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Economic Availability of Logging Residue in the Douglas-fir Region

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ECONOMIC AVAILABILITY OF LOGGING RESIDUE IN THE DOUGLAS-FIR REGION

Reference Abstract

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Large amounts of logging residue are generated each year in timber harvest operations in old-growth forests in the Douglas-fir region of western Washington and western Oregon. Economic availability of each piece, however, depends on its size, condition, location, and on the existence of markets, with an adequate price to cover costs. An estimated 185.8 million cubic feet of logging residue were found to have a positive conversion value in 1970. Lack of utilization is considered due to numerous technical inefficiencies and market imperfections such as low volumes per acre, lack of local markets, general market instability, and problems of setting specifications, scaling, and pricing.

KEYWORDS: Slash utilization, marketing (forest products).

RESEARCH SUMMARY

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Timber harvest in old-growth forests in the Douglas-fir region of western Washington and western Oregon leaves large amounts of logging residue. This residue has been classified in a recent inventory according to diameter, length, percent soundness, ownership class, and type of material. Using volume and value recovery data from a sawmill study covering use of such material, conversion values for the different classes of logging residue were developed. These conversion values also took into account representative logging and hauling costs.

Cumulative amounts of residue were arrayed by value class. Values ranged from $18 to minus $49 per cunit (hundred cubic feet). An estimated 185.8 million cubic feet (5.26 million cubic meters) were found to have a positive conversion value, available for stumpage, profit, and risk. This volume comprised about half of the total residue volume considered potentially available. The positive conversion values were concentrated in the larger diameter, sounder pieces.

Lack of utilization of this material is believed due to the numerous technical inefficiencies and market imperfections for residue-type material. These include such factors as low volumes per acre, long distance to market, difficulties of setting specifications and determining logging costs or recovery values for such material, lack of a local market, scaling and pricing problems, and general market instability.

Introduction

Timber harvest in old-growth forests generally leaves a large amount of logging residue in the form of broken, rotten, or otherwise defective pieces, tops, and small logs or trees. This residue is receiving increasing attention as a potential source of raw material for the wood products industry or for other uses such as electric power generation.

Total amounts of logging residue are impressive, especially on old-growth clearcut areas in the Douglas-fir region of western Washington and western Oregon. Its economic availability depends on the size, condition, and location of each piece, on specific costs of logging and manufacture, and on the existence of markets, with an adequate price to cover costs.

This report, which focuses on economic availability, presents one approach to evaluating logging residue. It examines the different sizes and other characteristics of logging residue in western Washington and western Oregon and classifies this material according to value classes, taking into account differences in percent chippable class and costs of logging and manufacture for the different diameter classes.

Cumulative amounts of residue are arrayed by value class and shown graphically to provide information on aggregate amounts that are economically available with inclusion of each successive value class.

This report is based on inventory data from 1969 logging operations and on product recovery data from a 1970 sawmill study. Costs and values are estimated as of 1970. Although conditions have since changed, the classification and valuation according to economic availability should still be helpful in understanding the heterogeneous nature of logging residue and some of the problems of its utilization. The amount of residue left on the ground at any given time will depend heavily on the state of the pulp and paper and chip export markets, and on the proportion of the chip market supplied by mill residue from sawmills and plywood plants.

Results of this study will be of interest to those persons concerned about the problem of residue management and the long-term potential for increased residue utilization, as well as forest managers and forest industry personnel who make and implement decisions affecting residue utilization. Results will also be of interest to research workers concerned with methodology of quantifying and valuing a highly variable material.

Procedure and Results

INVENTORY OF LOGGING RESIDUE

The starting point in determining economic availability was the 1969 inventory of logging residue in Washington, Oregon, and California (Howard 1973). That survey included all material at least 4 inches in diameter and 4 feet long left on the ground after logging, from a sample survey of 76 logging operations, 54 of which were in western Washington and western Oregon.[1/] It classified this material according to diameter, length, percent chippable class, geographic region, ownership class, and type of material. In the present study,

1/ The inventory involved only 1969 clearcut operations in western Washington and western Oregon but sampled all types of logging operations elsewhere.

these data were summarized by diameter and percent chippable classes (table 1).

