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SOME ECONOMIC CONSIDERATIONS IN FOREST LAND REHABILITATION

Paper Presented  
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INTRODUCTION

The interior forest regions of British Columbia accounted for approximately 60% of wood products produced and 75% of the land clearcut in 1980 (Annual Report, Min. of Forests, 1980-81). The predominant harvesting technique in these regions is ground-based yarding with tractor or skidders. Ground-based yarding requires the construction of skidroads and landings of timber extraction, sorting, and loading. However, the construction of skidroads and landings is an extreme form of site disturbance that poses land rehabilitation problems. The construction of skidroads and landings can not only lead to soil erosion but also reduced forest productivity through scarification and compaction (2, 3, 7, 8, 9, 10, 11).

The results of a 1981 Ministry of Forests survey of the percent of cut-over area occupied by skidroads and landings for the interior regions are presented in Table 1 (based on internal memos). There is a wide range in the estimates for each category from the various regions. Although regional terrain and season of logging will influence the amount of disturbance on cut-over land, one would expect areas that are logged by the same method to receive relatively the same level of disturbance. Except for the Cariboo Region, the Ministry of Forests estimates appear very conservative. This can be demonstrated using the Nelson Region as an example.

Table 2 presents a comparison of percent area occupied on cut-over lands by skidroads and landings from three sources. The Ministry of Forests estimate is from the regional headquarters (internal memo, Jan. 1982), the Canadian Forest Service (C.F.S.) estimate is from Smith and Wass (1979), and the Pacific Northwest estimate summarized from Dyrness (1965), Lull (1959), Steinbrenner (1955), Steinbrenner and Gessel (1959), and Froehilch (1973). The Ministry of Forests estimate approximately half of the C.F.S. estimate for the same region. The C.F.S. data compares favourably with the Pacific Northwest estimates from Oregon and Washington. This comparison points out the conservative nature of the Ministry of Forests estimates.

Using the Ministry of Forests estimates and combining them with the area clear-cut in the 1970's, the amount of land degraded by skidroads and landings is substantial (Table 3). From 1971-1980, approximately

TABLE 1

PERCENTAGE OF AREA ON CUT-OVER LANDS

REGION	SKID-ROAD	LANDING	HAUL ROAD
CARIBOO	16	4	3
PRINCE GEORGE	4	5	3
KAMLOOPS	2	1	2.5
NELSON	10	2	5
PRINCE RUPERT			
DRY-BELT	4	4	5
WET-BELT	0	0.7	2
VANCOUVER	0	1.2	4

TABLE 2

PERCENTAGE OF AREA ON CUT-OVER LAND  
 (COMPARISON)

	SKID-ROAD	LANDING	HAUL ROAD
NELSON REGION			
M.O.F.	10	2	5
C.F.S.			
SUMMER	25	7.6	6.5
WINTER	14.4	4	3
PAC. NORTHWEST	20-35		

TABLE 3

AREA OCCUPIED ON CUT-OVER LAND  
1971-1980  
(000 HA)

REGION	SKID-ROAD	LANDING	HAUL ROAD
CARIBOO	31.2	8.2	5.9
KAMLOOPS	2.8	1.4	3.5
NELSON	12.4	2.5	6.3
PRINCE GEORGE	17.3	22.0	13.0
PRINCE RUPERT	4.5	5.1	7.8
VANCOUVER	0	3.3	11.0
TOTAL	68.2	42.3	47.5

110,000 ha of forest land have been subject to scarification and compaction during landing and skidroad construction. If estimates of the percent area occupied were modified to more closely resemble the values reported in the literature (3, 4, 7, 8, 9, 10, 11), the result would be a near doubling of the area effected to approximately 200,000 ha (Table 4 and 5). The reduced productive capacity of these degraded sites represents a form of internal land alienation from the future forest land base.

#### EFFECT ON FOREST PRODUCTIVITY

Skidroads, which can occupy up to 35% of cut-over land, are often scarified to a depth greater than 25 cm (7). Landings, which may occupy an area as large as 0.5 ha; are usually scarified to depths greater than 1.0 m. Although both are subject to compaction, landings receive more severe treatment due to continual equipment operation.

The negative impacts of landings and skidroad construction on soil are:

1. nutrient removal during scarification (7, 10);
2. increased bulk density, ranging from 15-20% (2, 3, 4, 9, 11);
3. decreased infiltration, ranging from 35-93% (9, 10);
4. loss of macropore structure, ranging from 10-68% (2, 9, 10);
5. decrease in micropore space (2).

The resulting effects on forest site productivity are:

1. regeneration delay, ranging from 3-12 years (2, 7, 9,);
2. reduced stocking (9, 11);
3. poor tree vigor (9);
4. reduced tree growth, ranging from 6-14% (4, 7, 9, 10, 11);
5. volume reduction, prorated over the entire cut-over area, ranging from 12-15% (4, 7, 11).

In an attempt to quantify the effect on forest productivity for the interior forest regions, the following assumptions were made:

1. on skidroads, prorated volume reduction over the entire area, 0.45% reduction for each 1% skidroads (4, 7, 11);
2. landings, only 50% of landing area will support future tree growth (based on Ministry of Forests, Prince George Region estimate, Jan. 1982 memo).

