Advantage
Restricted to FERIC Members and Partners
Vol. 2 No. 45 September 2001

Contents

Cost analysis of harvesting with dispersed cut blocks

Abstract

This report presents the main factors to consider in evaluating the economic impact of using a dispersed block layout rather than traditional clearcuts separated by narrow leave strips. The costs related to the construction, maintenance, and restoration of roads, as well as travel by forestry machines and haul trucks and the indirect harvesting costs, are illustrated using a hypothetical example. An Excel spreadsheet is available so readers can perform comparative analyses based on their own operating conditions.

Keywords:

Dispersed cut blocks, Costs, Simulation, Excel spreadsheet.

Authors

Jean Favreau and Jean-François Gingras
Eastern Division

Introduction

With the revision of Quebec's Forest Act, dispersed cut blocks should become more prevalent in Crown forests in coming years, and companies are wondering about the economic impact of adopting this approach. FERIC has published an analysis of harvesting costs that compared dispersed cut blocks (with residual blocks) and clearcutting of larger areas (Gingras 1997), but this analysis provided hypothetical results *for a specific context* within an area near Lac St-Jean (Que.).

To help managers evaluate the economic impacts of dispersed cut blocks compared with traditional clearcutting using leave strips, FERIC has produced a Microsoft Excel spreadsheet that compares the harvesting costs for large areas based on the two approaches, while accounting for the specific operating conditions encountered. *This report presents an example of the most important factors to consider in such comparisons.*

Roads built in advance

In the boreal forest, an approach based on dispersed cut blocks involves separating the harvested areas using blocks of equivalent area that will be harvested some years later. The return period is defined based on adjacency constraints that prescribe the required regeneration height in the contiguous harvested blocks. In this approach, operations must obviously cover a greater area to harvest a given volume of wood. The main consequence thus becomes the decreased volume harvested per kilometre of road. During the first years of implementing the operation with dispersed cut blocks, additional kilometres of road must be built that will only be used in the future. The bank of roads built ahead of their use for harvesting represents an investment in future harvests, and the associated cost increase thus relates to the financing costs for these roads. However, if a forestry company considers these reserve roads as current expenditures rather than as a capital investment, the impact of the road costs becomes even greater.

Using a fictitious area to be harvested with dispersed cut blocks, Figure 1 illustrates an *example* of the annual number of kilometres of road that must be built in advance to permit harvesting of the residual stands, for each year after the start of the regime in the year 2000. The assumed harvest is 200 000 m³ annually over 32 years. In this example, the forest company would build around 12 km/year of additional roads until 2016, with the reserve of roads reaching a maximum of 200 km and subsequently decreasing gradually until 2032. In the traditional approach, the company would not have to build these roads in advance. The required road reserve depends strongly on the area's geography (geomorphology, hydrologic network, topography, forestry history, etc.), on the spatial distribution of the blocks to be harvested, and on the existing road network. Nonetheless, this example reveals how harvesting costs can vary in an approach with dispersed blocks. Four cost factors were considered in the analysis, in order of decreasing importance: road construction, road maintenance and restoration, travel by forestry machines and haul trucks, and indirect costs.

Note: The interest rate used in these calculations includes both the company's general financing rate and a risk factor to account for the possibility that various unforseen occurrences may prevent the company from harvesting the entire residual volume.

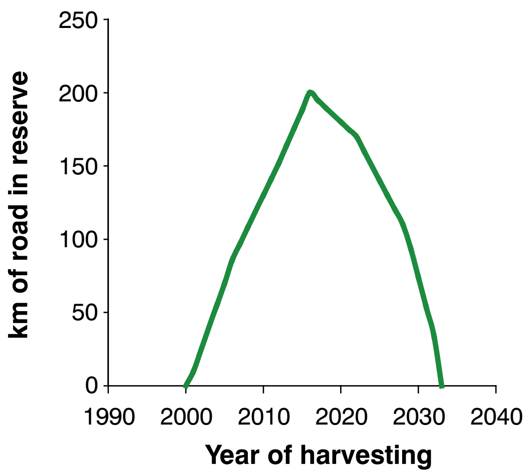

Figure 1. Example of the changing number of kilometres of road held in reserve for harvesting with dispersed cut blocks (annual harvest of 200 000 m³) over 32 years.

