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Harvesting and Renewal Costs of Stripcutting Relative to those of Clearcutting on Shallow-soil Upland Black Spruce Sites in North Central Ontario

J.D. Johnson and J.H. Smyth

Information Report O-X-380
Great Lakes Forestry Centre

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HARVESTING AND RENEWAL COSTS OF STRIPCUTTING RELATIVE TO THOSE OF CLEARCUTTING ON SHALLOW-SOIL UPLAND BLACK SPRUCE SITES IN NORTH CENTRAL ONTARIO

J.D. JOHNSON AND J.H. SMYTH

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ABSTRACT

Harvest and renewal costs of strip-cut harvesting and clear-cut harvesting on shallow-soil upland black spruce sites in north central Ontario are identified, estimated and compared. Additional costs and savings associated with strip-cut harvesting are analyzed for 12 renewal prescriptions and two strip lengths over leave periods of 3, 5 and 10 years. Harvesting costs are higher for stripcutting than for clearcutting; however, in all harvest-renewal alternatives that compare stripcutting with clearcutting followed by planting, these additional costs are more than offset by renewal savings. When stripcutting is compared with clearcutting followed by aerial or spot seeding, the analysis shows that it is less expensive to clear cut. A doubling of the strip length from 183 m to 366 m reduced harvesting costs, but alone this cost reduction is not enough to affect the decision to harvest sites by means of the strip-cut or the clear-cut system. Additional harvesting costs associated with stripcutting vary in proportion to the leave period. Leave periods of up to 10 years are acceptable, but not desirable.

RÉSUMÉ

On a étudié, calculé et comparé le coût de reboisement sur des stations élevées au sol mince peuplées d'épinettes noires, dans le centre-nord de l'Ontario. Les coûts et économies additionnels liés à la coupe en bandes sont étudiés dans le cas de 12 prescriptions de reboisement et de 2 longueurs de bande sur des périodes de réserve de 3, 5 et 10 ans. Le coût de la coupe en bandes dépasse celui de la coupe rase; cependant, dans toutes les alternatives où sont comparées les deux formes de coupe suivies d'une plantation, le coût additionnel est plus que compensé par les économies obtenues au reboisement. De la même façon, quand les deux formes de coupe sont suivies d'un ensemencement aérien ou en placeau, l'analyse montre que la coupe rase est plus économique. Le doublement de la longueur des bandes, de 183 à 366 m, a permis d'obtenir des économies, mais pas suffisantes pour influencer la décision d'opérer par coupe rase ou par bandes. Le coût additionnel de récolte associé à la coupe en bandes varie en proportion de la période de réserve. Une période de 10 ans reste acceptable, mais pas désirable.

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INTRODUCTION

In 1973, a cooperative research project involving the Great Lakes Forestry Centre, Ontario Ministry of Natural Resources (OMNR) and Domtar Inc., under the auspices of the Canada-Ontario Joint Forestry Research Committee (COJFRC), was established to explore the effectiveness of alternate stripcutting on shallow-soil upland sites as a means of obtaining natural regeneration of black spruce *(Picea mariana* [Mill.] B.S.P.).

The most widely employed method of harvesting in Ontario is clearcutting. Upland black spruce sites are extremely difficult to regenerate because of a limited mineral soil matrix, too great an exposure of these sites to wind and high temperatures, extremely dry surface conditions, susceptibility of these sites to erosion, and an inadequate supply of viable seed for natural regeneration. In stripcutting, the residual strip provides seed for the regeneration of the first cut strip. These residual strips also protect the natural regeneration from excessive drying.

Several reports (Ketcheson 1977; Ketcheson and Smyth 1977,[1] 1978; Ketcheson 1979) dealing with specific economic aspects of the strip-cutting project have been published to date. Details of the establishment, location, and objectives of this long-term cooperative study of stripcutting are provided by Jeglum (1980).

OBJECTIVES

The objectives of the current study are to identify, estimate, and compare harvesting and regeneration costs of strip-cut harvesting and clear-cut harvesting in the shallow-soil upland black spruce sites of north central Ontario, specifically within the Domtar Inc. timber limits north of Nipigon. In this study, neither costs nor revenues are considered beyond the point of stand establishment. The least-cost strategy is, therefore, not necessarily the most economically efficient strategy.

In the analysis, incremental harvesting costs and renewal savings are estimated for alternate stripcutting with strips 183 m and 366 m long and 60 m wide over leave periods of 3, 5 and 10 years. The shorter strip constitutes the maximum skidding distance allowed for conventional cut and skid under the present union agreement with Domtar Inc., while the longer constitutes the maximum distance for mechanical felling and forwarding. At the present time, industry appears to be moving toward mechanical felling and forwarding.

