EVALUATION OF ROLL-OFF TRAILERS IN SMALL-DIAMETER APPLICATIONS

by

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ABSTRACT

Concern about wildfire in overstocked forests of the western U.S. has led to increased emphasis on extraction of small-diameter material. Removing this material improves forest health, reduces fuel loading, and may generate value that can be used to offset the costs of operation. However, the cost of small-diameter operations (both in-woods and secondary processing) are often prohibitive due to handling and transport. This is a particular problem with small-volume niche markets that cannot absorb the productive capacity of conventional forest products transportation systems. This project studied the performance and costs of an innovative wood transport system using roll-off pallet racks to facilitate handling of small-diameter thinning material. Elemental studies defined the transport cycles and cost analysis compared the economics of the new system with conventional transport technology.

Introduction

A recent assessment of biomass in western forests of the U.S. (USFS, 2003) estimates that about 570 million bone dry tons of material could be removed through fuel reduction treatments to address high-risk stands. While much of the volume can be processed into conventional forest products, there is also interest in promoting diverse and specialized utilization. Small-volume niche markets can increase value-added by careful selection and merchandizing of the raw material. For example, logs for carving, rustic furniture material, log home components, post-and-rail, and specialized sawlogs are higher value niche products that can be recovered from fuel thinning projects. Although these niche products will not consume large quantities of forest biomass, they may make fuel reduction projects more cost-effective in some local areas.

A key problem for small producers is finding economical methods for harvesting, handling and transport of material when daily production levels are low. Conventional logging and transport equipment operates efficiently at high volumes. A drive-to-tree feller-buncher, for example, may be able to cut and pile 50 tons per hour. A conventional grapple skidder can produce 30 tons per hour. High production is essential to reducing harvesting and transport costs. However, when the total wood flow for a small-scale producer is less than potential productivity of conventional equipment, costs increase due to under-utilized capacity.

This objective of this project was to examine transportation alternatives for a case study of a small-volume shavings factory. Total woodflow through the mill is about 30 green tons per day. Because of a lack of conventional harvesting activities in the area, reliable wood delivery required the mill to develop an appropriately scaled harvesting and transport system. Trees were felled manually and skidded tree-length using either a skid-steer multi-purpose machine or a small cable skidder. At the landing, trees were manually bucked into 100" bolts and loaded with a front-end loader attachment on the skid-steer. The transport system had to integrate with this low-capital harvesting operation as well as the shortwood unloading equipment at the millyard. A prototype shortlog transport system based on roll-off wood racks was developed and tested and preliminary performance and cost estimates are presented in this report.

Prototype Roll-off System

Over the years, there have been various iterations of roll-off (RO) type log transport systems. The pallet system used in the southern U.S. from the 40's to the 60's was an early design that reduced handling and loading time. Pallets set at ground level could be manually loaded more easily than racks on a truck (Bromley 1949). Trees were bucked into shortwood at the stump and collected on the pallets for unitized extraction. The loaded pallets were then winched onto straight frame trucks for transport to the woodyard or mill. Improved mechanization in skidding, bucking, and loading functions eventually eliminated the advantage of palletized shortwood.

Sinclair (1985) revisited the unitized load concept to collect woody biomass from cable logging operations in Canada. Like the old pallet trucks, the Canadian system winched loaded transport containers onto a highway truck. The cost of the roll-off container system was considerably less than an alternative approach using conventional trucks and skidders to recover low-value biomass. Sinclair noted that use of an up-to-date RO truck configuration would improve the performance of the container system even further.

Current RO designs are typically a straight frame 300-hp class tractor with dual rear axles. The RO modification consists of a tilting frame that is elevated by hydraulic cylinders. A cable winch pulls a loaded RO container onto the truck. This transport system is commonly used for waste collection with solid bin containers. The Village of Ruidoso, New Mexico has an ongoing contract with a waste disposal firm to collect municipal and residential woody debris in RO containers.

For the small-wood thinning project, special wood racks were designed that were compatible with the local waste truck configuration. The wood racks hold approximately 5 cords (22,500 lbs) of 100" bolts loaded crosswise (Figure 1). While there is some additional space for load, this truck has a maximum legal weight of 46,320 lbs and a tare of about 24,000 lbs. In operation, when the trucker is notified that a loaded rack is ready for pickup in the woods, the truck takes an empty rack to the woods and drops it on the landing. The truck winches the full rack onto frame and the load is secured for highway travel. At the woodyard, a sling-type loader unloads a bunk at a time and the empty truck is returned to the truck staging yard or to the woods.

Figure 1. Roll-off wood rack for shortwood bolts.

System Evaluation

An initial elemental production study was conducted after the contractor had used the system for several months. The truck made 2 trips per day and Table 1 summarizes elemental data from 6 loads. Each load was followed to the millyard to measure average travel speeds on the various types of roadways (Table 2).

Table 1. Elemental cycle time summary for roll-off wood rack transport system.