The inventory was then reduced to reflect practical utilization limits for the different classes of material covered by Howard's report. For example, that report included 77.5 million cubic feet of material classified as not mechanically debarkable. In the present study, only 10 percent of such nondebarkable material was considered potentially usable, assuming that hydraulic debarkers would be available only in a few limited locations, as at the present time, or that this amount could be used without debarking.[2/] As a practical measure to simplify computations, all the material inventoried as slabs and splinters (40.6 million cubic feet) was assumed to be part of this material classified as not mechanically debarkable, even though it is recognized that some slabs and splinters would be debarkable.

Table 1--*Net volume of logging residue in western Washington and western Oregon, 1969*

Diameter class (inches)	Percent chippable class					
	1-20	21-40	41-60	61-80	81+	Total
	Million cubic feet[1/]					
4.0 - 7.9	0.0	0.2	0.7	4.3	44.2	49.4
8.0 -11.9	(2/)	.3	2.6	11.4	75.0	89.4
12.0 -15.9	.0	2.0	3.6	14.0	47.0	66.6
16.0 -19.9	.2	1.5	4.8	11.5	28.5	46.5
20.0 -23.9	.5	1.6	4.8	11.0	17.3	35.2
24.0 -27.9	.2	.8	2.2	7.1	10.7	21.0
28.0+	.7	10.7	15.8	28.7	55.6	111.6
Slabs and splinters	.4	1.6	6.5	13.5	18.4	40.6
Total	2.0	18.7	41.0	101.5.	296.7	460.2

1/ Data may not add to totals because of rounding.

2/ Less than 0.1 million cubic feet.

Source: Developed from table 11 of Howard (1973).

2/ The 10-percent utilization factor is not definitive but intended as a rough recognition that most western mills have only mechanical debarkers and require logs that can produce clean chips. A change in mill technology could change this factor greatly.

In addition, only 90 percent each of inventoried breakage and hardwoods were considered potentially usable, the hardwoods for chipping only. This is to recognize that some of the most irregularly shaped of these, and the more widely scattered hardwoods, would not be used in a realistic time frame.

The resulting inventory of potentially usable residue material totals 375.7 million cubic feet (10.6 million cubic meters) (table 2).

CONVERSION VALUES[3/]

Logging residue has a higher value when used for lumber or veneer products than for pulpwood chips. In good or average market periods, the majority of suitable veneer logs are recovered as either regular Peeler or Special Cull

[3/] Conversion value is estimated mill sale recovery value less costs of logging, log hauling, and manufacturing. It is the margin available for stumpage and profit and risk.

Table 2--*Net volume of logging residue potentially available in western Washington and western Oregon, 1970*

Diameter class (inches)	Percent chippable class					
	1-20	21-40	41-60	61-80	81+	Total
			Million cubic feet[1/]			
4.0 - 7.9	0	0.1	0.6	3.4	35.1	39.2
8.0 -11.9	(2/)	.2	2.1	9.1	59.5	71.0
12.0 -15.9	0	1.6	2.8	11.1	37.3	52.9
16.0 -19.9	.2	1.2	3.8	9.1	22.6	36.9
20.0 -23.9	.4	1.5	4.3	9.9	15.5	31.5
24.0 -27.9	.2	.7	2.0	6.3	9.6	18.7
28.0+	.7	9.6	14.1	25.7	49.8	99.9
	1.5	14.9	29.7	74.6	229.4	350.1
Hardwoods, usable, unclassified						25.6
Total						375.7

[1/] Data may not add to totals because of rounding.

[2/] Less than 0.1 million cubic feet.

Source: Data from table 1, less estimates for amounts of material not usable from hardwoods, breakage, and nondebarkable material.

grade logs.[4] Hence, for simplification, any additional amount of conversion to veneer products was not considered a significant part of the potential recovery mix from the logging residue inventory.

Since lumber recovery values are generally much higher than chip values, the recovery of lumber, wherever possible, is critical to a profitable outcome in most residue utilization efforts. In some cases, however, where lumber recovery is low and logs are difficult to handle, some residue might be more profitably processed into chips rather than lumber.

