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David M. Jones, Larry A. Leefers and Melvin R. Koelling, Forestry
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Costs and Returns in Michigan Christmas Tree Production, 1997



Costs and Returns in Michigan Christmas Tree Production, 1997¹

By David M. Jones, Larry A. Leefers and Melvin R. Koelling²

For several years, Michigan has been a leading state in the production of plantation-grown Christmas trees. Each year, nearly 4 million Christmas trees are harvested. Approximately 75 percent of these trees are sold to brokers, retail garden stores, chain stores, nursery outlets and service clubs outside the state (1). In several counties, Christmas tree production is among the leading agricultural endeavors. Individual operations vary in size from a few acres to more than 5,000. The combination of a favorable climate and diverse soils enables Michigan growers to produce several tree species. Offering many species has permitted Michigan producers to remain competitive in nearly all national markets.

Christmas tree production, like many other agricultural endeavors, tends to be cyclical. Periods of strong market demand and increased prices are generally followed by increased plantings, which eventually result in excess supplies and reduced prices. Historically, these cycles have tended to repeat themselves at 12- to

15-year intervals. The industry is emerging from a particularly intense cycle characterized by significant price declines and a decrease in the number of trees harvested and sold. The intensity of this most recent cycle — as evidenced by increased competition, lower market prices and increased production costs — has also resulted in several growers leaving the business. Numbers of trees planted annually have decreased, and many of those growers remaining in the business have experienced considerable difficulty in remaining profitable.

Since the late 1960s, the Department of Forestry at Michigan State University has conducted periodic studies on the costs and returns associated with Christmas tree production. The results of previous studies were published in 1968, 1972, 1982 and 1986 (2, 3, 4 and 5). Because considerable change in the industry had occurred since 1986, a new study was undertaken in 1997. The results of this most recent effort are reported in this publication.

Methods

To obtain data for this study, a questionnaire was prepared and mailed to 180 members of the Michigan Christmas Tree Association. Individuals selected to receive the survey questionnaire were primarily wholesale growers for whom Christmas tree production represented a significant portion of their total income. Furthermore, participants were selected from those growers who were known to apply intensive management practices during the course of production.

The survey form requested information related to several aspects of costs and returns for the three most important Christmas tree species produced in the state: Scotch pine, Douglas-fir and Fraser fir. Scotch pine and Douglas-fir have been important species for Michigan growers for many years. Fraser fir is a relatively new species to the Michigan industry, and in the past several years, it has increased in popularity in Michigan and elsewhere (7 and 8). It is viewed by many growers as the most

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² The authors are graduate assistant, associate professor and professor, respectively, Department of Forestry, Michigan State University.

important species for future Christmas tree production in the state.

The initial mailing of survey questionnaires occurred in July 1997. A follow-up mailing was made in August of the same year. Grower responses varied by species. From the 180 survey forms sent out, returns ranged from 73 for Fraser fir to 76 for Scotch pine. Some producers did not grow all three species and a few responses could not be used because of missing or incomplete data. Complete and usable responses varied from 21 for Fraser fir to 36 for Scotch pine (Table 1).

The Survey

Questionnaires requested detailed information on several cost components related to Christmas tree production as well as returns for trees of various sizes. Cost-related questions included land value, property taxes, annual land rental, site preparation, planting stock, cost of planting and replanting as required, overhead for management supervision and sales, chemical weed control, mowing, fertilization, shearing, basal pruning, staking, insect control, disease control and irrigation. Other costs incurred during the year of

harvest included color tinting, cutting, cleaning (shaking), baling, hauling to the loading yard, loading and field cleanup following harvest. Additional items in the questionnaire included type of planting stock, tree spacing, width of access lanes, number of rows between access lanes, survival rates of first-year plantings, percent of trees marketed, number of trees sold per acre in each year of the production period, price per tree sold and region of the state in which the plantation was located. Current costs and prices were for USDA No. 1 trees that were between 5½ and 7 feet in height at the time of sale. Representative management regimes were developed on the basis of information provided by respondents related to rotation length and number of trees sold in various years of the rotation.

