

The study reported herein analyzes the 1977 costs of a 10-acre Christmas tree plantation in the non-land investment in such a plantation (2) to estimate the cash and non-cash costs of developing a plantation over an eight-year period, (3) to anticipate the costs of delaying tree harvest from the eighth to the ninth or tenth year, (4) estimate the income per acre from stumpage sales of a plantation cross in 1977, and (5) determine the net income from the operation for the three alternate harvest years. The impact of federal income taxes was omitted from the study.

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# ESTIMATED COSTS OF DEVELOPING AND HARVESTING PLANTATION CHRISTMAS TREES IN NORTHEASTERN WASHINGTON



## SUMMARY AND CONCLUSIONS

The study reported herein analyzes the 1977 costs of a 10-acre Christmas tree plantation in northeastern Washington. Objectives of the study were to (1) determine the non-land investments in such a plantation, (2) to estimate the cash and non-cash costs of developing a plantation over an eight-year period, (3) to anticipate the costs of delaying tree harvest from the eighth to the ninth or tenth year, (4) estimate the income per acre from stumpage sales of plantation trees in 1977, and (5) determine the net income from the operation for the three alternate harvest years. The impact of federal income taxes was omitted from the study.

The planting consisted of one-half Scotch pine and one-half Douglas-fir. The trees were spaced five feet apart in rows that were five feet apart, which results in 1,568 trees per acre when space is allowed for alleys, roads, and buildings.

Results of the study indicate that growers should expect to invest approximately \$1,000 per acre in a plantation of the type considered, plus the costs of the land, residence, and pickup truck.

The accumulated cost of developing the plantation for eight years was determined to be \$4,031.64 per acre. That amounted to an average cost of \$2.96 per marketable tree, assuming that 1,363 trees were marketable. Approximately \$1.03 of that amount, or 35 percent, was for cash costs while \$1.93, or 65 percent, was for non-cash expenses.

Most growers sold their trees on a standing (stumpage) basis. The average stumpage price for eight-year-old trees was \$2.26, which resulted in a net loss of \$.71 per marketable tree. The added cost of harvesting the trees and loading them on a buyers truck was determined to be \$.40 each.

Delaying harvest to the ninth year increased the average discounted stumpage value to \$2.58 per marketable tree, but the development costs increased to \$3.46, causing a loss of \$.88 per tree. When harvest was delayed to the tenth year, the loss per marketable tree was increased to \$1.24.

Results of the study suggest that northeastern Washington plantation growers of the type studied received enough income from stumpage sales of their trees in 1977 to pay all the cash costs of developing the plantation. However, the income was not adequate to pay current commercial rates for such non-cash costs as operator's labor, interest on investment in the business, and annual charges for depreciation of the needed machinery.

ESTIMATED COSTS OF DEVELOPING AND HARVESTING PLANTATION  
CHRISTMAS TREES IN NORTHEASTERN WASHINGTON

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INTRODUCTION

Most of the Christmas trees harvested in northeastern Washington are from natural stand operations. In recent years, however, there has been increasing interest among full- and part-time farm operators, and forest landowners, in producing plantation Christmas trees for the commercial market. Because of that increasing interest, a study was conducted to determine the costs of developing and operating a "typical" Christmas tree plantation and the consequences of alternative harvesting strategies.

It was estimated that approximately 35,000 Christmas trees are harvested annually in northeastern Washington, and that about one-third of that amount are plantation trees. Douglas-fir and Scotch pine are the leading plantation species, but an increasing number of grand fir is being planted.

The better plantations in northeastern Washington are, for the most part, on lands that were originally forest sites. Those sites had been cleared for hay, grain, or pasture production. Some lands that are marginal sites for producing such crops can produce high-quality, plantation Christmas trees.

Plantation tree operations have many distinct advantages over natural stand operations. Growers can obtain high yields of good quality trees that sell for premium prices by selecting trees that suit their particular site, planting them at optimum spacing, and properly managing their stands. But plantation stands require more investment per acre, more care, and more operating capital than natural stands. In northeastern Washington, it normally takes eight to ten years for plantation trees to reach heights of five to six feet, which are normal sizes for marketing. Therefore, plantation operators need more financing per acre, and for a longer period of time, than do natural stand operators.

Christmas tree plantation operations usually fit into one of the following types:

1. Those producing trees as a single farm operation -
  - a. by operators that derive most of their income from producing Christmas trees.
  - b. by operators living on small farms (usually less than 25 acres) and growing Christmas trees to supplement their other income.
  - c. by persons who live off the farm but produce trees for supplemental income.
2. Those producing trees as only one part of their total farm operation.

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In northeastern Washington, most plantations are owned and operated by part-time farmers or semi-retired persons. They usually have less than 10 acres of plantation trees and limited experience in producing plantation trees.

#### OBJECTIVE OF THIS STUDY

The purpose of the study reported here was to determine the needed investment in a Christmas tree plantation in northeastern Washington in 1977, the costs of developing a plantation, the total production and harvest costs when the trees are harvested in selected years, the estimated standing value of trees at alternate harvest ages, and the expected net returns to a plantation operation.

More specifically, the study was conducted to:

1. Determine the investment (exclusive of the purchase of land, residence, and a pickup truck) needed for a 10-acre plantation in northeastern Washington in 1977.
2. Estimate the 1977 costs per acre to develop a plantation stand up to the point of harvest in the eighth year when all the trees are planted in one year.
3. Estimate the 1977 cost of harvesting trees and loading them on a buyer's truck.
4. Determine the added costs and stumpage value of trees when harvest is delayed from the eighth to the ninth or tenth year.
5. Determine the net income from the operation when the trees are harvested in the three alternate years.