Unpublished data were available from a sawmill recovery study of mostly Utility grade logs,[5] from which were derived predicted dollar values of combined lumber and chip recovery for logs in combinations of 0 to 100 percent usable for lumber and 40 to 100 percent usable for chips, by 10-percentage classes.

[4] The Douglas-fir Special Cull grade includes logs that do not meet the requirements of Peeler and Sawmill grade rules but are suitable for rotary cutting, and have surface characteristics of a good No. 2 Sawmill log. In addition, they must have an adjusted gross diameter of at least 16 inches and adjusted gross length of 8 feet 8 inches and contain at least 60 percent usable material of firm white speck or better (Columbia River Log Scaling and Grading Bureau et al. 1972).

[5] This sawmill study was conducted at Kalama, Washington, in 1970. It included logs from 4 to 37 inches in diameter and from 0 to 100 percent sound for lumber or for chips. This operation sought to obtain maximum lumber recovery value from each log. Data of this study are on file at the Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

The Utility log grade includes logs that do not meet the requirements of Peeler or Sawmill grade logs but will produce not less than 50 percent of the gross volume in firm usable pulp chips. Minimum diameter is 6 inches and minimum length is 12 feet unless otherwise requested (Columbia River Log Scaling and Grading Bureau et al. 1972).

Recovery amounts and conversion value of hogged fuel were also obtained from the above-mentioned sawmill recovery study. The conversion values in the mill study were derived from a compilation of actual sale recovery values, combined with estimates of costs of logging, hauling,[6] and manufacturing to give conversion values by log diameter class and percent chippable class (table 3). These conversion values show what could be paid for the residue. It should be noted that only the larger diameters, sounder volumes have a positive conversion value.

RESIDUE VOLUMES BY VALUE CLASS

The residue volumes of table 2 were combined with conversion values of table 3 to give total residue volumes, by value class (table 4). These tables show cumulative volumes by value class, used to construct the chart for economic availability of logging residue for the year 1970 (fig. 1).

Conversion values are also shown that take into account a profit margin, calculated as $9 per cunit.[7] These values were derived from analysis of profit margins used for appraisals in National Forest timber sales in Washington and Oregon for 1970. The reduced conversion values would apply to the extent that operators required at least the same profit margin for residue material as obtained in regular logging operations. Actually, with lower daily output for residue material, as compared to the larger, sounder material from regular logging, operators might require even higher profit margins when calculated as here on a unit volume basis.

[6] An average hauling distance of 40 miles was used in this compilation.

[7] One cunit equals 100 cubic feet (2.83 cubic meters).

Table 3--*Estimated conversion value*[1] *of logging residue potentially available in western Washington and western Oregon, 1970*

Diameter class (inches)	Percent chippable class				
	1-20	21-40	41-60	61-80	81+
	Dollars per cunit[2]				
4.0 - 7.9	-54	-49	-45	-41	-37
8.0 -11.9	-52	-46	-40	-22	- 9
12.0 -15.9	-44	-37	-31	- 5	7
16.0 -19.9	-43	-29	-14	2	14
20.0 -23.9	-34	-24	-14	6	16
24.0 -27.9	-38	-25	-12	6	18
28.0+	-42	-29	-16	4	17
Hardwoods, usable, unclassified					-14

[1] Conversion value is estimated mill sale recovery value less costs of logging, log hauling, and manufacturing. It is the margin available for stumpage and profit and risk.

[2] 1 cunit equals 100 cubic feet (2.83 cubic meters).

Source: Developed from unpublished data on file at Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

Also, the greater market instability and risk would further tend to require higher profit margins.

On a cubic-foot basis, conversion values ranged from $18 to minus $49 per cunit ($6.36 to minus $17.30 per cubic meter). Out of a total of 375.7 million cubic feet, 185.8 million or 49.4 percent had a calculated positive conversion value. With a $9 per cunit profit margin, however, only 97.5 million or 26.0 percent showed a calculated positive conversion value.

