Advantage
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Contents

Cost analysis of cut-to-length harvesting in hardwood stands

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Abstract

FERIC studied three log-producing harvesting systems to determine their productivities and costs in stands of *intolerant hardwoods*. The systems differed based on where the processing took place: during felling, at the stump, or at roadside. The system using a roadside processor proved most economical, but the two other systems we observed are also suitable for the highly variable harvesting conditions encountered in hardwood stands. An operation with at-the-stump processing was also studied in stands of *tolerant hardwoods*, and the results suggest that this operation was less productive and more expensive than the operations in intolerant hardwoods. The low productivity was, however, compensated for by the higher value of the sawlogs and veneer logs that were produced.

Keywords:

Harvesting cost, Cut-to-length systems, Tolerant hardwoods, Intolerant hardwoods, Operational study.

Introduction

With an increasing number of mills using hardwoods, forestry contractors must now extract more logs of variable dimensions from each tree. The single-grip and processing heads already used with softwoods are also being tried in hardwood stands, but they must meet different quality criteria to satisfy mill requirements. Are they capable of meeting these criteria?

FERIC studied three cut-to-length harvesting systems in stands of *intolerant hardwoods* to determine their productivities and costs and to develop recommendations on how to best use these systems. The first system consisted of a single-grip harvester and a shortwood forwarder. The second system comprised a feller-buncher, a processor working at the stump, and a shortwood forwarder. The third system used a feller-buncher, a grapple skidder, and a processor working at roadside. FERIC also observed a system with at-the-stump processing working in stands of *tolerant hardwoods*.

Operations observed

The three harvesting systems were studied during visits to operations in Ontario, Quebec, and New Brunswick. The terrain conditions were very favorable at each of the operations we visited, with flat terrain, good bearing capacity, and no obstacles (CPPA class 1.1.1). Snow depth never exceeded 50 cm on the harvesting sites studied during the winter.

System with a single-grip harvester

The single-grip heads we observed were generally designed to handle big softwood stems, and were thus sufficiently robust to handle hardwood stems that often exceeded 50 cm in DBH (Figure 1). The logs produced by the single-grip harvester were extracted by a shortwood forwarder.

The operators we observed all had at least 1 year of experience with the harvesting equipment. The data collection took place in 2001 and 2002 at Foleyet and Timmins (Ontario), as well as at Parent and La Sarre (Quebec).

System with an at-the-stump processor

In this system, the processor followed a feller-buncher and processed the bunched trees where they lay in the forest. The shortwood forwarder completed this system of three machines working on the cutover. As was the case with the single-grip harvester, at-the-stump processing left the delimbing slash in the forest. Some of the processing heads we observed were also capable of felling big stems. These machines could thus replace the feller-buncher when it is unavailable for felling.

Figure 1. A Valmet 965 single-grip head harvesting aspen.

The majority of our data on at-the-stump processing in intolerant hardwoods were gathered in the operations of Scierie Parent Inc. (Parent, Quebec), where the operators had more than 2 years of experience with this type of machine. Other data were also gathered in the fall of 2001 in New Brunswick near Boiestown (Bowater Canadian Forest Products Inc.) and Miramichi (UPM-Kymmene Miramichi Incorporated) with tolerant hardwoods. The operators in these studies had 1 to 5 years of experience.

System with a roadside processor

The third system we studied was a full-tree system in which the delimber was replaced by a roadside processor (Figures 2 and 3). A feller-buncher and a grapple skidder worked on the cutover. This system is popular in northern Ontario, and the observations primarily took place near Timmins (Ontario) during the winter of 2002. Operator experience ranged from 2 weeks to 9 years.

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Figure 2. On certain models of processing head, a butt plate helps the operator consistently buck stems at the target lengths.

Figure 3. The processing head lets the operator sort the products based on various quality criteria, including the minimum and maximum diameters accepted by each mill.

Productivities

The single-grip harvesters working with intolerant hardwoods had high productivities (Figure 4), but at a volume of 0.25 m³/stem, average productivity was around 30% lower per m³ than with softwood stems. The ease of delimbing and the regular taper of the softwood stems account for this difference, but the difference appears to diminish as mean stem volume increases. However, the two curves are difficult to compare directly because the mean volumes per harvested stem in the stands of intolerant hardwoods were always higher than those used to develop the productivity curve for the softwoods.