Costs and returns reported per tree or per 1,000 trees were converted to a per acre basis by taking into consideration the average number of trees planted and the number sold. Annual land rental costs were computed using 5.5 percent of the reported land values. This is the 1995 ratio of rent to value of Michigan cropland as reported by the National Agricultural Statistics Service (NASS) of the U.S. Department of Agriculture (9).

A supplementary phone survey was conducted in July of 1998. The purpose of this survey was to gather additional cost information pertaining to harvesting activities. Questionnaire responses in this area were highly variable and lower in cost than expected. Ten Michigan Christmas Tree Association members who grew all three species were contacted. From the 10 growers contacted, six were able to provide itemized costs for harvesting. The average cost values of these 10 growers were used in the economic analysis.

Survey Results

A majority of the survey respondents reported that their Christmas tree operations were located in the southern Lower Peninsula. Of those growing Scotch pine, 59 percent were in the southern Lower Peninsula, 35 percent were in the northern Lower Peninsula and 6 percent were in the Upper Peninsula. Douglas-fir growers followed a similar pattern, with 50 percent of growers located in the southern Lower Peninsula, 46 percent in the northern Lower Peninsula and 4 percent in the Upper Peninsula. No survey respondent was producing Fraser fir in the Upper Peninsula. Fifty-seven percent of the survey respondents growing Fraser fir were located in the southern Lower Peninsula, and 43 percent in the northern half of the Lower Peninsula.

Costs and Returns

Data provided by survey respondents were used to complete a cost and return analysis for each of the three Christmas tree species

Table 1. Questionnaires mailed, responses received and usable responses, by species.

Item	Scotch pine	Douglas-fir	Fraser fir
Questionnaires mailed	180	180	180
Total responses	76	78	73
Respondents that grew species	45	41	28
Usable responses	36	35	21

(Table 2). Included in each analysis are production period or rotation lengths, average land value per acre (a basis for annual rental costs), average number of trees planted per acre and average selling price per tree. Estimates of the average number of trees planted per acre were based on spacing, width of access lanes and number of rows between access lanes. An average of 1,222 trees planted per acre was used for all species. This represents a tree spacing of about 5½ by 6 feet with 13 rows of trees between access lanes 14 feet wide.

Average costs and returns for growing Scotch pine Christmas trees from eight to 10 years are presented in three tables (Tables 3a, 3b and 4). The timing or year in which each cost was incurred is presented along with per tree and

Item	Scotch pine	Douglas-fir	Fraser fir
Production periods, years	8 to 10	10 to 13	8 to 10
Average land value per acre	991	1,824	923
Average number of trees planted per acre	1,222	1,222	1,222
Average number of trees sold per acre	810	808	1,056
Average selling price per 5½- to 7-foot tree	\$9.40	\$14.00	\$22.56

Cost item	Average cost per year or per treatment		Rotation length in years		
			8	9	10
	(Per acre)	(Per tree)	(Years in which cost is incurred)		
Land rental	\$ 45.35	\$ 0.04	1-8	1-9	1-10
Site preparation	53.85	0.04	1	1	1
Planting stock	215.04	0.18	1	1	1
Planting	99.59	0.08	1	1	1
Replanting	20.34	0.16	2	2	2
Land taxes	15.69	0.01	1-8	1-9	1-10
Overhead	147.69	0.12	1-8	1-9	1-10
Mowing	20.91	0.02	1-8	1-9	1-10
Chemical weed control	28.42	0.02	1-5	1-6	1-7
Basal pruning	141.28	0.12	3	3	3
Staking	95.19	0.21	3	3	3
Insect control	47.26	0.04	3-8	3-9	3-10
Disease control	40.54	0.03	4-8	4-9	4-10
Cleanup after harvest	65.72	0.05	8	9	10

per acre costs (Tables 3a and 3b). Most costs are incurred on a per acre basis regardless of the number of trees present (Table 3a). Costs associated with shearing, tinting, cutting, cleaning, baling, hauling and loading are based on the number of trees harvested in a given year (Table 3b). Harvesting costs are calculated for all years during the rotation period in which trees are harvested. For example, in the case of a rotation where eight years are necessary to complete the harvest of all trees initially planted, harvest-related costs are calculated in years 6, 7 and 8 based on the number of trees harvested in each of those years.