Factor 1: Road construction

Figure 2 presents an *example* of the additional harvesting cost with dispersed cut blocks that results from building roads in advance *based on the construction levels shown in Figure 1*. The construction cost per kilometre of road and the interest rate that applies to the sums invested prior to harvesting greatly influence this additional cost. In the example, at an interest rate of 8%, the harvesting cost increases by around $0.40/m³ for a road construction cost of $10 000/km. When the construction cost reaches $30 000/km and the interest rate is 12%, the cost increases by $1.66/m³. Building roads in advance represents the greatest additional cost that the forestry company must sustain when adopting an approach based on dispersed cut blocks instead of clearcutting with leave strips. The number of kilometres of road held in inventory depends almost entirely on the spatial distribution of the cuts.

Find us Online!
www.feric.ca

Forest Engineering Research Institute of Canada (FERIC)

Eastern Division and Head Office
580 boul. St-Jean
Pointe-Claire, QC, H9R 3J9
(514) 694–1140
(514) 694–4351
admin@mtl.feric.ca

Western Division
2601 East Mall
Vancouver, BC, V6T 1Z4
(604) 228–1555
(604) 228–0999
admin@vcr.feric.ca

Publications mail #1677314 ISSN 1493-3381

Changes in the level of capital tied up in the roads built in advance and in the interest costs incurred by this investment are proportional to the amount of road being held in reserve. Using the data from Figure 1, Table 1 presents an *example* of the interest cost incurred annually on the immobilized capital at 5-year intervals, with a road-construction cost of $30 000/km and an interest rate of 8%. The money spent over the course of this regime represents the additional cost of building roads in advance of harvesting.

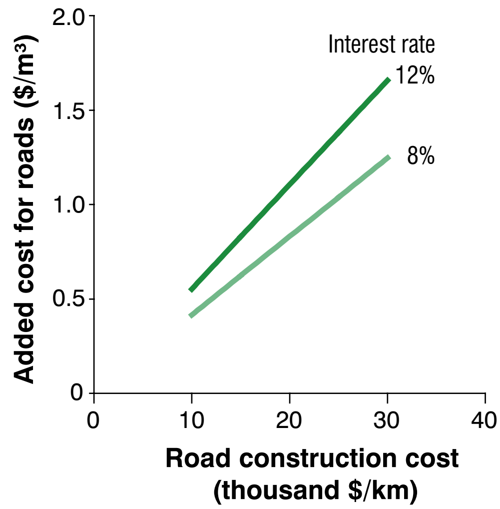

Figure 2. Example of the cost associated with building roads in advance for harvesting with dispersed cut blocks.

Factor 2: Road maintenance and restoration

Dispersed cut blocks also require the annual maintenance and restoration of a greater length of road. It may be necessary to maintain part of the network of roads built in advance of harvesting to let workers reach harvesting areas. The layout of the road network and fragmentation of the harvesting areas over the course of the harvesting operations both greatly influence the mean number of kilometres of road that must be maintained annually. Figure 3 presents an *example* of the increase in

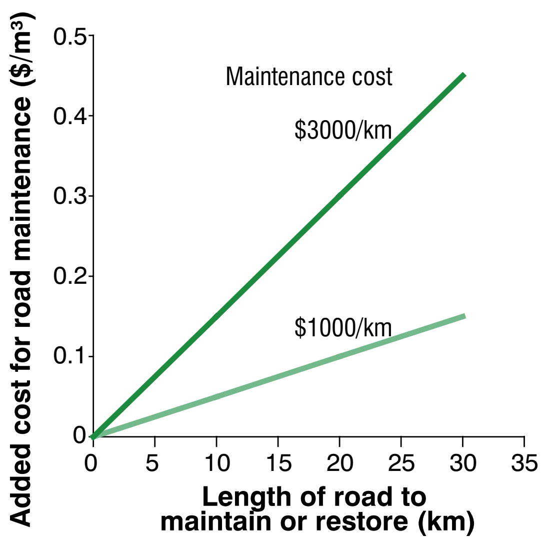

Figure 3. Example of the mean additional cost for the maintenance and restoration of roads for harvesting with dispersed cut blocks (harvest of 200 000 m³ per year).