This publication does not provide detailed information or recommendations about the cultural practices needed to produce, harvest, and market plantation trees. Considerable information about cultural practices is available from Cooperative Extension Service offices throughout the state. Therefore, it is assumed the operator uses proper production and harvest techniques for his plantation.

#### SOURCE OF DATA

Due to the limited number of plantation Christmas tree operations in northeastern Washington, the basic information presented herein was from a variety of local plantation operators and others associated with the Christmas tree industry.

The data should be viewed as "probable" rather than "average" costs for Christmas tree plantations. Therefore, considerable judgment is needed when comparing the information in this publication to any particular plantation. Variations in such factors as size and location of the operation, site conditions, tree species and strains, harvest grades, selling prices, and individual managerial efforts have considerable effect on the costs and returns when growing and harvesting plantation trees.

### ASSUMPTIONS FOR THE STUDY

Christmas tree plantations are operated under many conditions and those conditions have considerable effect on the costs of producing trees. For this study, the following assumed conditions were used:

1. A single enterprise Christmas tree plantation on 10 acres of northeastern Washington land that is irrigated with a hand-move sprinkler system.
2. The land was not purchased for commercial use. Therefore, no annual charge was made for interest on land investment.
3. No charge was made for clearing the land of shrubbery.
4. One-half the trees are Scotch pine and half are Douglas-fir.
5. Trees planted five feet apart in rows that are five feet apart. That spacing results in 1,568 trees planted per acre when space is allowed for access roads and for turning machinery at the end of the rows.
6. Only 643 Scotch pine and 720 Douglas-fir trees per acre were suitable for marketing in the eighth year. Alternatively, the marketable trees in year nine were 654 pine and 714 fir, or 646 pine and 729 fir trees per acre in the tenth year.
7. The plantation operator owns the land prior to establishing the plantation, so no charges were made for purchasing the property or annual interest on the land investment during the years the trees were being developed.

### INVESTMENT IN A PLANTATION

Table 1 presents the estimated investment in a plantation in 1977. Included are the machinery, sprinkler system, and tools needed for a 10-acre operation, exclusive of the land, family residence, and a pickup truck. The data suggest such a grower should be able to finance an investment of about \$10,000 in addition to the land, residence, and pickup.

Land prices in northeastern Washington range from less than \$200 to \$1,000 or more per acre, depending on such factors as location, land quality, and vegetative conditions.

Also shown in Table 1 are the expected annual depreciation and interest charges for the needed equipment. It was assumed that most items were not owned by the operator before the plantation was started.



Table 1. Estimated Non-Land Investment in a Northeastern Washington Christmas Tree Plantation, Based on 1977 Prices.

Item	1977 Purch. Price	Salvage Value	Average Value <sup>1/</sup>	Method of Depr. <sup>2/</sup>	Ann. Overhead <sup>3/</sup>		Cash Operating Costs (10 Ac.)	
					Depr.	Int. (9%)	Unit Cost	Total Annual
	\$	\$	\$		\$	\$	\$	\$
Tractor & rotovator <sup>4/</sup> (narrow gauge)	5,300	1,500	3,400	10 SL	380	306	Tractor \$1.25/hour Rotovator \$.50/hour	
Spray attachment	900	100	500	9 SL	89	45	\$1.00/hour	
Hand sprayer	65	0	32	9 SL	7	3		
Hand tools	200	0	100	9 SL	22	9		
Trailer	250	100	175	9 SL	17	16	\$.25/hour	
Fencing								
Toilets	200	0	100	9 SL	22	9		
Pickup truck <sup>4/</sup>							\$.15/mile	180.00
Machine shed, shop								
Irrigation system	3,000	250	1,625	18 SL	153	146		
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TOTAL - 10 Ac.	9,915 <sup>5/</sup>				690	534		180.00
- per Ac.	992 <sup>5/</sup>				69.00	53.40		18.00

<sup>1/</sup> Average value =  $\frac{\text{Purchase price} - \text{Salvage value}}{2} + \text{Salvage value}$ .

<sup>2/</sup> Straight line method of depreciation used; the number (10) indicates years of expected use.

<sup>3/</sup> Interest charge equals annual interest rate times average value.

<sup>4/</sup> Items normally purchased or owned during the first year.

<sup>5/</sup> The per-acre charge for annual depreciation and interest would change if there were more or less than 10 acres in the plantation.

## TREE INVENTORY DURING THE DEVELOPMENT YEARS

The number of plantation trees per acre commonly ranges from less than 1,200 to over 2,000, depending on the plant spacing, soil moisture conditions, the amount of land left for roads and buildings, etc. For this study, it was assumed the trees were planted five feet apart in rows spaced five feet apart. That spacing results in planting 1,568 trees per acre when 10 percent of the land is used for aisles, roads, and buildings.

Table 2 presents the tree inventory by species for each of the eight development years. The data indicate 20 percent mortality of the Scotch pine in the year they were planted, and 15 percent mortality of the Douglas-fir. Many inexperienced growers have tree mortality rates of 50 percent or more in the first year. By the third planting (in year four), however, growers are usually able to get most of their trees established; few growers continue to replant after the fourth year even though some trees die each year.

By the time of harvest in the eighth year, it is expected that a plantation of the type studied should have about 690 Scotch pine and 752 Douglas-fir per acre. However, it is not expected that all those trees will be marketable. For this study, it was assumed that only 643 pine and 720 fir per acre were suitable for the commercial market in the eighth year.