For Scotch pine, an average of 810 trees per acre, or 66 percent of the trees planted, are harvested regardless of the length of the

Table 3b. Scotch pine Christmas tree management costs associated with shearing and harvesting, eight- to 10-year rotations.

Cost item and years in which cost is incurred	Average cost per tree	Rotation length in years		
		8	9	10
(Cost per acre)				
Shearing				
3rd and 4th years	\$ 0.06	\$ 71	\$ 71	\$ 71
5th and 6th years	0.10	118	118	118
7th year	0.12	123	130	132
8th year	0.13	91	107	118
9th year	0.12		70	81
10th year	0.13			66
Color tinting				
6th year	0.37	56	34	27
7th year	0.37	120	98	71
8th year	0.37	123	87	86
9th year	0.37		81	62
10th year	0.37			53
Cutting				
6th year	0.19	29	18	14
7th year	0.19	62	50	36
8th year	0.19	63	44	44
9th year	0.19		41	32
10th year	0.19			27
Cleaning and baling				
6th year	0.63	96	59	47
7th year	0.63	205	167	121
8th year	0.63	210	147	147
9th year	0.63		137	105
10th year	0.63			91
Hauling and loading				
6th year	0.79	120	73	58
7th year	0.79	257	209	152
8th year	0.79	263	185	184
9th year	0.79		172	132
10th year	0.79			114

production period (Table 4). At a reported average sales price of \$9.40 per tree, total (gross) revenues of \$7,614 per acre are realized over the entire production period.

Tables 5a, 5b and 6 were compiled in a like manner for Douglas-fir, and Tables 7a, 7b and 8 for Fraser fir. Because it grows slower, Douglas-fir is generally grown for a longer period. Given management regimes presented in this study, total per acre revenues for Douglas-fir and Fraser fir exceed \$11,000 and \$23,000, respectively.

Economic Analysis

Several measures of economic efficiency can be used to compare the relationship between costs and revenues associated with Christmas tree production. The most commonly used measures are net future value, net present value and internal rate of return. Each of these concepts can be used to estimate the profitability of growing various species of Christmas trees, or to examine the effects of various rotation lengths or other management regimes for one species.

All three measures are based on net cash flows occurring each year or, expressed in another way, the difference between average revenues and average costs. Positive annual net revenues are not experienced until harvesting begins. Simply comparing total revenues to total costs does not allow a grower to adequately evaluate Christmas tree investments because of the time value of money. Net future value reflects the future return an investor would receive using a given interest rate. Present net value similarly reflects those future returns in

Table 4. Average number of Scotch pine Christmas trees sold by years in eight- to 10-year production periods, and revenues received.

Year of sale	Average number of trees sold per acre for each production period and revenues received at \$9.40 per tree		
	8-year rotation	9-year rotation	10-year rotation
6	152 \$1,429	93 \$874	74 \$696
7	325 \$3,055	265 \$2,491	192 \$1,805
8	333 \$3,130	234 \$2,200	233 \$2,190
9		218 \$2,049	167 \$1,570
10			144 \$1,354
Trees sold	810	810	810
Gross revenue	\$7,614	\$7,614	\$7,614

Table 5a. Douglas-fir Christmas tree management costs other than those associated with shearing and harvesting, 10- to 13-year rotations.

Cost item	Average cost per year or per treatment		Rotation length in years			
			10	11	12	13
	(Per acre)	(Per tree)	(Years in which cost is incurred)			
Land rental	\$ 73.53	\$0.06	1-10	1-11	1-12	1-13
Site preparation	88.93	0.07	1	1	1	1
Planting stock	366.53	0.30	1	1	1	1
Planting	158.86	0.13	1	1	1	1
Replanting	39.26	0.30	2	2	2	2
Land taxes	26.48	0.02	1-10	1-11	1-12	1-13
Overhead	143.65	0.12	1-10	1-11	1-12	1-13
Mowing	25.52	0.02	1-10	1-11	1-12	1-13
Chemical weed control	25.00	0.02	1-7	1-8	1-9	1-10
Fertilizer	35.68	0.03	5-10	6-11	7-12	8-13
Basal pruning	167.06	0.14	4	4	4	4
Insect control	20.04	0.02	4-10	4-11	4-12	4-13
Disease control	29.80	0.02	7-10	7-11	7-12	7-13
Cleanup after harvest	101.27	0.08	10	11	12	13

present terms — that is, future costs and returns are discounted to the present. Incorporating the concept of rate of return enables individual operations to compare their returns with our calculated rates.