ADDITIONAL HARVESTING COSTS ASSOCIATED WITH STRIPCUTTING

Alternate stripcutting results in higher harvesting costs than those associated with conventional clearcutting. Ketcheson (1979) analyzed the costs of stripcutting over and above those associated with clearcutting on the basis of

[1] Ketcheson, D.E. and Smyth, J.H. 1977. The impact of stripcutting on slashing costs. Dep. Environ., Can. For. Serv., Sault Ste. Marie, Ont. 8 p. (Unpubl. rep.)

data collected from the woodlands divisions of two major companies operating on shallow-soil upland sites in northern Ontario. Relevant cost data from Ketcheson (ibid.), with some modifications, have been used in this report. All costs are in constant 1985 dollars[2]. A real discount of 4.5%, which appears to be an appropriate rate for long-term forestry investments as discussed by Row et al. (1981), has been used.

Additional harvesting costs associated with alternate stripcutting can be grouped into the following six categories[3]:

1) planning, layout and supervision
2) in-strip effects
3) roadside processing
4) movement of equipment
5) road construction and maintenance
6) losses to blowdown.

Figures 1 and 2 illustrate, by leave periods, those items which contribute to extra stripcutting costs for the 183-m and 366-m strips, respectively. Overall costs for the two lengths of strip are similar, but harvesting costs are slightly lower for the longer strips because there is a lower tertiary road density for these, and less loss to blowdown.

Planning, Layout and Supervision

The highest planning, layout and supervision costs provided by Ketcheson (1979) for companies operating on shallow-soil upland sites were used. Ketcheson's estimate was augmented to account for the additional resources required by the operator to retype OMNR's Forest Resource Inventory (FRI) maps to a level of operational resolution appropriate for effective strip layout. The additional cost to Domtar Inc. of retyping FRI maps reflects the broken and irregular topography characteristic of the Lake Nipigon Forest. A cost of $42.50/ha was used to estimate additional planning, layout, and supervision costs.

In-strip Effects

The most critical assumption underlying the analysis is that felling and forwarding costs do not increase relative to clearcutting costs for 60-m-wide strips with either the 183-m or the 366-m strip lengths. It is assumed that strip-cut operations will employ harvesting equipment in a manner consistent with the strip-cutting system and specific site conditions. In addition, it is assumed that blowdown in the residual strip does not affect productivity significantly.

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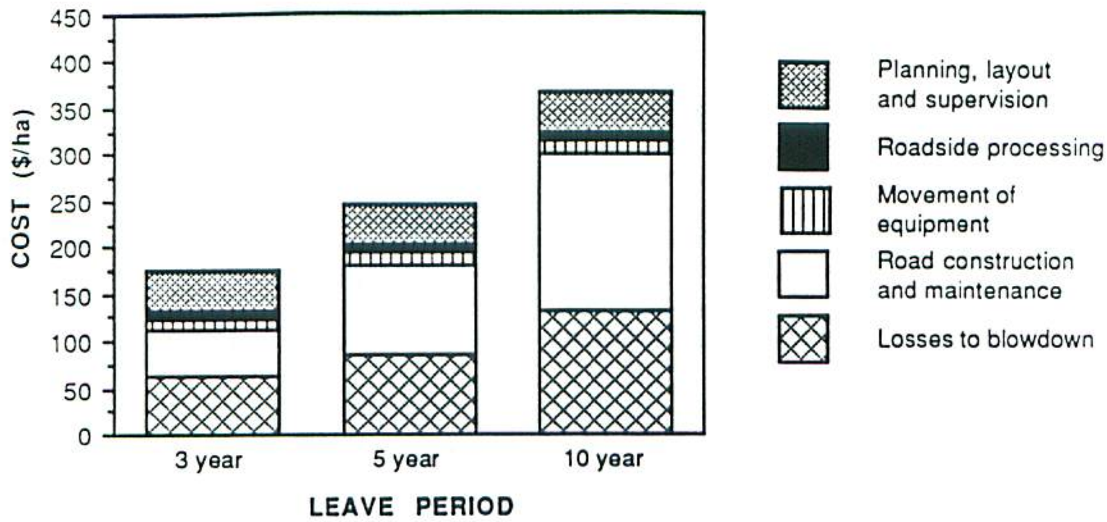
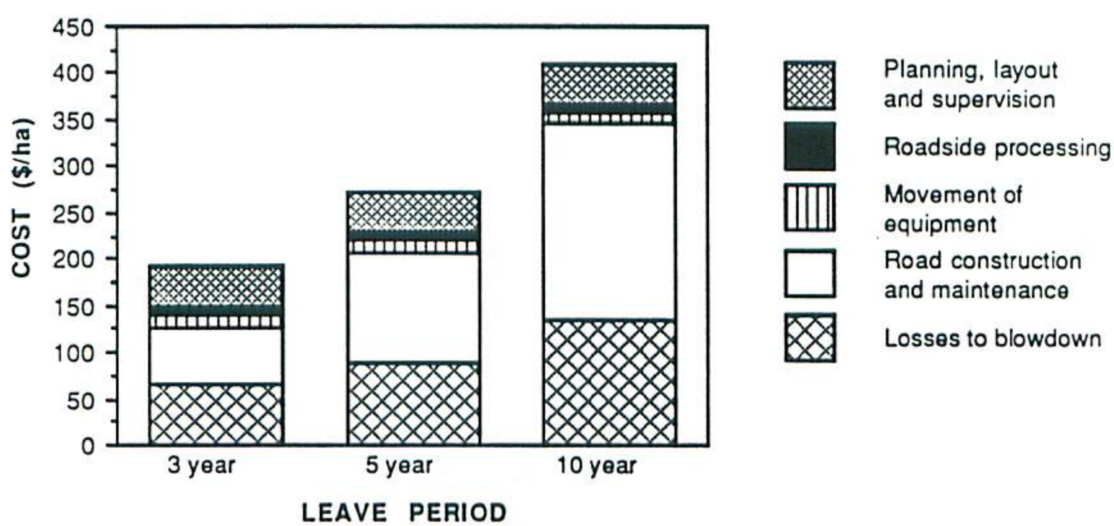
[2] Costs from Ketcheson (1979) are expressed in 1985 dollars and are based on the Gross National Expenditure Implicit Price Index.

