The Price of Freedom: Single-Operator Timber Harvests in the Northeast United States

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Abstract
Running a successful logging business is challenging given the high capital and operating costs involved. Profitability hinges, in part, on the costs and productivity of the harvest system (i.e. configuration of machines and operators). In the Northeast United States, many contractors are choosing to work alone. These owner-operators move from one machine to the next as they single-handedly carry out every element of a timber harvest. This study used shift-level production data to assess productivity and costs for three single-operator harvests in New York. Machine rates were calculated to determine total system costs for the three harvests. These costs were then compared with simulated costs for an expanded two-person crew scenario to estimate potential cost savings. Results show that hiring a second logger to operate existing equipment would increase machine utilization rates, drive down machine costs, and reduce overall system costs, resulting in reduced costs per ton.

Keywords: logging costs, logging productivity, machine rate, harvest systems

Introduction
Crew size, equipment configuration, and level of mechanization affect the productivity and costs of harvest operations. Harvest systems that achieve high operational efficiency are characterized by high machine utilization rates, minimal delays, and a balanced configuration of concurrently operating machines. Striking the right balance between costs and productivity affects the overall profitability of independent logging businesses, whose services help landowners realize their management goals and whose outputs fulfill market demand for wood products. In essence, viable logging businesses are critical for the sustainable management of forest resources.

However, many logging businesses in the Northeast operate at sub-optimal levels of productivity, particularly those who chose to work alone in the woods. These owner-operators split time between multiple pieces of equipment as they single-handedly carryout each element of a harvest operation (e.g. felling, skidding, sorting, loading, closeout, etc.). By their very nature, single-operator harvest systems produce low machine utilization rates as machines lay idle for relatively large amounts of time.

The advantages of a balanced, fully mechanized system, which include improved safety and increased productivity, have resulted in increased use of these systems in the Central Appalachians (LeDoux, 2010). However, the Northeast is expected to see an increase in independent owner-operators (Johnson, 2014) who typically use conventional handfelling

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systems. In fact, a recent survey revealed that 61% of logging businesses across the region have zero employees (Leon and Benjamin, 2012). Contractors have cited various costs (e.g. fuel, insurance, equipment) as reasons why they will not expand their businesses (Egan, 2009). These trends beg several important questions:

- How productive and how costly are single-operator harvest systems?
- What gains are to be made, in terms of higher productivity and lower costs, by hiring an additional crew member to operate existing equipment?
- What is the impact of delays on single-operator systems compared to more balanced systems, particularly with regard to implementing best management practices (BMPs)?
- What is preventing these business owners from hiring additional loggers?

These questions are being explored as part of an on-going study that aims to assess costs and productivity of ground-based harvest systems commonly employed throughout the northeast, ranging from the single-operator model, to fully mechanized 4- or 5-man crews, to cut-to-length systems. This study also seeks to determine the impact of BMPs on various harvest systems in terms of their effect on system productivity and cost.

The focus of this paper is the single-operator harvest system. We provide early results from three timber harvests cut by different single-operator loggers. The objective is to determine machine utilization, system productivity and system costs for each harvest as well as for a simulated scenario in which the contractor hires an additional logger to operate existing equipment.

**Methods**

Shift-level data was collected for three timber harvests between August and November of 2013 at different locations across New York (Figure 1). Each harvest was cut by a different single-operator contractor. All three sites were characterized by rolling terrain ranging from slight to moderate slopes (0-15%) and similar composition of northern hardwood species, though site B contained a relatively larger component of eastern hemlock (*Tsuga canadensis*).

![Figure 1](image.png)

Figure 1. Study sites: Three single-operator harvests across New York, U.S.
Contractors were provided forms on which they recorded daily production and general site conditions. Each contractor also recorded the amount of time spent on each piece of equipment as well as any delays caused by routine maintenance, mechanical failure, and implementation of best management practices (BMP). Individual machine utilization rates were calculated as the productive hours of the machine divided by the total hours required to complete the harvest (1). Note, we did not account for machine availability.

\[ MU_i = \frac{PH_i}{TH} \]  

Where,  
- \( MU_i \) = the utilization rate for machine \( i \)  
- \( PH_i \) = productive hours for machine \( i \)  
- \( TH \) = total hours required to complete harvest (i.e. sum of all machine productive hours + delays)

Equipment information (i.e. make, model, hours, purchase price, etc.) was collected during interviews with each contractor. This information was used in combination with utilization rates to calculate machine rates following Miyata (1980) and Stenzel et al. (1985). When available, direct cost information was used to determine fixed and variable costs when calculating machine rates. When cost information was missing, assumptions were based on recommendations made by Sessions (1992) and Miyata and Steinhelm (1981).