The internal rates of return (IRR) determined in this study are real rates — that is, rates that are earned above the rate of inflation. Inflation was assumed to affect returns and costs at the same rate. Because growers have widely varying tax situations, the IRRs were also calculated before taxes. In an earlier study, before-tax rates of return were 1.3 to 3.5 percent higher than after-tax IRRs (9).

The return on an investment is expressed as a percentage, which represents the rate at which the money invested earns income. In addition to being referred to as the IRR, it is also known as the return on investment (ROI). The IRR can be compared with, among others, the interest rate earned on a savings account, a money market fund or a certificate of deposit (CD), if inflation is included in the IRR calculation. The existence of inflation means that the rates of return have to be expressed either as current — that is, including inflation — or real, with inflation removed. The rate of return on a savings or other account quoted by a bank is a current rate. If inflation is 3 percent per year, then a CD that earns 7 percent per year has kept pace with inflation and had a real increase of 4 percent. In judging investments, a real rate of return between 4 and 6 percent is often used as the minimum acceptable rate. The real rate of interest that is earned on so-called "safe" investments falls within this range.

Table 5b. Douglas-fir Christmas tree management costs associated with shearing and harvesting, 10- to 13-year rotations.

Cost item and years in which cost is incurred	Average cost per tree	Rotation length in years			
		10	11	12	13
(Cost per acre)					
Shearing					
4th-6th years	\$0.14	\$167	\$167	\$167	\$167
7th year	0.14	157	159	167	167
8th year	0.14	140	149	161	161
9th year	0.21	157	183	237	206
10th year	0.24	128	157	239	195
11th year	0.21		104	163	135
12th year	0.23			139	128
13th year	0.20				103
Cutting					
6th year	0.20	14	12		
7th year	0.20	24	14	9	8
8th year	0.20	51	38	4	34
9th year	0.20	43	43	26	34
10th year	0.20	30	32	44	34
11th year	0.20		22	35	17
12th year	0.20			44	9
13th year	0.20				26
Cleaning and baling					
6th year	0.62	45	37		
7th year	0.62	75	44	27	26
8th year	0.62	157	119	14	105
9th year	0.62	133	134	81	105
10th year	0.62	92	100	135	105
11th year	0.62		68	109	53
12th year	0.62			135	27
13th year	0.62				79
Hauling and loading					
6th year	0.83	60	49		
7th year	0.83	100	59	37	35
8th year	0.83	210	159	18	141
9th year	0.83	178	179	109	141
10th year	0.83	123	134	181	141
11th year	0.83		90	145	71
12th year	0.83			181	36
13th year	0.83				106

Cost and return data (Tables 2-8) were used to calculate the IRRs for the three species of Christmas trees grown over the various production periods. A computer-based spreadsheet was used to calculate the IRRs (Table 9).

Discussion

The resulting internal rates of return generally indicate that shorter production periods yield higher rates of return (Table 9). The eight-year rotation of Fraser fir demonstrates the highest IRR of all species and all rotation lengths, followed by the nine-year and 10-year Fraser fir rotations, respectively. However, relatively short production periods, somewhat lower land values and a higher number of trees sold per acre also contributed to the higher IRRs for Fraser fir. The high IRRs associated with Fraser fir are primarily due to the high price received — \$22.56 per tree. The relatively lower Scotch pine IRRs can be attributed to the relatively low sales price of \$9.40 per tree.