Figure 5 presents the productivities of the processors we observed working at the stump and at roadside. The two upper curves indicate that roadside processing was no more productive than at-the-stump processing in the stands of *intolerant hardwoods*. Indeed, our results indicate that operator experience and the branchiness of the stems had a larger effect on productivity than where the machine worked. In the *tolerant hardwood* stands, the low productivity of at-the-stump processing (illustrated by the lower curve in Figure 5)

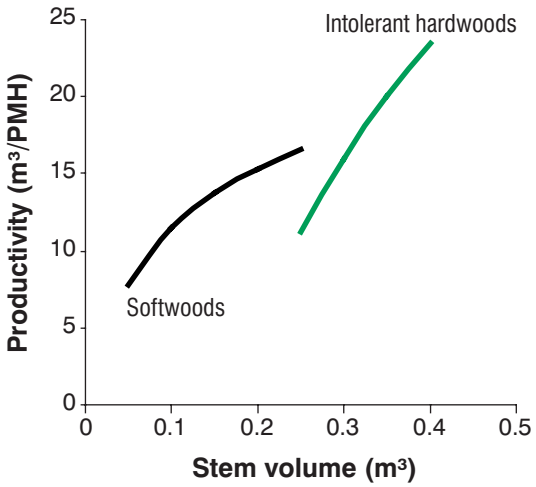

Figure 4. Comparison of the productivities of single-grip harvesters in stands of softwoods and intolerant hardwoods (the softwood curve comes from FERIC's database).

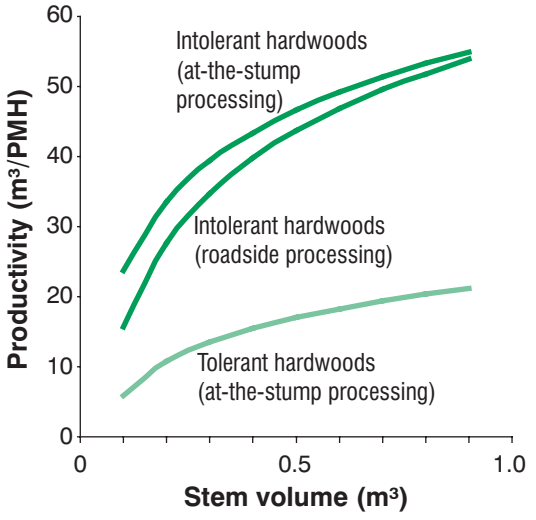

Figure 5. Comparison of the productivities of the processors in stands of intolerant and tolerant hardwoods.

resulted primarily from the difficulty of delimbing large branches, the clutter created by the large tops, and the additional time required to produce 2.44-m (8-ft) logs from the big branches.

Cost analysis

To determine the cost of producing pulpwood and logs ready for loading in each of the three systems we studied, the following direct operating costs were used:

Feller-buncher:	$138/PMH
Grapple skidder:	$102/PMH
Shortwood forwarder:	$123/PMH
Processor:	$144/PMH
Single-grip harvester:	$152/PMH

The operating cost of the processor working at roadside could be lower than that of a processor working at the stump because a less-robust excavator can be used at roadside. The system based on a roadside processor may thus cost even less than the value presented here.

The average productivities observed during this study were used for the single-grip harvester and the processors. The other productivities required to estimate the costs of the three systems come from FERIC's *Interface* software and a study by Favreau and Légère (1999). Figure 6 presents the costs of the three systems in stands of intolerant hardwoods and the cost of the system we observed working with tolerant hardwoods. Among the systems used with intolerant hardwoods, the one with roadside processing (illustrated by the lower curve) was the most economical. This system represented a cost reduction of around 40% compared with the system based on a single-grip harvester working in a similar stand. In addition, the system with a processor working at the stump also proved less expensive than that with a single-grip harvester, particularly at stem volumes of less than 0.5 m^3. The cost of the system with an at-the-stump processor working with tolerant hardwoods is illustrated by the upper (highest-cost) curve in Figure 6. Note that the costs in Figure 6 don't include the additional cost of treating the delimbing debris produced by roadside processing.