Table 1. Example of the additional annual cost for building roads in advance of harvesting with dispersed cut blocks (@ $30 000/km and an 8% interest rate)

	Inventory of roads (km)	Immobilized capital (thousand $)	Additional interest cost (thousand $)	
			Current $	Constant $
Year				
2001	10	300	24	23
2006	86	2580	206	135
2012	152	4560	365	151
2018	190	5700	456	119
2024	150	4500	360	59
2030	74	2220	178	18

harvesting costs in an operation with dispersed cut blocks as a function of this number of kilometres, plus the relative expenditures per kilometre to maintain and restore the additional road network required, for a harvest of 200 000 m³ per year. For example, at $1000/km, the maintenance and restoration of an additional 20 km of road per year represents an added cost of $0.10/m³. At $3000/km, the additional cost reaches $0.30/m³.

Factor 3: Travel by forestry machines and haul trucks

By increasing the average distance between blocks, the dispersed cut blocks require more frequent or longer travel by forestry machines to harvest a given volume. Consequently, these machines spend more hours per year travelling, and if the travel distances are sufficiently large, a low-bed truck may be necessary. Figure 4 presents an *estimate* of the increase in harvesting costs caused by the increased travel for all the machines used to harvest 200 000 m³ per year, and suggests that this factor doesn't contribute greatly to the cost increase. For example, if the mean hourly cost of the machines during travel, including the low-bed truck, is $120/PMH, the total travel time must reach 200 hours/year to increase the cost by $0.12/m³.

In addition to increasing the amount of travel by the trucks during loading, increased dispersion of the cut blocks can increase the average haul distance to the mill under certain circumstances. This latter factor can thus become quite significant in the cost analysis.

Factor 4: Indirect costs

Supervision of the operations across the greater area required to harvest a given volume of wood can require additional human resources and materials. Longer and more frequent travel between the cut blocks reduces the productive time of supervisors. An additional supervisor may be required, and it's possible that camps may have to be relocated more often to reduce the average travel distance.

Figure 5 provides an example of the impact on harvesting costs associated with the increase in annual indirect costs. With additional indirect costs of $40 000/year in an operation with dispersed cut blocks, the harvesting cost increases by $0.20/m³ for a harvest of 200 000 m³/year.

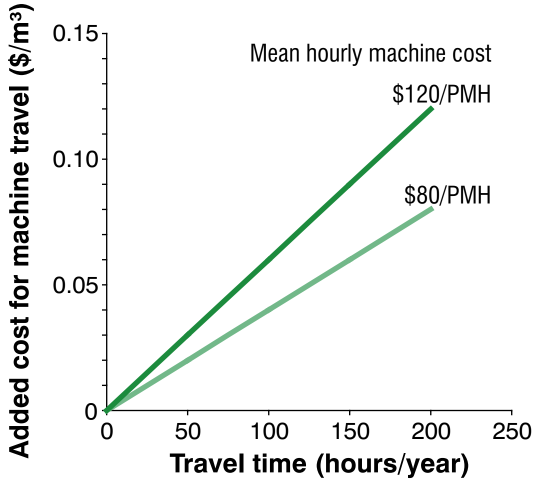

Figure 4. (*left*) Cost of the additional travel of forestry machines, floats, and haul trucks for harvesting with dispersed cut blocks as a function of the mean hourly cost of the machines (200 000 m³/year).