A second set of machine rates was calculated for the hypothetical scenario in which each contractor hired a second operator, thereby increasing the crew size to two. We assumed a $20/hr wage for the hired operator and a $30/hr wage for the owner-operator. The hired operator was assigned to a single machine, which was determined based on utilization rates calculated from daily production data. For example, if the owner-operator spent 50% of his time felling trees, with the remaining time split between skidding, slashing and loading/sorting, then the hired operator was assigned to run a chainsaw. In this example, the total person-hours required to complete the harvest would remain the same while the total elapsed time would reduce by half. Consequently, machine utilization rates would increase. Therefore, the machine utilization rates for the two-operator scenarios can be expressed as:

\[ MU_i = \frac{PH_i}{TH - PH_j} \]  

Where,  
- all variables are the same as in (1)  
- \( PH_j \) = productive hours of machine \( j \), which represents the machine assigned to the hired operator.

Total system costs were calculated for the single-operator harvest and the simulated two-operator scenario. The difference between the two costs represents the additional cost each contractor was willing to accept to avoid the burden of hiring and managing of a second operator.
Results

System configurations are listed in Table 1. All three sites were cut by hand. Operator A’s set-up differed from operators B and C in several important ways. Most notably, operator A owned a log truck and thus hauled his own loads, whereas the other two operators contracted their trucking. In addition, operator A owned a dozer, which was used for various tasks including pre-bunching hitches, clearing recreational trails of slash, installing waterbars and skidding during extremely muddy conditions.

Table 1. Equipment configurations for three single-operator harvest systems

<table>
<thead>
<tr>
<th>Operator</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>chainsaw, cable skidder, log truck with loader, dozer</td>
</tr>
<tr>
<td>B</td>
<td>chainsaw, grapple skidder, slasher/loader</td>
</tr>
<tr>
<td>C</td>
<td>chainsaw, grapple skidder, slasher/loader</td>
</tr>
</tbody>
</table>

Productivity was similar for operators B and C (6-7 tons/hr) (Table 2), who ran near identical systems (Table 1). Operator A produced far less volume per hour (1.8 tons/hr) despite reporting an average skid distance that was less than half of the other two.

Table 2. Productivity for three single-operator harvests

<table>
<thead>
<tr>
<th>Operator</th>
<th>Hours*</th>
<th>Tons</th>
<th>Tons/hr</th>
<th>Avg. skid distance (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>154</td>
<td>270</td>
<td>1.8</td>
<td>625</td>
</tr>
<tr>
<td>B</td>
<td>239</td>
<td>1528</td>
<td>6.4</td>
<td>1678</td>
</tr>
<tr>
<td>C</td>
<td>372</td>
<td>2516</td>
<td>6.8</td>
<td>1374</td>
</tr>
</tbody>
</table>

*Total hours to fell, skid, land, and buck including all delays

There are likely several contributing factors to the lower productivity reported by operator A. First, as part of the requirements of the sale, the contractor felled a large amount of cull trees as part of timber stand improvement treatments that were applied to two areas of the harvest site. Second, operator A spent a relatively greater amount of time on activities tallied as delays, such as BMP implementation and clearing slash from recreational trails (Figure 2). Third, operator A skidded to three landings, as opposed to a single landing for operator B and two landings for operator C. Therefore, additional system moves negatively affected productivity. Fourth, operator A ran a cable skidder while the other two ran grapple skidders, which Kluender et al. (1997) observed to be consistently more productive than cable skidders. Finally, operator A bucked by hand while the other two contractors used slashers.