Table 4--*Cumulative net cubic volumes of logging residue, by conversion value class, western Washington and western Oregon, 1970*[1]

Conversion value per cunit[2]	Minus $9 margin for profit and risk	Residue volume	
		In class	Cumulative
------ Dollars ------		----- Million cubic feet -----	
18	9	9.6	9.6
17	8	49.8	59.4
16	7	15.5	74.9
14	5	22.6	97.5
7	-2	37.3	134.8
6	-3	16.2	151.0
4	-5	25.7	176.7
2	-7	9.1	185.8
-5	-14	11.1	196.9
-9	-18	59.5	256.4
-12	-21	2.0	258.4
-14	-23	33.7	292.1
-16	-25	14.1	306.2
-22	-31	9.1	315.3
-24	-33	1.5	316.8
-25	-34	.7	317.5
-29	-38	10.8	328.3
-31	-40	2.8	331.1
-34	-43	.4	331.5
-37	-46	36.7	368.2
-38	-47	.2	368.4
-40	-49	2.1	370.5
-41	-50	3.4	373.9
-42	-51	.7	374.6
-43	-52	.2	374.8
-45	-54	.6	375.4
-46	-55	.2	375.6
-49	-58	.1	375.7

1/ Conversion value is estimated mill sale recovery value less costs of logging, log hauling, and manufacturing. It is the margin available for stumpage and profit and risk.

2/ 1 cunit equals 100 cubic feet (2.83 cubic meters).

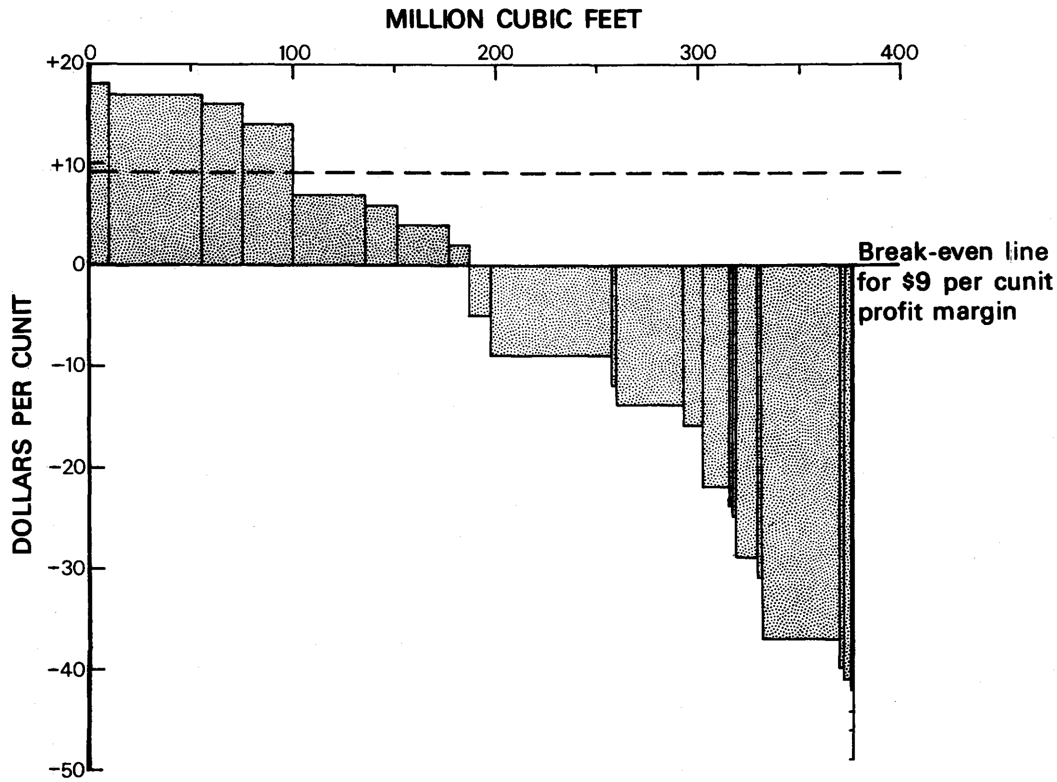

Figure 1.--Net volume of logging residue potentially available in western Washington and western Oregon, by conversion value, per cunit, 1970.