The IRRs had the expected steady decline with respect to rotation length period for both Fraser fir and Scotch pine. In other words, the longer the rotation period, the lower the IRR. The Douglas-fir IRR did not exhibit the same pattern. In the 13-year rotation period, the IRR increases over the 12-year rotation period and then continues a steady decline. This may be due to the existence of two separate Douglas-fir Christmas tree markets. Many growers raise a 5½- to 7-foot Douglas-fir, while some raise larger trees. Larger trees obviously require more time to grow. Evidence of separate markets can be observed in

the number of Douglas-fir trees harvested, as shown in Table 6. Most of the rotation periods for the three species show an increase in the number of trees harvested per year followed by a decline in the final year(s). The 12-year and 13-year Douglas-fir rotation periods both demonstrate the increase followed by the decrease in trees harvested over time, but then an increase occurs in the later years of the rotation.

The IRRs for both Douglas-fir and Scotch pine have significantly decreased since 1986 (5). In the 1986 study, IRRs for Scotch pine produced in eight-, nine- and 10-year rotations ranged from 35 to 25 percent. Results in the current study indicate the IRR for Scotch pine had dropped by more than half (16 to 19 percent) since the 1986 survey. Internal rates of return for Douglas-fir decreased by 11 to 16 percent during this same time period. The costs and revenues of Fraser fir were not measured before the 1997 survey and therefore can not be compared with results of earlier studies.

After-tax IRRs would be slightly lower, as previously noted, but in most instances these returns compare favorably with other investment opportunities. Less experienced growers may have higher costs or produce lower quality products. To assess the effects of higher costs, we performed a sensitivity analysis in which all costs were increased by 10 percent except for land rental and land tax costs, which may be out of growers' control. Rates of return for Scotch pine decreased by approximately 4 percent, so the eight-, nine- and 10-year rates of return were 12, 8 and 5 percent,

Table 6. Average number of Douglas-fir Christmas trees sold by years in 10- to 13-year production periods, and revenues received.

Year of sale	Average number of trees sold per acre for each production period and revenues received at \$14 per tree			
	10-year rotation	11-year rotation	12-year rotation	13-year rotation
6	72 \$1,008	59 \$826		
7	121 \$1,694	71 \$994	44 \$616	42 \$588
8	253 \$3,542	192 \$2,688	22 \$308	170 \$2,380
9	214 \$2,996	216 \$3,024	131 \$1,834	170 \$2,380
10	148 \$2,072	161 \$2,254	218 \$3,052	170 \$2,380
11		109 \$1,526	175 \$2,450	85 \$1,190
12			218 \$3,052	43 \$602
13				128 \$1,792
Trees sold	808	808	808	808
Gross revenue	\$11,312	\$11,312	\$11,312	\$11,312

Table 7a. Fraser fir Christmas tree management costs other than those associated with shearing and harvesting, eight- to 10-year rotations.

Cost item	Average cost per year or per treatment		Rotation length in years		
			8	9	10
	(Per acre)	(Per tree)	(Years in which cost is incurred)		
Land rental	\$ 52.22	\$0.04	1-8	1-9	1-10
Site preparation	94.38	0.08	1	1	1
Planting stock	586.56	0.48	1	1	1
Planting	202.11	0.17	1	1	1
Replanting	42.48	0.29	2	2	2
Land taxes	18.98	0.02	1-8	1-9	1-10
Overhead	122.29	0.10	1-8	1-9	1-10
Mowing	15.22	0.01	1-8	1-9	1-10
Chemical weed control	27.72	0.02	1-7	1-8	1-9
Fertilizer	30.00	0.02	3-8	4-9	5-10
Basal pruning	118.76	0.10	4	4	4
Insect control	19.58	0.02	4-8	4-9	4-10
Disease control	2.38	0.00	7-8	7-9	7-10
Cleanup after harvest	84.17	0.07	8	9	10

respectively. The declines on Fraser fir rates of return were between 2 and 2.5 percent. Thus, the rates of return were 45, 36 and 31 percent for eight-, nine- and 10-year rotations, respectively. For Douglas-fir, the reduction was also between 2 and 2.5 percent. As a result, the 10-year rate of return dropped to 13 percent.