Table 2. Annual Tree Inventory Per Acre During the Eight Development Years.

Year	Beginning Inventory	Trees Planted		Tree Mortality		Ending Inventory	
		S. pine	D. fir	S. pine	D. fir	S. pine	D. fir
1	-	-	-	-	-	-	-
2	0	784	784	157	118	627	666
3	1,293	157	118	66	32	718	752
4	1,470	66	32	42	15	742	769
5	1,511			20	7	722	762
6	1,484			15	5	707	757
7	1,464			10	3	697	754
8	1,451			7	2	690	752

## COSTS OF DEVELOPING A PLANTATION

The years required to develop a plantation depends upon the site, type of trees planted, care of the trees, desired height at harvest, and the soil moisture conditions. During the development years there is no income to pay the operator for the investment in land, labor and management, and for the equipment and other items that must be purchased. Therefore, it is important to realize the total amount and rate of expenses during those years.

Table 3 presents a detailed estimate of the expenses per acre to develop a plantation up to time of harvest in the eighth year. Again, that amount is in addition to the purchase price of the land, equipment, etc. It was assumed the trees were planted in year two.

For Table 3, the costs for each cultural operation were estimated by assembling the labor expense, machinery operating costs, and needed materials. The operating costs are separated into cash and non-cash. Charges were then made for such cash overhead expenses as taxes, general cash overhead, and interest on needed operating capital. Finally, the non-cash costs due to depreciation and interest on investment in the plantation (exclusive of land, pickup truck, and residence) were added to determine the total annual costs.<sup>1/</sup>

Year 1 - Preparing The Site

Land preparation costs vary from plantation to plantation depending on soil conditions and the vegetation. For this study, it was assumed that no brush removal was needed. Thus, a charge of \$12.75 per acre was made for custom plowing and discing. Notice that Table 1 does not show the operator owning a plow or disc since they are not needed after year one.

Additional first-year cash costs include \$3.00 for pickup truck travel, and \$4.00 for property taxes, general overhead, and interest on cash operating costs. The general overhead charge (based on 6 percent of cash operating costs) is for such unitemized expenses as insurance, utilities, office costs, miscellaneous supplies, etc. The interest on cash operating expenses assumes all operating capital was borrowed at a 10-percent annual interest rate.

The non-cash charges include unpaid operators' labor, depreciation of equipment, and interest on the needed investment. Details are shown in Table 1.

Table 3 shows an estimated annual cost of \$88.35 per acre for the first year. That amount consists of \$19.75 cash and \$68.60 non-cash.

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<sup>1/</sup> For this study, it was assumed the operator owned the land and equipment debt-free, so interest on these investments were listed as a non-cash, or opportunity, cost.



Table 3. Estimated Eight-Year Costs of Developing a Christmas Tree Plantation in Northeastern Washington, 1977.

Item	Year								Total Per Acre	Cash Costs	Non-Cash Costs
	1	2	3	4	5	6	7	8			
	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
<b>Costs per Acre</b>											
Plow (custom rate) <sup>1/</sup>	8.00								8.00	8.00	
Disc (custom) or rotovate <sup>2/</sup>	4.75	9.50	9.50	9.50	9.50	9.50	9.50	9.50	71.25	29.25	42.00
Plant - check row (6 hrs/A) <sup>3/</sup>		18.00							18.00		18.00
- machinery (2 hrs/A)		2.50							2.50	2.50	
- trees (6¢ each)		94.08	16.50	5.88					116.46	116.46	
- labor (5¢ per tree) <sup>4/</sup>		78.40	13.75	4.90					97.05	48.50	48.55
Rodent control - labor		3.00		3.00		3.00			9.00		9.00
- material (50¢ per lb.)		2.50		2.50		2.50			7.50	7.50	
- rent burrow builder		2.00		2.00		2.00			6.00	6.00	
Weed control - labor and equipment			15.75		15.75		15.75		47.25	20.25	27.00
- material (banded in rows)			12.00		12.00		12.00		36.00	36.00	
Prune, shear, stake, handles <sup>5/</sup>											
- prune, shear (5¢ each)			64.65	88.20	105.77	118.72	131.76	145.10	654.20	436.14	218.06
- straighten trees (5¢ each)			64.65	13.75	4.90				83.30		83.30
- stake trees - labor				9.60	2.00	1.00			12.60		12.60
- material				2.90	.60	.30			3.80	3.80	
- handles (5¢ each)			64.65	13.75	4.90				83.30	55.54	27.76
Irrigation - labor <sup>4/</sup>		48.00	48.00	48.00	48.00	48.00	48.00	48.00	336.00	168.00	168.00
- power, maintenance		17.50	17.50	17.50	17.50	17.50	17.50	17.50	122.50	122.50	
Insect, disease control											
- material						13.00			13.00	13.00	
- custom apply (aerial)						12.00			12.00	12.00	
Fertilizer - applic. labor <sup>6/</sup>			9.00				4.50		13.50		13.50
- material			15.00				4.00		19.00	19.00	
Machinery operation & repair <sup>7/</sup>	3.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	129.00	129.00	
Theft protection <sup>8/</sup>											
Taxes, R.E. and P.P.	2.00	3.00	4.00	5.00	5.00	5.00	5.00	5.00	34.00	34.00	
General overhead (6% of cash operations) <sup>9/</sup>	1.00	12.00	12.00	9.00	9.00	10.00	10.00	10.00	73.00	73.00	
Int. on cash operating costs (6 mo. @10%) <sup>9/</sup>	1.00	11.00	11.00	8.00	8.00	9.00	9.00	8.00	65.00	65.00	
<b>CASH COSTS PER ACRE</b>	<b>19.75</b>	<b>229.28</b>	<b>233.30</b>	<b>168.70</b>	<b>178.14</b>	<b>195.95</b>	<b>197.59</b>	<b>182.73</b>		<b>1,405.44</b>	