Productive Element	Mean	Max	Min
In-woods			
Position to unload (min)	1.02	1.73	0.32
Unload rack (min)	3.33	4.25	2.40
Position to load (min)	4.48	7.06	2.04
Load rack (min)	3.99	5.27	2.44
Bind down load (min)	6.61	10.19	2.69
Millyard			
Unbind load (min)	2.15	3.31	1.65
Unload with sling loader (min)	12.98	16.45	10.12

Table 2. Average travel speeds for the roll-off truck.

Road Type	Mean Empty (mph)	Mean Loaded (mph)
Woods road	4.2	4.1
Gravel road	30.3	26.0
Paved, in-town	33.7	28.2
Paved, out-of-town	44.7	41.5
4-lane highway	50.9	45.1

The initial cycle time and travel speed estimates were combined with a standard machine rate based on a new $100,000 truck and $15/hour labor. A spreadsheet template was created with a constant haul route of woods, gravel and in-town mileage combined with an increasing amount of highway mileage to estimate the effect of total haul distance on wood transport cost (Figure 2).

Two other wood transport configurations were modeled in the spreadsheet. The first was a conventional 5-axle logging truck with a shortwood trailer operating at 85% utilization. This would reflect potential wood transport costs if existing harvesting and utilization operations were able to keep the trucking system busy. One load per day would be delivered to the shavings mill while additional loads would be taken to other wood-consuming facilities. The second configuration estimated transport costs for the conventional shortwood trailer system operating at 30% utilization, reflecting the limited woodflow needed by just the shavings mill. Figure 2 shows the results, with the underutilized conventional system having the highest cost line, the RO wood rack system in the middle, and the conventional fully utilized system having the lowest costs.

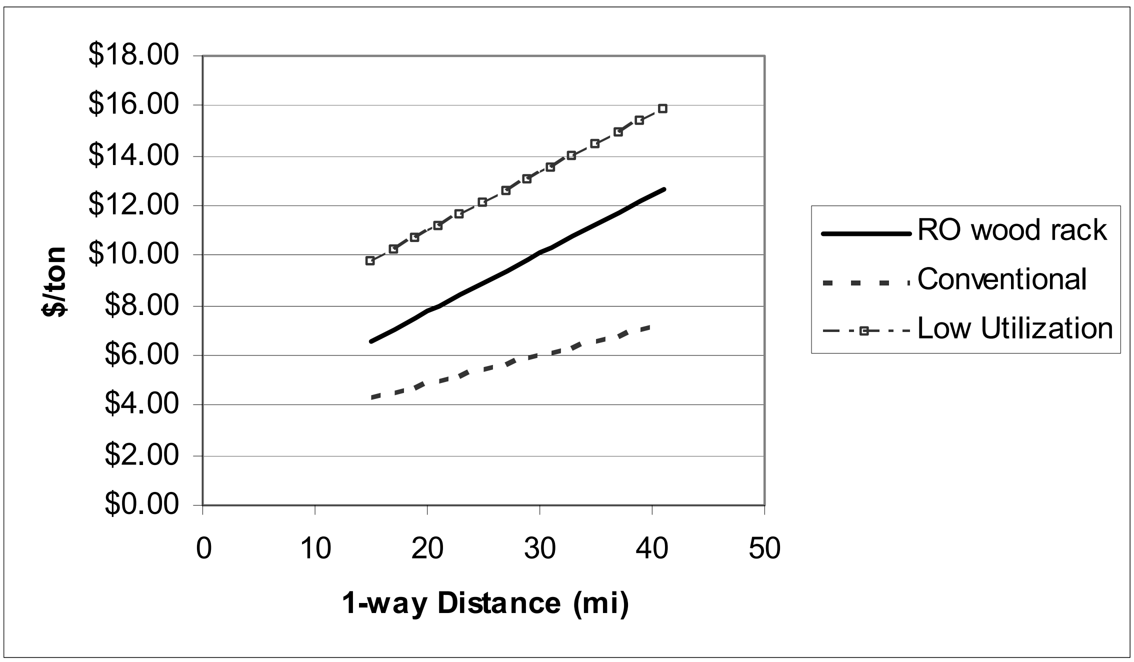

Figure 2. Estimated costs for three alternative transportation scenarios.

Summary

Small-volume wood consumers may not be able to take advantage of the economies of scale offered by conventional wood harvesting and transport systems. If the small consumer is the only delivery market, it is important to find an appropriately-scaled system to avoid the cost penalties of underutilized equipment. The shortwood transport system using roll-off wood racks shows the value of matching transport system capacity to woodflow requirements. This analysis also suggests that additional cost savings can be realized if multiple markets are available to share a transportation system. For example, two small facilities may be able to fully utilize a single conventional trucking operation reducing wood costs for both consumers. However, multiple markets must be able to have some consensus on product form and wood-handling system requirements in order to use a common trucking system.

As new utilization opportunities are developed for small-diameter wood products it is important to understand the economies of scale in wood transport. Markets that require less than 50 green tons per day will likely pay a premium in transport and handling compared to larger utilizers.

References

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