5-160 km). Forwarding distance was 300 m. The harvested wood was chipped either at a roadside landing or at a terminal. The comparison of the supply systems was done using recently published productivity parameters and data obtained from complementary field studies.

The study showed that the productivity of transportation and chipping of delimbed longwood was significantly higher compared to the whole-trees. In the case of whole-tree bundling, savings in transportation costs did not offset the high felling and compaction costs, and the bundling system was the least competitive alternative.







The cost of whole-tree and delimbed longwood chips was at the same level when the breast height diameter of the harvested trees was 11 cm (pine) or more. The cutting of whole-trees is cheaper, but the cost difference diminished as a function of tree size.

For more information:

Laitila, J. 2008. Harvesting technology and the cost of fuel chips from early thinnings. Silva Fennica 42(2):267-283

Laitila, J. & Väätäinen, K. 2011. Kokopuun ja rangan autokuljetus ja haketustuottavuus. Metsätieteen aikakauskirja 2/2011