Table 3. (continued)

Item	Year								Total Per Acre	Cash Costs	Non-Cash Costs
	1	2	3	4	5	6	7	8			
	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$	\$
<u>Non-cash Costs</u> <sup>10/</sup>											
Operator's labor	.00	90.20	162.65	92.78	82.78	73.57	87.42	78.37	(667.77)		667.77
Depreciation - equipment <sup>7/</sup>	38.00	69.00	69.00	69.00	69.00	69.00	69.00	69.00	521.00		521.00
Interest - equipment <sup>7/</sup>	30.60	53.40	53.40	53.40	53.40	53.40	53.40	53.40	404.40		404.40
Interest on accumulated investment (9%) <sup>11/</sup>		7.95	48.44	99.45	142.95	190.31	242.71	301.22	1,033.03		1,033.03
NON-CASH COSTS PER ACRE	68.60	220.55	333.49	314.63	348.13	386.28	452.53	501.99			2,626.20
TOTAL ANNUAL COSTS PER ACRE	88.35	449.83	566.79	483.33	526.27	582.23	650.12	684.72	4,031.64	1,405.44	2,626.20
ACCUMULATED COSTS PER ACRE	88.35	538.18	1104.97	1588.30	2114.57	2696.80	3346.92	4031.64			

<sup>1/</sup> Custom plowing in year before planting.

<sup>2/</sup> Two cultivations annually except in year 1, at one hour per cultivation.

<sup>3/</sup> 1,568 trees planted in year 2; 275 replants in year 3; and 98 replants in year 4.

<sup>4/</sup> One-half the labor by hired workers. All labor charged at \$3.00 per hour cash wages.

<sup>5/</sup> Removal of double leaders and suckers, and installing of handles, in year after planting or replanting. Pruning costs based on following charges, with operator doing one-third the work:

Year 3 - 1293 trees @ 5¢	Year 6 - 1484 trees @ 8¢
Year 4 - 1470 trees @ 6¢	Year 7 - 1464 trees @ 9¢
Year 5 - 1511 trees @ 7¢	Year 8 - 1451 trees @ 10¢

<sup>6/</sup> General fertilizer application in year 3. Additional amount applied to Douglas-fir in year 7 to improve color.

<sup>7/</sup> See Table 1 for details.

<sup>8/</sup> Requirements for theft protection will vary according to plantation location and where the operator lives.

<sup>9/</sup> Rounded to nearest whole dollar.

<sup>10/</sup> Assumes operator has no principal or interest payments on land or equipment.

<sup>11/</sup> Interest is 9 percent of accumulated investment for previous year.

### Year 2 - The Planting Year

The land is usually tilled once in the second year prior to planting. Laying out the rows prior to planting is reported to take about three hours of labor per acre, costing \$18.00 in non-cash wages, and two hours of tractor time at \$1.25 per hour. Tree planting costs include \$94.08 for purchasing the trees and \$78.40 for planting them.

After planting, the major operating costs are irrigation, rodent control, and a second tilling. The irrigation costs shown in Table 3 were based on four irrigations per year. However, the actual number of irrigations will vary, depending on soil moisture conditions and vigor of the trees.

Rodents often cause serious damage in Christmas tree plantations, particularly when the plantation has been previously used for forage production or is adjacent to fields producing forage crops. Therefore, an extensive rodent control program is usually necessary, either the year prior to planting trees or the year they are planted. The rodent control charges shown in Table 3 assume the operator rents a burrow builder for that purpose.

Other second-year charges include machinery operations and repairs, general overhead, and interest on the cash operating capital. For the most part, those charges were determined in the same manner as for year one. However, the machinery operating costs were increased due to the need for more pickup travel. Travel was increased to 1,200 miles for the second and subsequent years.

Non-cash costs were also determined in the same manner as before. It was assumed that the remaining machinery was purchased, so the amounts for depreciation and interest were increased. Some plantation operators also need to install a fence in the first or second year.

Table 3 also shows a \$7.95 charge per acre for interest on the first-year investment. That amount is an annual "opportunity cost" charge for the \$88.35 invested the first year; it assumes the operator could have invested that money in another manner and received a 9-percent return on his money. Alternatively, it is possible he would need to pay interest on borrowed money.

The estimated second-year cash costs were \$229.28 per acre, as shown in Table 3, while the non-cash costs totaled \$220.55. Thus, the total annual costs were \$449.83. The accumulated costs for the first and second year were \$538.18 per acre.

### Year 3

Growers realize that a significant number of trees may die in the year they are planted. They are usually replaced the next spring. Table 3 shows a charge of \$30.25 per acre for purchasing and replacing 275 trees per acre in the third year.

Pruning and straightening young trees is a major third-year expense. It was estimated those operations cost about \$129.30 per acre. Most operators also establish the tree handles on those trees planted the previous year. That is done by removing the lower branches. The reported cost was \$.05 per tree, or \$64.65 for 1,293 trees per acre.

Applying a chemical to control weeds along the tree rows is usually done in the third year, at an estimated cost per acre of \$27.75. This is in addition to the cost of tilling between the trees twice during the growing season.

Nitrogen fertilizer is applied to most plantation trees in the second growing year. Therefore, a charge of \$15.00 per acre was made for fertilizer and \$9.00 for three hours' labor per acre to apply the material.