TABLE 4

PERCENTAGE OF AREA ON CUT-OVER LANDS  
(REVISED)

REGION	SKID- ROAD	LANDING	HAUL ROAD
CARIBOO	16	4	3
PRINCE GEORGE	15	5	3
KAMLOOPS	15	5	2.5
NELSON	15	5	5
PRINCE RUPERT (I)	15	4	5

TABLE 5

REVISED

AREA OCCUPIED ON CUT-OVER LAND  
1971-1980  
(000 HA)

REGION	SKID-ROAD	LANDING	HAUL ROAD
CARIBOO	31.2	8.2	5.9
PRINCE GEORGE	65.0	22.0	13.0
KAMLOOPS	21.0	7.0	3.5
NELSON	18.6	6.3	6.3
PRINCE RUPERT (I)	16.9	5.3	4.5
	<hr/> 152.7	<hr/> 48.8	<hr/> 33.2

This was combined with the revised estimate of percent area occupied (Table 4) and the amount of land clearcut in 1980-81 (from the annual report) to produce an estimate of the area annually created (Table 6) and the reduction in forest productivity due to landing and skidroad construction (Table 7). On forest land harvested by ground-based yarding, the productive capacity is reduced by approximately 9%. The result is a loss of almost 4 million cubic metres of wood products in the next rotation on the internal alienation of nearly 11,000 ha equivalent land base in one year. Obviously, corrective measures for soil decompaction and nutrient retention or enhancement must be incorporated into management policy.

#### LANDING AND SKIDROAD REHABILITATION POLICY

The Ministry of Forests is directed to maintain and improve the forest and range resources of the province. Soil is the fundamental resource to be preserved in the case of landing and skidroad construction and rehabilitation. Over the past five years, all forest regions have instituted a landing policy that deals not only with landing construction but also rehabilitation. Most of the regional policies are based on the Cariboo Regional Policy, the first regional landing policy in the province. A summary of the rehabilitation measures are(3):

1. ripping or scarification to a depth of 30 cm, if deemed necessary;
2. burning of slash piles;
3. respreading of topsoil and ash pile on the landing.

These measures are aimed at soil decompaction and restoration of soil nutrients.

Unfortunately, a policy is not effective unless properly adhered to or enforced. The results of a 1981 survey of landing rehabilitation in the Cariboo Region revealed the following (6):

1. poor landing location resulted in excessive site disturbance;
2. topsoil was removed and seldom respread;
3. scarification did not always conform to policy, only 8% in the I.D.F. (b) subzone while 90% in the S.B.S. zone;
4. compaction reduced only at the soil surface; compaction remained high below 15 cm;

TABLE 6

REVISED

AREA OCCUPIED ON CUT-OVER LAND  
1981 CLEAR CUT  
(HA)

REGION	SKID- ROAD	LANDING	HAUL ROAD
CARIBOO	3600	940	680
PRINCE GEORGE	6900	2300	1390
KAMLOOPS	2400	800	400
NELSON	2100	200	710
PRINCE RUPERT (I)	2300	760	530
	<hr/> 17300	<hr/> 5000	<hr/> 3710

TABLE 7

1981 REDUCTION IN FOREST PRODUCTIVITY

REGION	%	VOLUME 000 M <sup>3</sup>	LAND EQUIV. HA
CARIBOO	9.2	640	1900
PRINCE GEORGE	9.25	1300	4900
KAMLOOPS	9.25	790	1500
NELSON	9.25	610	1300
PRINCE RUPERT (I)	8.75	630	1100
		<hr/> 3970	<hr/> 10700

5. slash disposal conformed to policy except where dirty piles reduced the effectiveness of the burn;
6. planted spruce did not appear healthy and were growing poorly.

Among the recommendations of Mitchell's survey, the following pertain to landing rehabilitation (6):

1. restrict the size of landings to reduce the rehabilitation problem;
2. push topsoil into one retrievable pile;
3. pile and burn slash away from topsoil;
4. rip compacted surfaces to a depth of 20 cm;
5. spread the ashes and topsoil as evenly as possible over the landing;
6. plant landings with hardy stock (i.e. lodgepole pine);
7. maintain accurate and current information on all areas;
8. enforce the landing guidelines.

Based on these recommendations, a new landing policy is being drafted for the Cariboo Region. Additionally, the Research Branch is investigating the practice of deep ripping (50 cm) and the use of legumes in landing rehabilitation (E.P. 834:07). The deeper ripping allows for a greater unrestricted rooting zone for regeneration. The use of legumes may assist in the recovery of nitrogen lost from the site during scarification or slash burning. The results from this work should be available in 1983-84.

#### CONCLUSIONS

There is no doubt that landings and skidroads occupy a large portion of cut-over forest land. These areas are scarified and compacted, resulting in a decrease in future forest productivity. Although the future cost of the internal land alienation is difficult to assess, the forest industry cannot afford the equivalent loss of 11,000 ha per year of productivity. Both preventative and corrective measures must be applied to alleviate the problem of land degradation due to harvesting activities. Although some modification of current landing construction and rehabilitation policies is needed, these policies must be fully integrated into forestry planning and operations. If ignored, the future role of forestry in British Columbia may be greatly reduced.

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