Maximizing Value of Timber Resources in Northern Hardwood Forests: Log Sorting in Wisconsin Timber Sales

Shuva Gautam, Adam Wysocki, and Baburam Rijal[1]

Abstract.—Northern hardwoods produce a variety of logs suitable for different final products. It is generally understood that sorting logs based on grade generates maximum value for all stakeholders. However, the benefits of log sorting may depend also on the geographical distribution of forest stands and manufacturing mills. The objective of this study was to evaluate the profitability of log sorting based on geographical location of forest stands, destination mills, and market parameters. A decision-support tool was used to allocate logs from timber sales to highest-profit-yielding mills. Factors considered by the model included logging cost, transportation cost, stand's distance to mills, mills' acceptance criteria, and price at the mill gate. Four small scale timber sale tracts from across Wisconsin were selected for the study. Several scenarios were tested with each scenario yielding different mixtures of log grades. The results showed that log sorting increased profit by up to $\$11.33 \cdot m^{-3}$ in certain locations but was not profitable in other locations. The methods proposed can help practitioners and landowners increase the monetary value and utilization of timber. Practitioners should systematically analyze forest stands to determine the gain or loss in profit resulting from sorting logs. Implementation of the proposed tool will help increase the use of under-utilized timber, especially in areas where profits are marginal.

INTRODUCTION

Wisconsin forests contain many different species in a single stand that may be managed using even- or uneven-aged silvicultural practices. Such stands contain logs that are suitable for manufacturing a variety of forest products. The task of sorting logs is important given the significant amount of profit that could be lost if done incorrectly (Dramm et al. 2004). For example, veneer logs of certain species can yield over $1000/MBF[2] and the price for log grade 1 can drop precipitously to less than $500/MBF. However, studies have demonstrated that logging cost increases with the number of log sorts (Manner et al. 2013). This can be attributed to the inefficiencies due to additional time taken by operators to sort logs. Logs will need to be sorted either at the felling site or at the landing. Sorting logs at the felling site will reduce the productivity of the harvester, the forwarder may also need to transport the different piles separately, increasing the number of trips. Higher number of sorts will also require larger landing area whether it is sorted at the felling site or at the landing site. All this ensemble will reduce productivity significantly. Therefore, log sorting decisions need to be made judiciously, otherwise it could lead to a net loss. The decision to sort logs is not straightforward because it is influenced by a number of supply-chain parameters and market conditions. The location of timber sales is a major factor that influences the profitability of sorting logs. If the mill is beyond a certain distance, it may not be profitable to sort a particular grade even if the price paid at the mill is high. Transportation cost can be a highly influential factor. Such decisions will not be obvious in all scenarios in all

[1] Faculty (SG and AW), College of Natural Resources, University of Wisconsin-Stevens Point, WI; Researcher (BR) Department of Forest Research, Ministry of Forest Wildlife and Parks, Quebec, Canada. SG is corresponding author: to contact, email shuva.gautam@uwsp.edu.

[2] MBF = thousand board feet

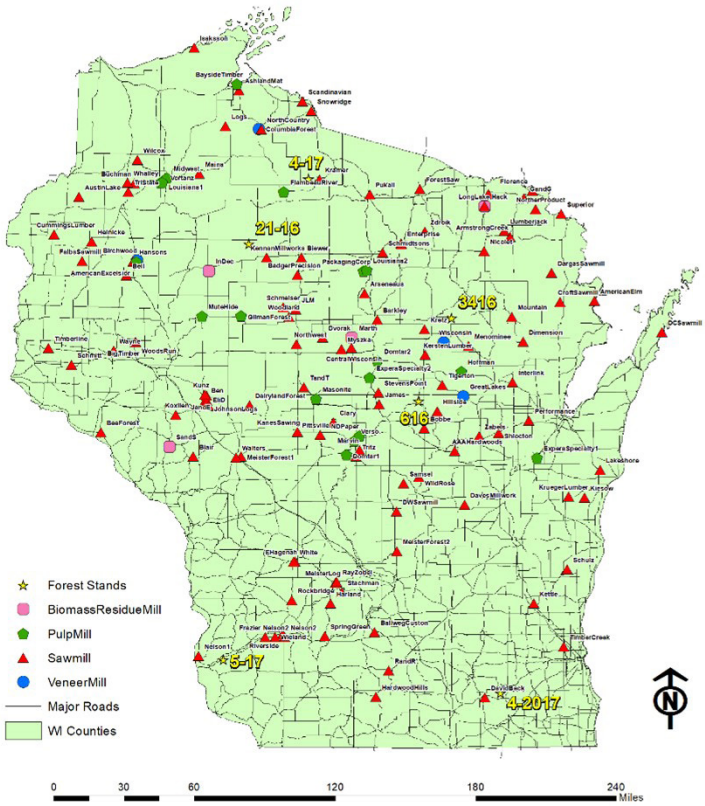

Figure 1. —Map of the study area showing mill and harvest site locations.

locations across Wisconsin. Making an optimal decision can be quite complex when taking into consideration various factors, such as the number of log sorts, the prices paid at the potential mills, and distance to each of those mills. Regardless, such decisions are made by practitioners without the use of any analytical tools. The objective of this study is to quantify the potential profit or loss associated with log sorting at various locations across Wisconsin.