The remaining charges for year three were calculated in the same manner as for year two. Table 3 shows total annual costs of \$566.79 per acre, and accumulated costs of \$1,104.97 by the end of the third year.

#### Year 4

It is expected that additional replanting is needed the fourth year. Table 3 shows \$10.78 per acre expenses for replanting 98 trees per acre that year. A follow-up operation is also needed to straighten trees and put handles on those that were replanted in year three. Most plantation operators also stake some trees in the fourth year, those that had not already been adequately straightened. Labor and materials for staking were reported to cost about \$12.50 per acre.

Although an intensive rodent control program is usually conducted in the year trees are planted, most plantation operators find it necessary to continue that program at least every other year. Therefore, Table 3 shows an expense of \$7.50 per acre for rodent control again in year four and in year six. The frequency of these operations, however, will vary from plantation to plantation.

Other costs for year four are approximately the same as before. Total costs for the year are \$483.33 per acre, of which \$168.70 are cash costs and \$314.63 are non-cash expenses.

#### The Remaining Development Period

By the fifth year, plantation operations usually have become somewhat routine. Most growers apply an insect or disease control chemical some year during the development period. For this study, the \$16.00 per acre expense for that operation was entered in the sixth year. Many growers have the material aerially applied by a custom operator.

It is also necessary to periodically control rodents and weeds as well as continue pruning and shearing the trees.

Most growers apply a small amount of nitrogen fertilizer to the Douglas-fir trees the year before they are harvested to improve tree color. Table 2 shows an expense of \$8.50 per acre in year seven for that purpose.

#### Summary of Development Costs

Table 4 summarizes the annual tree inventory and development costs for the eight-year period.



Table 4. Summary of Annual Tree Inventory And Development Costs.

Year	Year-End Inventory Per Acre	Cash Costs <sup>1/</sup>		Non-Cash Costs <sup>1/</sup>		Total Annual Costs <sup>1/</sup>		Accumulated Costs <sup>1/</sup>	
		Per Acre	Per Tree	Per Acre	Per Tree	Per Acre	Per Tree	Per Acre	Per Tree
		\$	\$	\$	\$	\$	\$	\$	\$
1	0	19.75	0.01	68.60	0.05	88.35	0.06	88.35	0.07
2	1293	229.28	0.17	220.55	0.16	449.83	0.33	538.18	0.39
3	1470	233.30	0.17	333.49	0.25	566.79	0.42	1104.97	0.81
4	1511	168.70	0.12	314.63	0.23	483.33	0.35	1588.30	1.16
5	1484	178.14	0.13	348.13	0.26	526.27	0.39	2114.57	1.55
6	1464	195.95	0.15	386.28	0.28	582.23	0.43	2696.80	1.98
7	1451	197.59	0.15	452.53	0.33	650.12	0.48	3346.92	2.46
8	1363	182.73	0.13	501.99	0.37	684.72	0.50	4031.64	2.96
TOTAL		1405.44	1.03	2626.20	1.93	4031.64	2.96		
% OF TOTAL		34.86		65.14		100.00			

<sup>1/</sup> Assumes 643 Scotch pine and 720 Douglas-fir marketable trees per acre in the eighth year.

The data suggest the annual development costs per tree, based on 1977 prices, range from about \$.35 to \$.50 per marketable tree, except for the first year. As a result, the total accumulated development costs for eight years were estimated to be \$2.96 per marketable tree. An estimated \$1.03 per tree (35 percent of the total) is cash costs while \$1.93 (65 percent) is for non-cash expenses.

## IMPACT OF HARVESTING IN ALTERNATE YEARS

There are several alternate strategies for harvesting and selling plantation Christmas trees. All the trees can be harvested in one year or harvest can be spread over two or three years. Table 5 shows four sample harvest schedules. Also, it must be decided whether the buyer or the seller pays the harvest costs. Some growers prefer to sell their trees on a standing (stumpage) basis while others choose to sell them after harvest. Each of those strategies have significant financial consequences.

Table 5. Sample Harvest Strategies.

Year and Grade	Trees Harvested Per Acre			
	Scotch pine		Douglas-fir	
	%	No.	%	No.
-----One-Year Harvest Strategies-----				
<u>Year 8</u>				
No. 1 and better	20	129	20	181
No. 2's	30	193	50	337
Other marketable	50	321	30	202
Not marketable		47		32
TOTAL PER ACRE		<u>690</u>		<u>752</u>
<u>Year 9</u>				
No. 1 and better	50	327	70	500
No. 2's	20	131	10	71
Other marketable	30	196	20	143
Not marketable		31		36
TOTAL PER ACRE		<u>685</u>		<u>750</u>
<u>Year 10</u>				
No. 1 and better	70	452	80	583
No. 2's	20	129	15	110
Other marketable	10	65	5	36
Not marketable		36		19
TOTAL PER ACRE		<u>682</u>		<u>748</u>
-----Three-Year Harvest Strategy-----				
<u>Year 8</u>				
No. 1 and better	20	129	20	146
<u>Year 9</u>				
No. 1 and better	30	194	50	365
<u>Year 10</u>				
No. 1 and better	20	129	10	73
No. 2's	20	129	15	109
Other marketable	10	65	5	36
Not marketable		36		19
TOTAL PER ACRE		<u>682</u>		<u>748</u>

Table 6 shows the 1977 costs when the trees are harvested in three alternate years. That table is based on the plantation operator paying the costs of harvesting the trees and loading them on the buyer's truck.