[3] Ketcheson (1979) identified and costed items 1-5; item 6 was included and costs were estimated by the authors of the present report.



Note: The assumption is that there are no in-strip operating costs.

Figure 1. Alternate stripcutting relative to clearcutting: incremental harvesting costs, by leave period, for areas harvested in 183-m strips.



Note: The assumption is that there are no in-strip operating costs.

Figure 2. Alternate stripcutting relative to clearcutting: incremental harvesting costs, by leave period, for areas harvested in 366-m strips.

Roadside Processing

Ketcheson (1979) found that stripcutting, in comparison with clear-cutting, did not increase loading and hauling costs and that slashing costs were increased only marginally. Slashing costs were increased because two sweeps of the road were required (one for each leave period) and additional time was needed to move between piles. The highest additional cost of roadside processing in the two operations examined by Ketcheson (ibid.) was used in the analysis. Additional roadside processing costs were set at $9.01/ha.

Movement of Equipment

This minor cost element accounts for the additional cost of moving harvesting equipment to and from the site and of servicing this equipment (i.e., garage costs). In this report, the additional garage cost associated with cut and skid operations as estimated by Ketcheson (1979) was used. Additional overhead charges for equipment that were attributable to the strip-cutting harvesting system were estimated at $13.31/ha.

Road Construction and Maintenance

Ketcheson (ibid.) found that, with the strip-cutting system, the most important cost element contributing to additional harvesting cost was road construction and maintenance. Standards of secondary and tertiary access roads do not differ from those for clear-cut operations; however, twice as much area as in the clear-cutting operation must be accessed initially to extract the same volume of timber. Accordingly, the opportunity cost associated with carrying the initial road investment over a longer period must be accounted for in the analysis. The capital charges associated with road construction vary directly with leave period.

Deterioration of tertiary haul roads increases with leave period (Ketcheson, ibid.). Therefore, the costs of reconstructing tertiary haul roads to standards set for the harvesting of the residual strip also vary directly with leave period.

Road construction costs vary with strip length. Strip dimension affects the spacing and, therefore, the length of tertiary road construction in the strip-cutting area. It is assumed that the length of secondary haul road in the clear-cut area is the same as in the area harvested under the strip-cutting method, and that tertiary road length is the same in the area clear cut as in the area harvested in strips with a strip length of 183 m.

On the other hand, the 366-m strip length results in a lower tertiary road density and, therefore, lower capital and maintenance costs. In 1986, Domtar forestry personnel mapped a tertiary road network, using both the 366-m and the 183-m strip lengths in an area designated for stripcutting[4]. A factor

[4] L. Morrow, Domtar Inc., Red Rock, Ontario, 1986 (pers. comm.)

equivalent to the proportion of tertiary road lengths required with the two different strip lengths was applied to the capital and maintenance costs for tertiary roads in the 183-m strips to estimate the capital and maintenance costs for tertiary roads for the area laid out in 366-m strips. Table 1 shows the additional (estimated) average cost per ha of secondary and tertiary road construction and maintenance for the two strip lengths by leave period.

Table 1. Incremental road construction and maintenance costs[a] associated with alternate stripcutting and clearcutting ($/harvested hectare).