Overall, operator A spent most of his time on the chainsaw felling and bucking (36%) and the least amount of time skidding (16%) (Figure 2). Operators B and C both spent most of their time skidding, while delays were generally minimal. This makes sense, given their use of slashers to buck logs and their longer average skid distances (Table 2)
System costs were determined by first calculating machine rates ($/PH) and then multiplying each rate by the total hours a given machine was used during the harvest (PH) to estimate a total cost per machine. Machine costs were then summed to arrive at total system costs. This was done for both the single-operator and 2-operator scenarios. The differences between the two system costs were calculated as a measure of estimated savings associated with hiring a second operator. (Table 3).

Figure 2. Breakdown of activities for three single-operator harvests (* Examples of “other” delays include meeting with forester or landowner, clearing recreation trails, and applying herbicide treatments to cull trees)
Table 3. System costs for single-operator harvests and the estimated savings by employing a second operator

<table>
<thead>
<tr>
<th>Operator</th>
<th>1-man</th>
<th>2-man</th>
<th>% change</th>
<th>1-man</th>
<th>2-man</th>
<th>% change</th>
<th>Elapsed time (10-hr days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (truck)</td>
<td>37.09</td>
<td>30.74</td>
<td>-17</td>
<td>540</td>
<td>814</td>
<td>51</td>
<td>18.5  11.8  -36</td>
</tr>
<tr>
<td>A (no truck)</td>
<td>24.18</td>
<td>15.74</td>
<td>-35</td>
<td>442</td>
<td>568</td>
<td>29</td>
<td>14.7  8.0   -46</td>
</tr>
<tr>
<td>B</td>
<td>12.56</td>
<td>9.95</td>
<td>-21</td>
<td>819</td>
<td>1288</td>
<td>57</td>
<td>23.9  12.1  -47</td>
</tr>
<tr>
<td>C</td>
<td>7.49</td>
<td>6.30</td>
<td>-16</td>
<td>502</td>
<td>806</td>
<td>61</td>
<td>37.2  22.1  -41</td>
</tr>
</tbody>
</table>

Discussion

According to our simulations, the addition of a second operator reduced costs per ton by between 16 and 35 percent (Table 3). These savings result from increased machine utilization and decreased machine rates. Costs per 10-hour day increased by 30 to 60 percent due to additional labor and operational costs while the total time required to complete the harvest decreased by 36 to 49 percent. Nevertheless, the addition of a second operator would have lowered total costs for each harvest.

While the addition of a second operator improved profitability and safety, the contractor would need to cut more volume per year to keep the more productive two-person crew busy. The ability to procure additional work either on a contract basis or by purchasing stumpage must be weighed in the decision to hire or not hire a second operator. Moreover, finding a competent, trust-worthy logger willing and available to work might prove to be a serious obstacle, particularly given the lack of young loggers entering the workforce (Egan and Taggart, 2004).

Despite having comparable production, operators B and C had markedly different costs. This is primarily the result of differences in ownership costs. For example, operator C ran a much older skidder that was purchased used for a fraction of what operator B paid for his new skidder. Thus, Operator B’s ownership costs were substantially higher.

In a study by Mayo et al. (2002), loggers attributed lost productivity primarily to weak markets, weather, mechanical failure, and poor planning. Interestingly, an unbalanced system did not make the list. In this study, it is apparent that working alone results in reduced productivity and increased costs per volume.

Conclusion

Single-operator harvest operations are common throughout the Northeast U.S. This approach results in low machine utilization and inflated machine rates with implications for profitability. Working alone also puts contractors at greater risk should an accident or injury occur. The potential savings associated with hiring a second logger to operate existing equipment can be significant. Nevertheless, single-operator contractors are choosing to forego adding a second logger, presumably for the freedom and flexibility that working alone offers. However, other obstacles may be affecting the decision to work alone, such as lack of competent and available loggers or the inability to line-up enough work to keep a two-person crew busy throughout the year. Moreover, it is possible that single-operator contractors are not aware of the savings that
can be realized through the addition of a second logger. On the other hand, if they are aware of the potential savings, they may simply prefer to incur the added costs to avoid the hassle of hiring, managing, and possibly even training a second operator. Further research is needed to understand the motivations behind these decisions as well as their implications for the long-term viability of the single-operator approach.

**Literature Cited**