### Harvesting In The Eighth Year

The first column in Table 6 shows the harvest and loading costs for the eighth year. It assumes 1,363 marketable trees per acre (643 Scotch pine and 720 Douglas-fir). The costs amount to \$541.05 per acre, or \$.40 per tree. They are based on a charge of \$.25 to cut and haul each tree to the loading site, and \$.10 to load it on the buyer's truck. An additional charge of \$12.00 per acre was for harvest supervision, and \$15.00 for postharvest cleanup. Cleanup included cutting and removing 47 Scotch pine and 32 Douglas-fir trees that were not marketable.

The eighth-year harvest and cleanup costs shown in Table 5 amount to \$.38 cash costs and \$.02 non-cash costs per tree for 1977. On that basis, the operator could have sold the trees for \$.40 less if the buyer paid all the harvesting and loading costs.

When the tree development costs (\$4,031.64 per acre) are added to the harvest and cleanup costs (\$541.05 per acre), it was determined the total cost of an eight-year development and harvest operation was \$4,572.69 per acre. That amounts to \$3.36 per marketable tree, which includes \$1.41 cash costs and \$1.95 non-cash costs.

### Delaying Harvest To The Ninth Year

Delaying harvest to the ninth year means there will be operating costs for another year. But it also means the trees should be larger and of better quality. They will cost more but should sell for a higher price. Let us look at the effect of that harvest strategy.

The second column in Table 6 shows the added operating and harvest costs for the ninth year to be \$1,296.75 per acre. In order to compare the ninth-year costs with those for the eighth year, it is necessary to discount the ninth-year costs by an appropriate discount factor.<sup>2/</sup> An annual discount factor of 9 percent was used. On that basis, the eighth-year present value costs of delaying harvest one year was \$1,189.64 per acre, or \$.87 per marketable tree. Thus, it appears that delaying harvest of all the trees until the ninth year means the grower will have to sell the trees for an additional \$.47 per tree in order to receive a price comparable to what he would have received the previous year.

Total costs for the nine years of tree development and harvest, when adjusted for difference in the time of harvest, are \$4,031.64 plus \$1,189.64, or \$5,221.28 per acre. That amounts to \$3.82 per tree for 1,368 marketable trees, consisting of \$1.50 cash and \$2.32 non-cash costs.

<sup>2/</sup> See Appendix Table 1 for explanation of present value (or discount) concept.

Table 6. Annual and Discounted Value of Operating and Harvest Costs Per Acre and Per Marketable Tree When Harvesting in Alternate Years.

	Harvest in Year 8	Harvest in Year 9	Harvest in Year 10	
			Year 9	Year 10
Number of marketable trees per acre	1,363	1,368		1,375
- Scotch pine	643	654		646
- Douglas-fir	720	714		729
<u>COSTS PER ACRE</u>				
Rotovate		9.50	9.50	9.50
Shearing - 1,442 in year 9 @ 10¢ <sup>1/</sup>		144.20	144.20	
- 1,435 in year 10 @ 10¢ <sup>1/</sup>				143.50
Rodent control - fall of year 8		7.50	7.50	
Irrigation <sup>2/</sup>		65.50	65.50	65.50
Machinery, operation and repair		18.00	18.00	18.00
Theft protection				
Harvest - cut, drag (20¢ per tree) <sup>3/</sup>	272.60	273.60		275.00
- machinery (5¢ per tree)	68.15	68.40		68.75
- loading truck (10¢ per tree)	136.30	136.80		137.50
- supervision	12.00	12.00		12.00
Postharvest cleanup - 4 hrs. operators labor, 2 hrs. tractor and trailer	15.00	15.00		15.00
Taxes, R.E. and P.P.		5.00	5.00	5.00
General overhead (6% of cash operations)	29.00	39.00	10.00	39.00
Int. on cash operating costs - 2 mo. @ 10%	8.00			
- 3 mo. @ 10%		17.00	4.00	17.00
<hr/>				
CASH COSTS - annual per acre	517.05	706.43	182.63	703.92
- discounted value (9%) <sup>4/</sup>	517.05	648.08	167.54	592.49
- per tree	0.38	0.47	0.12	0.43
<hr/>				
<u>NON-CASH COSTS</u>				
Operator's labor	24.00	105.07	81.07	101.83
Deprec. - equipment		69.00	69.00	69.00
Int. - equipment		53.40	53.40	53.40
Int. on accum. investment <sup>2/</sup>		362.85	362.85	430.25
<hr/>				
NON-CASH COSTS - annual per acre	24.00	590.32	566.32	654.48
- discounted value (9%)	24.00	541.56	519.54	550.88
- per tree	0.02	0.40	0.38	0.40
<hr/>				
TOTAL COSTS - annual per acre	541.05	1,296.75	748.95	1,358.40
- discounted value (9%)	541.05	1,189.64	687.08	1,143.37
- per tree	0.40	0.87	0.50	0.83

<sup>1/</sup> Based on operator doing one-third of the shearing.

<sup>2/</sup> One-half the irrigation labor done by operator.

<sup>3/</sup> All labor charged at \$3.00 per hour except for piecework.

<sup>4/</sup> The discount factor for ninth-year costs was .9174; it was .8417 for costs in the tenth year, as shown in Appendix Table 1.



The Costs of Waiting Until the Tenth Year

The costs of waiting until the tenth year to harvest the trees are also shown in Table 6. The eighth-year present value of those amounts is \$1,830.45 per acre (\$687.08 plus \$1,143.37 equals \$1,830.45). Thus, the adjusted total development and harvest costs for the ten-year rotation are \$5,862.09 per acre, or \$4.26 per tree when 1,375 trees per acre are marketed. The cash costs were \$1.57 per marketable tree, while the non-cash expenses were \$2.69.