	(1) Capital charges			(2) Reconstruction		
Leave Period	Secondary[b]	Tertiary 183 m[c]	Tertiary 366 m[d]	Secondary[b]	Tertiary 183 m	Tertiary 366 m
3	6.76	11.67	8.68	0.00	32.57	24.25
5	10.45	22.12	16.45	14.95	60.83	45.28
10	19.87	35.43	26.38	30.52	114.70	85.37

	(3) = (1) + (2) Total construction			(4) Maintenance		
Leave Period	Secondary[b]	Tertiary 183 m	Tertiary 366 m	Secondary[b]	Tertiary 183 m	Tertiary 366 m
3	6.76	44.24	32.93	0.00	10.65	7.93
5	25.40	82.95	61.73	0.00	10.86	8.07
10	50.38	150.13	111.75	0.00	11.47	8.52

	(5) = (3) + (4) Total road cost		
Leave Period	Secondary[b]	Tertiary 183 m	Tertiary 366 m
3	6.76	54.89	40.86
5	25.40	93.81	69.80
10	50.38	161.60	120.27

[a] average of costs determined in Ketcheson (1979) for companies operating on shallow-soil, upland black spruce (all costs in 1985 constant dollars)
[b] secondary haul roads
[c] tertiary haul roads in areas harvested by 183-m strip lengths
[d] tertiary haul roads in areas harvested by 366-m strip lengths

Losses to Blowdown

There is a loss of merchantable volume caused by blowdown in the residual strip which, under a clear-cut system, could have been retrieved and utilized. The loss to blowdown in the residual strip is, therefore, a major source of additional cost. If one assumes that the net mortality attributable to the strip-cutting system is left on the site and that in-strip productivity is not affected by this debris, the cost of blowdown in the residual strip can be estimated as the cost per cubic metre "on the stump" of accessing new harvest areas (i.e., administration, planning, camp and garage costs). A study (Anon. 1977) in which wood costs in northern Ontario were analyzed was used to estimate a 1985 overhead cost of $12.00/m^3$.

Fleming and Crossfield (1983) related merchantable blowdown losses in the residual strip to site index, initial density, strip dimension and leave period. This relationship was used to estimate blowdown in the leave strips of the Domtar Inc. operating area. Table 2 provides an estimate of the volume of blowdown and the cost of this blowdown in the residual strips by strip length and leave period.

Table 2. Estimated value[a] and volume of blowdown losses in the leave strip by strip length and leave period.

	Leave Period					
	3-year		5-year		10-year	
	(%)	($/ha)	(%)	($/ha)	(%)	($/ha)
183-m strips	8.3	65.00	11.2	88.00	17.1	134.00
366-m strips	8.1	63.00	10.9	85.00	16.7	131.00

[a] All costs are in 1985 constant dollars.

RENEWAL COSTS OF STRIPCUTTING RELATIVE TO THOSE OF CLEARCUTTING

It has been shown that, under similar site conditions, strip-cut harvesting results in higher unit area harvesting costs than does clearcutting. However, it is reasonable to assume that, under some conditions, it may be less expensive to establish a new stand in a strip-cut area than in a clear-cut area. To determine whether or not this is the case, it is necessary to estimate renewal costs in the strip-cut areas and compare these with renewal costs on similar sites that have been clear cut. Such a comparison implies that the forest manager has a choice between clearcutting and stripcutting and a choice among renewal options for the clear-cut and the residual strip. It is assumed that the first strip will be adequately stocked by natural regeneration when the residual strip is harvested.

Elements of Renewal Costs

Renewal costs for the strip-cut and clear-cut systems are grouped in the following categories:

1) site preparation
2) stock/seed procurement
3) planting/seeding.

Site Preparation

It was assumed that both the clear-cut and the strip-cut areas could be adequately prepared with the Bräcke Badger pulled by a skidder. No relevant cost studies have been completed that indicate whether or not site preparation in the 60-m strips would be significantly more expensive per unit area than in the clear-cut area. Nonetheless, discussions with personnel at Domtar Inc. and elsewhere indicate that if the "land pattern method" (Anon. 1978) were used in the residual strips, no significant additional scarification costs would be incurred. The flexibility of the Bräcke Badger enables the manager to modify the frequency and distance between patches to accommodate the desired renewal option without affecting the forward motion or swath width of the machine. Site preparation of the residual strip will require marking and monitoring to protect regeneration on the first cut. It is assumed that these duties can be performed by the foreman already on site and, therefore, will not generate additional costs.

Stock/Seed Procurement

Stock and seed costs for jack pine (*Pinus banksiana* Lamb.) and black spruce delivered reasonably close to the planting area were obtained from OMNR's tree nursery at Thunder Bay. Seed procurement charges were estimated at $140.87/kg for jack pine (at 288,300 seeds/kg). Container seedling procurement charges were estimated at $180.50/thousand seedlings (delivered) for jack pine, and $188.50/thousand seedlings (delivered) for black spruce. A planting density of 2,500 trees/ha[5] was used. An aerial seeding rate of 50,000 jack pine seeds/ha and a spot seeding rate of 25,000 seeds/ha were used to estimate the purchase cost of seed or stock/ha. Stock and seed costs/ha were halved in the strip-cutting system since the first strip was assumed to have seeded in naturally.

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[5] L. Morrow, Domtar Inc., Red Rock, Ontario, 1986 (pers. comm.)