Discussion

Results show substantial volumes of logging residue economically available, even with the indicated profit margins. Why, then, was this material that had a positive conversion value not utilized? The answer lies in numerous technical inefficiencies of harvesting and manufacture, and market imperfections, such as:

1. Low volumes per acre, of widely scattered logging residue.
2. Long distance to market, beyond the 40-mile distance used in calculation of conversion values.
3. Practical difficulty of determining actual logging costs for residue-type material, and of relating estimated costs to a specific operating situation.
4. Difficulty of setting specifications for acceptable material, and of piece-by-piece inspection to weed out cull material.
5. Relatively high overall risk.
6. Lack of local market of mills willing to accept residue-type material.
7. Scaling and pricing problems in an unstable market.
8. Operator's lack of hauling equipment to accommodate mostly short pieces, especially pieces 4 to 8 feet in length.
9. No provision for residue in contract between timber sale purchaser and operator.
10. Risk that some pieces would be scaled and graded as merchantable logs, requiring stumpage payment at the full bid rate.

11. Lack of sorting facilities to separate Utility grade logs from other logs, either at the landing or at delivery point.
12. Payment to logging operator on the basis of net scale rather than gross scale.
13. Competitive pressure to keep net volume production at a high level.
14. Lack of local mills with whole log chipping capabilities.
15. Availability of better and more profitable logging opportunities elsewhere, and a psychological preference for working with sound material, rather than "junk."

Many of the above factors can be summed up in a general lack of enthusiasm for residue-type material by both loggers and mill operators. Moreover, at any given time and place, it is hard to force any additional residue onto existing mills, already supplied from other sources.

Another influence is the human factor: it takes time for people to change their established patterns of activity, even after they become aware of potential opportunities. Moreover, some persons react quickly to a new idea or procedure; others are by nature slow to adopt, or may prefer not to adopt at all (Zaltman 1965).

Enlargement of the total market for logging residue tends to come in spurts, chiefly as new chippers, log-handling facilities, hogged fuel boilers, or export facilities are installed in response to increased demand for chips or the other residue products. In addition, a major decrease in lumber output, as occurred in the winter of 1973-74, can reduce the flow of chipped sawmill residue so that pulpmills and chip export suppliers turn to more logging residue as a supplemental source.

The 1973-74 increased demand for Utility grade logs is reflected in average prices of Douglas-fir Utility grade logs rising from $27.70 per thousand board feet Scribner scale, in 1972 to $53.90 in 1974 (from $5.87 to $11.42 per cubic meter), and western hemlock logs of this grade rising from $36.10 per thousand board feet in 1972 to $68.30 in 1974 (from $7.65 to $14.47 per cubic meter).[8/] Most of this price increase was due to the favorable chip market, which, became unfavorable generally in 1975.

In the long run, however, the positive market forces are bound to work themselves out to bring greater residue utilization. Stated differently, this means greater logging utilization will leave less residue in the first place.

Empirical studies are not conclusive, but these market forces can probably be encouraged by such means as YUM yarding (required yarding of unutilized material) and per-acre pricing for small, sound logs and for Utility grade or Cull logs of any size (Hamilton et al. 1975). These timber sales arrangements tend to lower the direct cost of residue-type material and in theory should make it economically more attractive, because there is no direct stumpage charge related to volume removed, and because YUM yarding costs are fixed costs borne by the sale as a whole. Such pricing arrangements are currently in effect in many timber sales on public forest lands, especially the National Forests.

8/ Developed from Industrial Forestry Association composite log price data (Industrial Forestry Association 1975).

Conclusions

Favorable opportunities are developing for major expansion into logging residue as a source of raw material, especially as time goes on and the forest industries gear up to more efficient use of this material. This is from a long-term point of view. Experience of the 1973-75 period shows that current economic conditions at any given point in time strongly influence the profitability of removing logging residue, and wide fluctuations in logging utilization can occur, both upward and downward. Technical inefficiencies in harvesting and manufacturing and marketing imperfections may hold back utilization of logging residues even when positive values are present.

Residue utilization will be chiefly for pulpwood chips, together with any higher value products in the form of lumber or veneer that can be produced from residue. However, aggregate amounts are misleading, and the potential value of logging residue, either positive or negative, can only be determined for specific situations with respect to type of residue, location, sale arrangements, and development of suitable processing facilities.

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