Comparing the Three Harvest Strategies

Table 7 summarizes the development and harvest costs per marketable tree for the three harvest strategies, when adjusted to an eighth-year basis. The data indicate an added cost of 47 cents per tree to delay harvest from the eighth to the ninth year, and an additional 47 cents per tree to delay harvest until the tenth year.

Table 7. Summary of Development and Harvest Costs Per Marketable Tree When Harvesting in Alternate Years.

	Year 8		Year 9		Year 10	
	Per Acre	Per Tree	Per Acre	Per Tree	Per Acre	Per Tree
	\$	\$	\$	\$	\$	\$
Marketable trees	1,363		1,368		1,375	
Develop. costs (8 yrs)	4,031.64	2.96	4,031.64	2.95	4,031.64	2.93
- cash	1,405.44	1.03	1,405.44	1.03	1,405.44	1.02
- non-cash	2,626.20	1.93	2,626.20	1.92	2,626.20	1.91
Disc. value of harv. and cleanup costs	541.05	0.40	1,189.64	0.87	1,830.45	1.33
- cash	517.05	0.38	648.08	0.47	760.03	0.55
- non-cash	24.00	0.02	541.56	0.40	1,070.42	0.78
Disc. total develop. and harvest costs	4,572.69	3.36	5,221.28	3.82	5,862.09	4.26
- cash	1,922.49	1.41	2,053.52	1.50	2,165.47	1.57
- non-cash	2,650.20	1.95	3,167.76	2.32	3,696.62	2.69
Disc. costs of delaying harvest						
- one year	-	-	648.59	0.47	-	-
- two years	-	-	-	-	1,289.40	0.94

## 1977 INCOME FROM PLANTATION TREES

To this point, we have considered only the costs of developing and harvesting plantation trees in northeastern Washington. A plantation operator should also be concerned about the income from sale of the trees.

Table 8 shows the reported local stumpage prices in 1977 for the three common grades of Scotch pine and Douglas-fir.

Table 8. Plantation Christmas Tree Stumpage Prices in Northeastern Washington, 1977.

Market Grade	Price Per Tree	
	Scotch Pine	Douglas-fir
	\$	\$
No. 1 and better	4.00	3.20
No. 2's	2.75	2.25
Other marketable	1.25	1.25

Using the data in Tables 5 and 8, it is possible to calculate the income per acre a grower might have received for his standing trees in 1977, according to their age at harvest.

Table 9 presents the estimated tree harvest and income by year of harvest. The data indicate that delaying harvest to the ninth year would result in an increased average selling price of 32 cents per marketable tree. Delaying harvest to the tenth year would result in an additional 11-cent increase in the average selling price of a tree. It should be realized, however, that the calculated sales income can be significantly changed by modifying 1) the proportion of Scotch pine and Douglas-fir, 2) the number of trees in each grade, or 3) the stumpage price of the varieties and/or grades.

Table 9. Estimated 1977 Income from Stumpage Sales of Plantation Christmas Trees in Northeastern Washington by Year of Harvest.<sup>1/</sup>

	No.	Price Per	Scotch Pine		No.	Price Per	Douglas-fir	
			Tree	Total Per Acre			Tree	Total Per Acre
<b>Year 8</b>								
No. 1 and better	129	4.00		516.00	181	3.20		579.20
No. 2's	193	2.75		530.75	337	2.25		758.25
Other marketable	321	1.25		446.00	202	1.25		252.50
TOTAL	643			1,492.75	720			1,589.95
Value per tree		2.32				2.21		
Average for all trees				2.26				
Discounted average value				2.26				
<b>Year 9</b>								
No. 1 and better	327	4.00		1,308.00	500	3.20		1,600.00
No. 2's	131	2.75		360.25	71	2.25		159.75
Other marketable	196	1.25		245.00	143	1.25		178.75
TOTAL	654			1,913.25	714			1,938.50
Value per tree		2.92				2.71		
Average for all trees				2.82				
Discounted average value				2.58				
<b>Year 10</b>								
No. 1 and better	452	4.00		1,808.00	583	3.20		1,865.60
No. 2's	129	2.75		354.75	110	2.25		247.50
Other marketable	65	1.25		81.25	36	1.25		45.00
TOTAL	646			2,244.00	729			2,158.10
Value per tree		3.47				2.96		
Average for all trees				3.20				
Discounted average value				2.69				

<sup>1/</sup> Based on data in Tables 5 and 8.

### COMPARING THE ESTIMATED EXPENSES AND INCOME

The final phase of the study compared the estimated 1977 costs of producing plantation trees with the expected 1977 income from selling the trees on a stumpage basis. The data in Table 10 indicate that, under the conditions used for the study, a plantation Christmas tree operation in northeastern Washington showed an average cost of \$2.97 per marketable tree for trees harvested in the eighth year, and a 1977 stumpage sales value of \$2.26. Thus, the net loss was \$0.71 per tree.

The Table 10 data suggest that 1977 income from stumpage sales covers only about 76 percent of the eight-year total costs of developing a Christmas tree plantation in northeastern Washington, even when annual interest charges for the land and pickup are omitted. However, it does cover the average cash costs of \$1.03 per tree shown in Table 4.

Delaying harvest to the ninth year results in a net loss of \$0.88 per marketable tree, or 17 cents more than if the trees were harvested in the eighth year.