Planting/Seeding

The operational costs associated with planting and seeding were taken from the 1985 cost schedules presented in five major forest management agreements (FMA)[6] in the area. The highest costs were used to reflect the difficult conditions common to the shallow-soil upland sites in the study area. A 1985 planting cost of $161.09/thousand seedlings and an aerial seeding cost of $6.96/ha were used.

The additional cost of carrying the expense of site preparation of the initial strip over the leave period is not accounted for because it is assumed that the cost is offset by the additional value of the crop trees in this strip when the next harvest occurs. Accordingly, renewal costs vary by renewal option but not by leave period or strip length.

RENEWAL OPTIONS

The renewal options listed below were examined for stripcutting (i.e., for the residual strip) and clearcutting. It is necessary to be aware that the magnitude of net renewal savings or losses depends on the renewal options chosen for the clearcut and the residual strip.

The following renewal options were examined for the clear-cut comparisons:

1) container planting of black spruce or jack pine
2) aerial seeding of jack pine
3) spot seeding of jack pine with the Bräcke Badger.

The following renewal options were examined for the residual strips:

1) container planting of black spruce or jack pine
2) spot seeding of jack pine with the Bräcke Badger.

It was assumed that all clear-cut and strip-cut areas could be site prepared with the Bräcke Badger no matter what the choice of stock or renewal method. All first-cut strips were assumed to be satisfactorily stocked naturally to a desirable species.

A paring of renewal options for the clear-cut and the residual strip can be considered a strip-cut/clear-cut renewal prescription. In all, 12 renewal prescriptions were developed.

Figure 3 illustrates, by renewal prescription, the renewal savings or losses attributable to the strip-cutting system.

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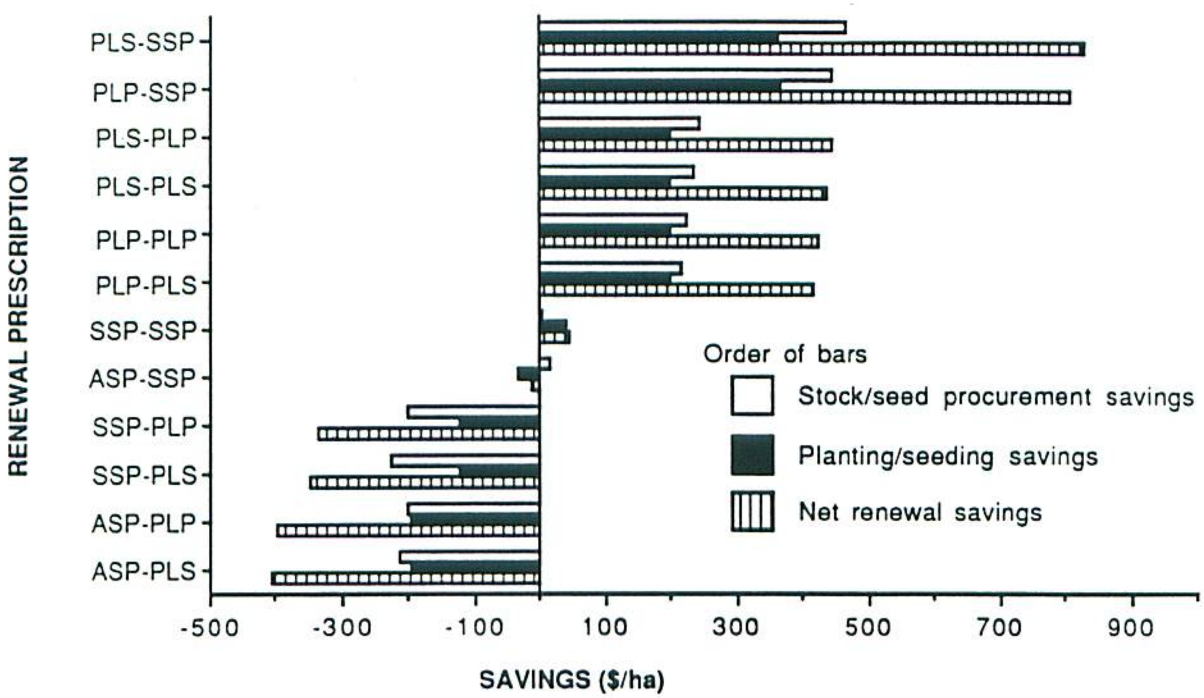
[6] An FMA between an individual forest company and the province of Ontario includes a schedule of costs to be rebated to the company by the province for eligible silvicultural work successfully completed.



EXPLANATION OF RENEWAL PRESCRIPTIONS

Code	Renewal option for clearcut	Renewal option for second strip
PLS-SSP	plant spruce	spot seed pine
PLP-SSP	plant pine	spot seed pine
PLS-PLP	plant spruce	plant pine
PLS-PLS	plant spruce	plant spruce
PLP-PLP	plant pine	plant pine
PLP-PLS	plant pine	plant spruce
SSP-SSP	spot seed pine	spot seed pine
ASP-SSP	aerial seed pine	spot seed pine
SSP-PLP	spot seed pine	plant pine
SSP-PLS	spot seed pine	plant pine
ASP-PLP	aerial seed pine	plant pine
ASP-PLS	aerial seed pine	plant spruce

Figure 3. Alternate stripcutting relative to clearcutting: savings realized, by leave period.