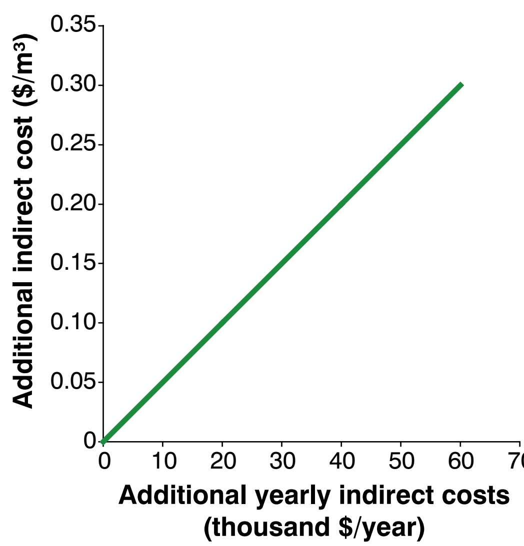

Figure 5. (*right*) Additional indirect costs for harvesting with dispersed cut blocks (200 000 m³/year).

Implementation

The example we used to illustrate the potential cost increase that results from harvesting with dispersed cut blocks highlights the importance of several variables. *However, we recommend that readers use FERIC's Excel spreadsheet to compare the two types of harvesting using their own data to obtain a measure of the costs that more closely reflects local conditions*. The geographical and temporal distribution of the harvesting areas, the manner in which the road network will be deployed over time, the risk of losing standing timber, and partial harvesting of residual stands all affect the magnitude of the additional costs of using dispersed cut blocks.

Table 2 uses our example to create two possible scenarios based on the use of dispersed cut blocks. The first results in a low additional cost when all the operating conditions are largely favorable; the second results in a high additional cost because the operating conditions are less conducive to this approach. In these examples, the cost increase lies between \$0.46 and \$3.30 per m³. It's obviously possible to develop scenarios in which the costs lie outside this range, particularly if the roads built in advance of harvesting are treated as current expenses rather than as investments in future harvests (i.e., rather than capitalizing the costs). *The magnitude of the variations in the results obtained for these scenarios illustrates the importance of using the Excel spreadsheet to better estimate the actual cost of dispersed cut blocks based on local operating conditions.*

Table 2. Scenarios for the added cost of using dispersed cut blocks (annual harvest of 200 000 m³)

	Low additional cost		High additional cost	
	Assumption	**Additional cost (\$/m³)**	**Assumption**	**Additional cost (\$/m³)**
Type of additional cost				
Construction of roads in reserve	\$10 000/km 8% interest	0.42	\$30 000/km 12% interest	1.66
Maintenance and restoration of roads	5 km more per year @ \$1000/km	0.025	20 km more per year @ \$3000/km	0.30
Machine travel	50 hours more per year @ \$80/PMH	0.02	200 hours more per year @ \$120/PMH	0.12
Increase in the average haul distance[a]	No increase in distance	0.00	Additional 30 km of distance (return trip) per year	0.77
Indirect costs (camps, supervisors, etc.)	\$0/year	0.00	\$90 000/year	0.45
Total		**0.46**		**3.30**

[a] The calculation is based on an average two-way haul distance of 240 km at a haul cost of \$10/m³.

On the other hand, an approach based on dispersed cut blocks offers certain advantages. For example, it lets managers open up an area more rapidly, and this lets them better gauge the operating conditions therein, thereby facilitating subsequent planning and budgeting. A well-developed road network also facilitates silvicultural work, permits more rapid control of forest fires, potentially reduces the risk of windthrow, provides opportunities for partial cuts in the residual stands, and permits better balancing of annual haul distances. The added road costs associated with using dispersed cut blocks can be reduced by increasing the extraction distance (thereby cutting back on the number of kilometres of forestry road that must be built) and by more judicious road positioning.

Reference

Gingras, J.-F. 1997. Harvesting with residual blocks or leave strips: an economic comparison. For. Eng. Res. Inst. Can. (FERIC), Pointe-Claire, Que. Tech. Note TN-263, 8 p.