When the harvest is delayed to the tenth year, the discounted value of the loss was \$1.24 per marketable tree, which is 54 cents more than if the trees were sold in the eighth year.



Table 10. Estimated Eighth-Year Stumpage Value and Grower Returns by Year of Harvest, 1977.

	Year of Harvest					
	Year 8		Year 9		Year 10	
	Per Acre	Per Tree	Per Acre	Per Tree	Per Acre	Per Tree
	\$	\$	\$	\$	\$	\$
Marketable trees per acre	1,363		1,368		1,375	
Development costs <sup>1/</sup>	4,031.64	2.96	4,031.64	2.95	4,031.64	2.93
Discounted value of added non-harvest costs <sup>2/</sup>	15.00	0.01	699.93	0.51	1,379.07	1.00
Discounted value of total non-harvest costs	4,046.64	2.97	4,731.57	3.46	5,410.71	3.93
Discounted stumpage value of trees <sup>3/</sup>	3,082.70	2.26	3,533.60	2.58	3,705.25	2.69
Discounted value of estimated net returns	-963.94	-0.71	-1,197.97	-0.88	-1,705.46	-1.24
Loss due to delaying harvest						
- one year		-	234.03	0.17		-
- two years		-		-	741.52	0.54

<sup>1/</sup> Data from Table 4.

<sup>2/</sup> Calculated by subtracting harvest costs from data in Table 6.

<sup>3/</sup> Calculated by discounting estimated income shown in Table 9. The discount factor for year 9 is 0.9174; it is 0.8417 for year 10 as shown in Appendix Table 1.

Appendix Table 1. Present Value (Discount) Table

Year	7.5%	8.0%	8.5%	9.0%	9.5%	10.0%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	.9302	.9259	.9217	.9174	.9132	.9091
3	.8653	.8573	.8494	.8417	.8340	.8364
4	.8050	.7938	.7829	.7722	.7616	.7513
5	.7488	.7350	.7216	.7084	.6958	.6830
6	.6966	.6806	.6650	.6499	.6352	.6309
7	.6480	.6302	.6129	.5963	.5801	.5645
8	.6028	.5835	.5650	.5470	.5297	.5132
9	.5607	.5403	.5206	.5019	.4838	.4665
10	.5216	.5002	.4798	.4604	.4418	.4241
11	.4852	.4632	.4423	.4224	.4035	.3855
12	.4513	.4289	.4077	.3875	.3685	.3505
13	.4199	.3971	.3757	.3555	.3365	.3186
14	.3906	.3677	.3463	.3262	.3073	.2897
15	.3633	.3405	.3192	.2992	.2807	.2633
16	.3380	.3152	.2941	.2745	.2563	.2394
17	.3144	.2919	.2711	.2519	.2341	.2176
18	.2925	.2703	.2499	.2311	.2138	.1978
19	.2720	.2502	.2303	.2120	.1952	.1799
20	.2531	.2317	.2122	.1945	.1783	.1635

### Present Value or Discounting Concepts

To properly consider the impact of costs or income that occur over more than one year, it is necessary to recognize the time value of money. Many people avoid "time value" concepts although they are not really difficult to understand.

Suppose a person owed you \$1,000 which is due one year from today, but said we wanted to pay the debt now. How much would you settle for? If you could invest the amount you received today in an insured savings account that earned 8 percent interest, you could settle for \$925.93. At the end of the year of savings you would have earned \$74.07 interest on that savings, leaving you with \$925.93 plus \$74.07, or \$1,000. This concept applies to either income or expenses, and for any number of years. The present value of an amount (income or expense) that occurs at some future date decreases as that date is extended and as the discount rate increases.

The most critical part of discounting is determining the appropriate annual discount rate. Most people realize that long-term interest rates are often adjusted to compensate for risk and inflation factors as well as for the possible rates of return on no-risk alternative investments. The same is true for discount rates. In discounting, one should use an annual discount rate which is approximately equal to the interest rate on best available investments with similar risk.

Appendix Table 2. Compound Interest Table

Year	7.5%	8.0%	8.5%	9.0%	9.5%	10.0%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0750	1.0800	1.0850	1.0900	1.0950	1.1000
3	1.1556	1.1664	1.1772	1.1881	1.1990	1.2100
4	1.2423	1.2597	1.2773	1.2950	1.3129	1.3310
5	1.3355	1.3605	1.3858	1.4116	1.4377	1.4661
6	1.4356	1.4693	1.5036	1.5386	1.5742	1.6105
7	1.5433	1.5869	1.6315	1.6771	1.7238	1.7716
8	1.6590	1.7138	1.7701	1.8280	1.8976	1.9487
9	1.7835	1.8509	1.9206	1.9926	2.0654	2.1436
10	1.9172	1.9990	2.0838	2.1719	2.2632	2.3580
11	2.0610	2.1589	2.2610	2.3674	2.4782	2.5937
12	2.2156	2.3316	2.4532	2.5804	2.7136	2.8531
13	2.3818	2.5182	2.6617	2.8127	2.9714	3.1384
14	2.5604	2.7196	2.8879	3.0658	3.2537	3.4523
15	2.7524	2.9372	3.1334	3.3417	3.5628	3.7975
16	2.9589	3.1722	3.3997	3.6425	3.9013	4.1772
17	3.1808	3.4259	3.6887	3.9703	4.2719	4.5950
18	3.4194	3.7000	4.0023	4.3276	4.6778	5.0545
19	3.6758	3.9960	4.3424	4.7171	5.1222	5.5599
20	3.9515	4.3157	4.7116	5.1417	5.6088	6.1159