NET SAVINGS ATTRIBUTABLE TO THE STRIP-CUTTING SYSTEM

A renewal prescription, when considered with a strip-cut harvest prescription and compared with a clear-cut, can be considered a harvest-renewal alternative. Three different leave periods and two strip lengths were used in the analysis of the 12 renewal prescriptions discussed previously. In all, 72 harvest-renewal alternatives were analyzed.

An estimate of the net saving or cost associated with harvesting and renewing a site by stripcutting rather than clearcutting can be obtained by totalling incremental harvesting costs and renewal savings for each harvest-renewal alternative. Proponents of stripcutting would hope that reduced renewal costs associated with stripcutting could more than offset the additional harvesting costs. Figure 4 illustrates the structure of the costing model used to estimate the net savings attributable to the strip-cutting system.

Net savings are estimated for each harvest-renewal alternative for the two strip lengths and three leave periods according to the following equation:

$$N_{i,j,k} = R_{i,j,k} - H_{i,j,k}$$

where: N = net saving for each renewal option i, strip length j, and leave period k

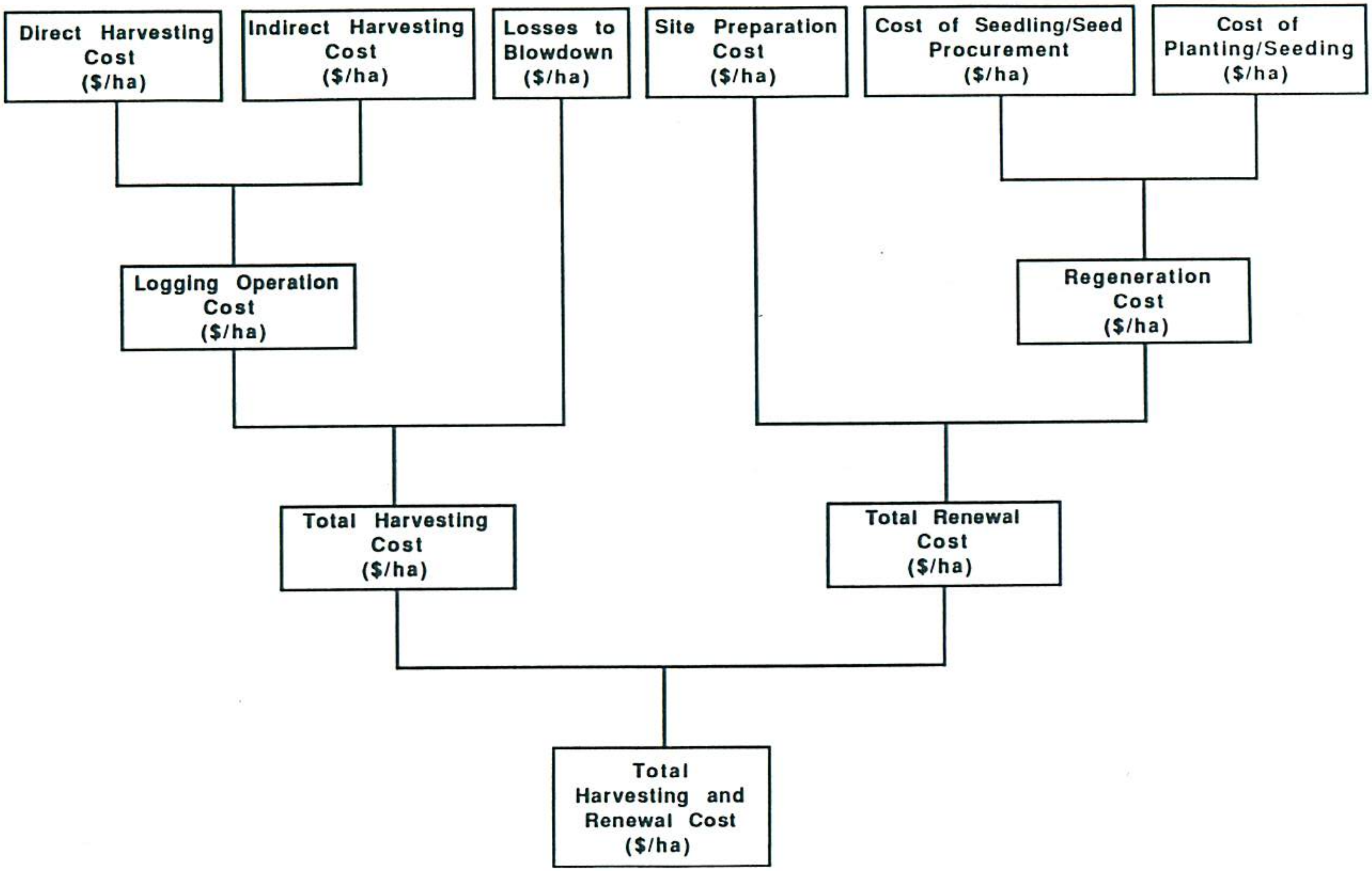
R = renewal saving associated with stripcutting for each renewal option i, strip length j, and leave period k

H = incremental harvesting costs associated with stripcutting for each renewal option i, strip length j, and leave period k.