Implementation

Although the production cost to roadside of a log-producing system is an important criterion in choosing an appropriate solution, the system's flexibility is also an important factor to consider. This is particularly true in hardwood forest, where the harvesting conditions are highly variable and the production of logs is subject to multiple requirements imposed by the mill. For example, a system with processing at the stump is a wise choice when there is insufficient space for roadside landings; in contrast, a system using only two machines on the cutover (a single-grip harvester teamed with a forwarder) is well adapted to soils with low bearing capacity. Some contractors only harvest a few hectares of large hardwoods per year. In this situation, it would be preferable to use a three-machine system to avoid the need to purchase an expensive, high-capacity single-grip head.

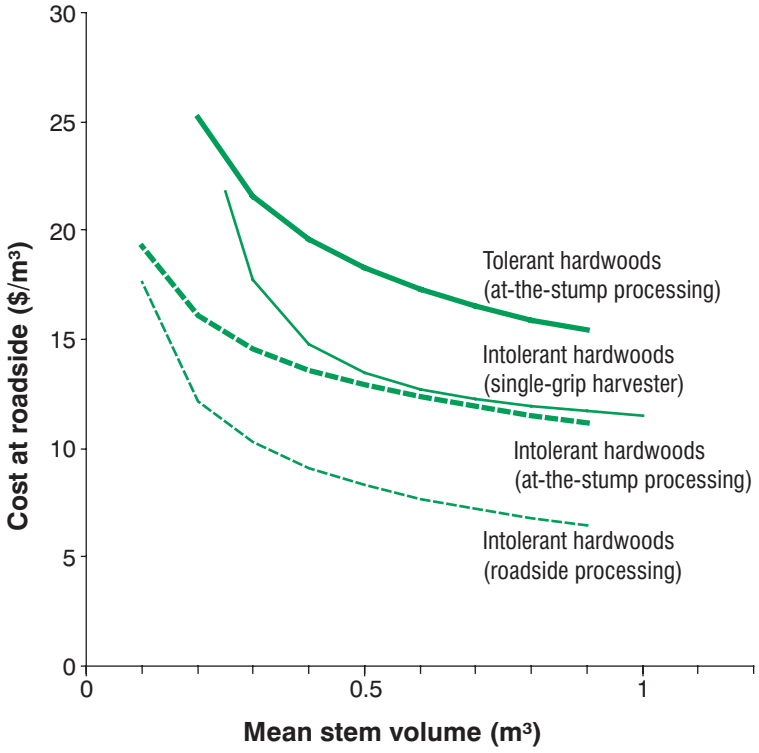

Figure 6. Comparison of system costs for the production of pulpwood and other logs in stands of tolerant and intolerant hardwoods.

A single-grip or processing head designed to handle large softwood stems can also be used with *intolerant hardwoods*, but it must be highly robust, capable of processing trees with diameters greater than 50 cm, and preferably equipped with a topping saw (a second saw near the top of the head). As well, the processing head should have a diameter-measuring system if stem diameter affects the choice of the products to be produced and should have a butt plate to provide good length-measurement accuracy.

We recommend using a very robust head designed specifically for processing hardwoods when you plan to work in stands of *tolerant hardwoods*. The contractors we visited experienced frequent problems with the rotor, which was insufficiently robust to handle the heavy hardwood stems. The delimbing knives must be made from special high-strength steel and the metal plate that supports the fixed knives at the top of the head should be made from steel at least 1.91 cm (¾ in.) thick rather than the 1.27-cm (½-in.)

thickness that is typical for heads designed to handle softwoods. A topping saw is particularly important for recovering the maximum amount of wood from the large tops of tolerant hardwoods. Some feed rollers are very aggressive and can efficiently delimb large tolerant hardwoods, but these rollers can also damage the high-quality logs and potentially reduce the yield of these products.

FERIC's studies have demonstrated that mechanized processing systems are capable of efficiently producing pulpwood in hardwood stands. However, when the proportion of hardwood sawlogs or veneer logs in the stand becomes significant, we recommend using the single-grip harvester just for the production of pulpwood and leaving the processing of sawlogs and veneer logs to a slasher working at roadside so as to optimize the overall value yielded by the operation.

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