METHODS

Data from several different timber sales that occurred on Wisconsin state lands were used as the supply data for this study. The data contained location of the timber sale tracts and volumes by species. Four different locations were selected to represent different supply and market dynamics within the State. Volumes were further categorized into pulpwood, biomass, sawbolt, and grade logs. Three hypothetical scenarios were subsequently developed. Volumes of pulpwood, sawbolt, and biomass remained constant in all scenarios, but the volumes of graded logs were different. Scenarios 1 contained the largest proportion of higher grade logs followed by scenarios 2 and 3. The log grades included in the study were veneer, grades 1, 2, and 3. Mill location and data on their capacity were obtained from the Wisconsin Department of Natural Resources (Fig. 1). The data also contained information on the types of logs accepted by each of the mills. The ArcGIS Network Analyst extension was used to calculate the distance between each mill and the timber sale. A linear programming model was developed to allocate each assortment in each of the timber sales to a mill. The objective was to maximize profit through the sales of the logs at the mill gate. Costs taken into consideration included logging cost, transportation costs, and stumpage. The profitability of different log-sorting scenarios at various locations across Wisconsin were subsequently assessed.

Table 1.—Summary of results of the optimization process for different timber sale tracts and scenarios

Tract	Scenario	Total volume harvested (m^3)	Profit ($)	Profit ($/m^3$)
Southwest	1	360	18,919	52.59
	2	377	22,423	59.49
	3	394	18,981	48.17
Central	1	1,030	18,546	17.99
	2	1,006	18,082	17.96
	3	1,023	12,944	12.65
Southeast	1	257	764	2.98
	2	411	1,222	2.98
	3	257	764	2.98
Northwest	1	7,613	23,838	3.13
	2	7,645	22,153	2.90
	3	7,614	19,640	2.58

RESULTS

A summary of the results is shown in Table 1. Although scenario 1 generated the highest proportion of high values logs in all scenarios, it produced the greatest profit in only two of the four scenarios. The tract in the Southeast region did not have many mills operating so there was limited choice regarding where the various log assortments could be sent. The lack of mills meant that only sawbolt was utilized although higher value logs were sorted. Southwest region tract was another case where scenario 1 did not generate the highest profit. This region produced the highest profit per cubic meter harvested due to the presence of high value trees such as walnut and cherry. The reason that scenario 1 did not produce the highest profit was because the region did not have veneer mills nearby where the highest value logs could be sent. Scenario 1 would have likely yielded the greatest profit if mills in other states were also included in the study. Nevertheless, the difference between scenario 2 and scenario 3 was over $\$11 \cdot m^{-3}$ indicating that sorting was worth it in the tract.

The Central and Northwest regions yielded the highest profit for scenario 1, followed by scenarios 2 and 3. These timber sale tracts had a diversity of species and access to a variety of mills nearby that processed multiple products and species. Logs sorted in these regions were sent to as many as 11 mills. It was worthwhile to sort logs in these regions because each sort could be sent to a mill at a feasible transportation cost. The increase in profit in the Central region between scenario 3 and 1 was $\$5.34 \cdot m^{-3}$, and just below $\$2 \cdot m^{-3}$ for the Northwest region, which is relatively low but the quality of trees in the tract limited the profit.

CONCLUSION

Log sorting is an important task, particularly in northern hardwood forests that produce a range of log assortments that are suitable different types of mills. The right decision for each scenario depends not only on the species mix present in the forest but also on market conditions and location. This study demonstrates that there may be significant gains associated with using decision-support tools to make log sorting decisions. Such tools are particularly useful in areas with variety of mills and in areas that grow high value trees.

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LITERATURE CITED

Dramm, J.R.; Govett, R.; Bilek,T.; Jackson, G.L. 2004. **Log sort yard economics, planning and feasibility**. Gen. Tech. Rep. FPL-GTR-146. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 31 p. https://doi.org/10.2737/FPL-GTR-146.

Manner, J.; Nordfjell, T.; Lindroos, O. 2013. **Effects of the number of assortments and log concentration on time consumption for forwarding**. Silva Fennica. 47(4): 1030. https://doi.org/10.14214/sf.1030.

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