Figure 5 illustrates the net savings resulting from stripcutting relative to those resulting from clearcutting, as estimated for each harvest-renewal alternative.

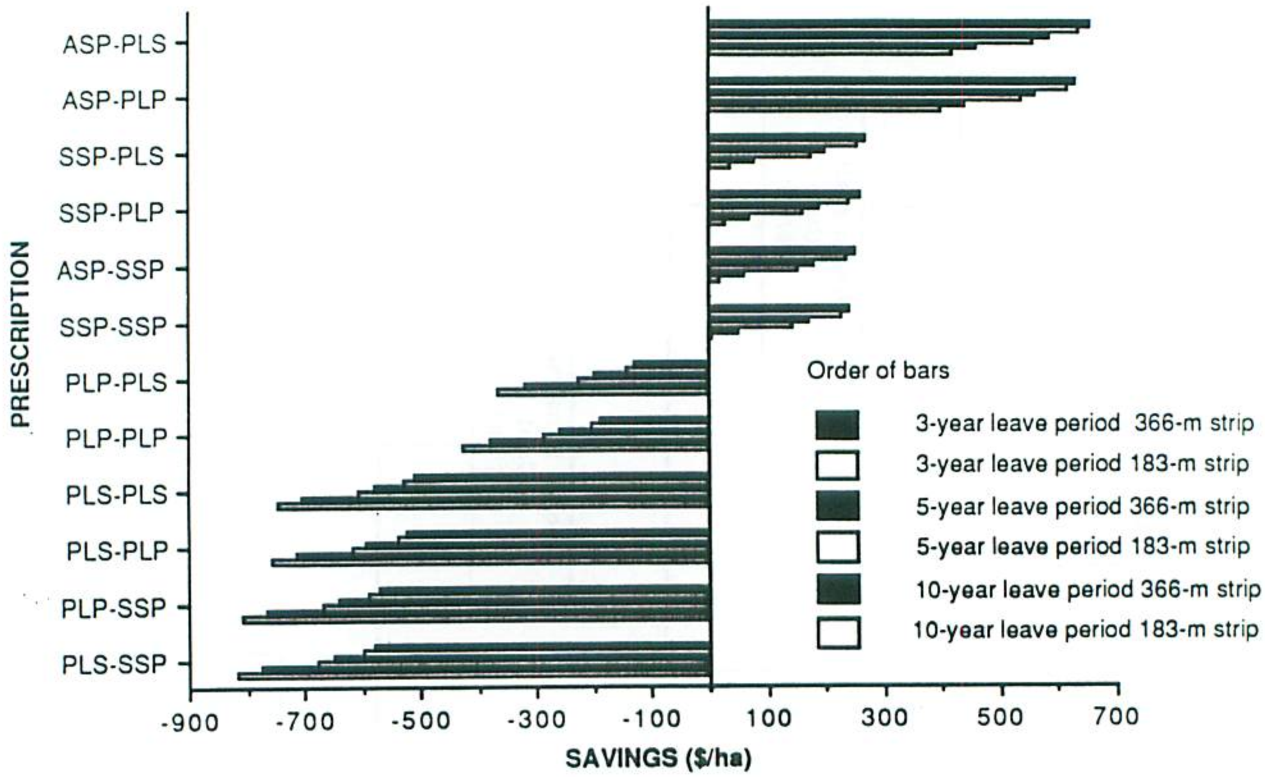
Several points are worth noting in Figure 5. First, it reveals that not all of the harvest-renewal alternatives considered in this analysis result in savings. A closer examination reveals that those alternatives which compare stripcutting on the one hand with clearcutting followed by seeding (aerial or spot) on the other result in net losses. This implies that, if the area can be clear cut and successfully regenerated by scarification and seeding, the manager should in all cases choose the clearcut over the stripcut regardless of which renewal option is chosen for the residual strip. This simply reflects the high cost of purchasing and planting container seedlings in comparison with the purchase and application of seed.

Second, the alternatives that compare stripcutting to clearcutting followed by planting of containers result in significant net savings. This suggests that, if the manager is faced with the choice of clearcutting followed by planting or stripcutting, he should choose stripcutting regardless of which renewal option he chooses for the residual strip.



Note: All costs represent the differences in cost between the strip-cut system and the clear-cut system.

Figure 4. Economic model developed to estimate net savings attributable to the strip-cut harvesting system.



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PLS-SSP	plant spruce	spot seed pine
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PLS-PLP	plant spruce	plant pine
PLS-PLS	plant spruce	plant spruce
PLP-PLP	plant pine	plant pine
PLP-PLS	plant pine	plant spruce
SSP-SSP	spot seed pine	spot seed pine
ASP-SSP	aerial seed pine	spot seed pine
SSP-PLP	spot seed pine	plant pine
SSP-PLS	spot seed pine	plant pine
ASP-PLP	aerial seed pine	plant pine
ASP-PLS	aerial seed pine	plant spruce

Figure 5. Alternate stripcutting relative to clearcutting: net harvesting and renewal savings, by leave period, strip length, and renewal prescription.

Third, Figure 5 shows that the impact of leave period and strip length is the same in absolute terms for all alternatives. This is because the cost of renewal does not depend on leave period or strip length. Accordingly, strip length and leave period have the highest relative impact on those strip-cut alternatives which result in lowest savings or losses. These are the harvest-renewal alternatives in which the renewal option of the clearcut and the residual strip are similar. In none of these alternatives does a change in leave period or strip length determine whether or not stripcutting is preferable to clearcutting.

Fourth, the figure also reveals that longer strips result in marginally higher net savings for each harvest-renewal alternative examined. This is explained by the lower tertiary road density required in the longer strips and by the fewer losses to blowdown in the longer strips. The impact of strip length is much greater for longer leave periods, but clearly a doubling of strip length does not result in significant savings.

Finally, Figure 5 illustrates that stripcutting becomes more attractive as leave periods are shortened. This is explained by the compounding effect associated with road construction and by the direct relationship among leave period, strip length and blowdown established by Fleming and Crossfield (1983).

Shorter leave periods are desirable because they are less costly; however, the choice of leave period ultimately depends on the ability of the first strip to regenerate naturally to adequate stocking. Leave periods can be reduced by improving the receptivity of the seed bed. Managers, however, should be aware of tradeoffs between reductions in the leave period and higher site preparation costs. From the analysis, for example, managers can absorb an additional $160/ha in the 183-m strips and up to $140/ha in the 366-m strips in extra site preparation costs of the initial strip to reduce leave periods from 5 to 3 years.

DISCUSSION

Treatment costs and stand values have not been estimated beyond the point of stand establishment. The harvest-renewal alternative with the greatest savings, therefore, might not be the alternative with the highest economic value. The least-cost harvest-renewal alternative (that which realizes the greatest savings) will have the highest value only if all stands resulting from these alternatives are assumed to have the same net present value at the point of stand establishment. Realistically, the established stands resulting from the different renewal options used in this analysis will vary considerably depending on species mix, tending requirements, and rotation age.

The assumption underlying the analysis is that stripcutting will not result in any reduction in extraction productivity. An increase in extraction costs of only $6 per m^3 would negate the savings of even the best strip-cutting and renewal options examined in the analysis. Managers who believe that extraction productivity would suffer during stripcutting would be wise not to employ this harvesting method.

The decision to stripcut or not cannot be based solely on cost. Often the choice of harvest and renewal systems will be determined by the site itself. In some cases, the choice might be to stripcut an area or to designate it a protection forest. In other cases, sites might be harvested and renewed by means of a strip-cut system, but the relatively high cost of employing such a system could not be justified.

Clearly, forest managers in Canada will be interested in generating renewal savings only if these savings can be applied against the higher harvesting costs associated with stripcutting. In some cases, however, the organization that is financially responsible for harvesting is not the same one that is financially responsible for renewal costs. In these situations, the most efficient combination of harvesting and renewal operations may not be chosen. Because stripcutting always results in higher harvesting costs, operations managers who do not realize renewal savings will, with justification, discriminate against this harvesting system. It is unlikely that stripcutting will gain wide acceptance until these institutional constraints are removed.

CONCLUSIONS

1) Stripcutting increases harvesting costs.

2) Stripcutting is less costly than clearcutting followed by planting but more costly than clearcutting followed by seeding.

3) Increasing the leave period results in higher harvesting costs; leave periods of up to 10 years are acceptable, but not desirable.

4) Doubling strip length from 183 to 366 m does not significantly affect harvesting costs.

RECOMMENDATIONS

1) Managers should consider stripcutting a more cost-effective means of harvesting than clearcutting for those harvest-renewal alternatives in which renewal savings more than offset the additional harvesting costs.

2) Managers should make every effort to minimize leave periods.

3) Since increasing strip length does not significantly reduce harvesting costs, operations personnel should use a flexible strip length to accommodate site-specific operating constraints such as topography., tertiary road construction costs, and the configuration of extraction equipment.

4) When the organization that is financially responsible for renewal costs is not responsible for harvesting costs, arrangements should be made to ensure that the most cost-efficient harvest/renewal system is employed.

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