Christmas tree growers can compare their costs, yields and revenues to those presented here to better understand their rate of return. Growers may also contact the authors regarding the availability of computer spreadsheets with which to make individual calculations. Using this approach, individual growers can compare their practices, costs, yields and revenues with those of the experienced growers presented in this report.

As investors in a business, Christmas tree growers expect to receive an acceptable return on their investment. To be satisfactory, the return should be at least as good as the return on their next best alternative investment opportunity. Therefore, to evaluate individual Christmas tree operations, each grower should look at all of his/her opportunities, including the length of the investment period and the risk involved. It is obvious that plantations that are managed but not harvested yield high costs but no returns. Likewise, harvesting all trees initially planted and selling for a price significantly above production costs will yield a higher return. To be financially responsible, growers should determine the minimum rate of return acceptable for their operations.

Table 7b. Fraser fir Christmas tree management costs associated with shearing and harvesting, eight- to 10-year rotations.

Cost item and years in which cost is incurred	Average cost per tree	Rotation length in years		
		8	9	10
(Cost per acre)				
Shearing				
3rd and 4th years	\$0.05	\$ 59	\$ 59	\$ 59
5th and 6th years	0.08	95	95	95
7th year	0.11	115	131	131
8th year	0.13	63	121	146
9th year	0.15		76	119
10th year	0.17			73
Cutting				
6th year	0.20	29		
7th year	0.20	113	52	14
8th year	0.20	70	84	66
9th year	0.20		75	73
10th year	0.20			59
Cleaning and baling				
6th year	0.58	82		
7th year	0.58	327	151	39
8th year	0.58	204	245	191
9th year	0.58		217	211
10th year	0.58			172
Hauling and loading				
6th year	0.83	117		
7th year	0.83	467	216	56
8th year	0.83	292	350	273
9th year	0.83		310	301
10th year	0.83			246

Another observation noted in the current study is the decline in the number of trees harvested per acre. In 1986, an average of 972 Scotch pine and 944 Douglas-fir were harvested from each plantation acre. The 1997 survey determined these numbers to be 810 for Scotch pine and 808 for Douglas-fir. For these two species this represents a decrease of 17 and 15 percent, respectively, in the number of trees harvested per acre between 1986

and 1997. Undoubtedly these decreases in the number of trees harvested per acre reflect increasing difficulty in marketing lower quality trees and greater losses due to cultural factors, including increased insect and disease problems. The average Fraser fir grower sold 1,056 trees per acre, or 86 percent of the total planted. This is about 20 percent more than the number of Scotch pine and Douglas-fir sold and suggests less loss to insects

Table 8. Average number of Fraser fir Christmas trees sold by years in eight- to 10-year production periods, and revenues received.

Year of sale	Average number of trees sold per acre for each production period and revenues received at \$22.56 per tree		
	8-year rotation	9-year rotation	10-year rotation
6	141 \$3,181		
7	563 \$12,701	260 \$5,866	68 \$1,534
8	352 \$7,941	422 \$9,520	329 \$7,422
9		374 \$8,437	363 \$8,189
10			296 \$6,678
Trees sold	1,056	1,056	1,056
Gross revenue	\$23,823	\$23,823	\$23,823

Table 9. Internal rate of return earned by three species of Christmas trees grown for production periods of varying length.

Production period, years	Internal rate of return earned, percent		
	Scotch pine	Fraser fir	Douglas-fir
8	16	48	
9	12	39	
10	9	33	16
11			13
12			7
13			8

and/or diseases. It may also reflect the strong demand for this species and the ability to market trees of lower quality. The short rotation period of Fraser fir (eight to 10 years) also suggests a growing demand with harvests occurring more quickly.

Price and cost comparisons between this report and the 1986 study highlight several significant points. First, average prices for Scotch pine and Douglas-fir declined slightly between 1986 and 1997. With inflation, which was about 2.5 percent per year, real prices declined more than 25 percent during the 11-year period. Second,

most costs increased over the period as expected, and some were up sharply. Costs increased in 15 of the 19 cost categories for Scotch pine management. Douglas-fir costs increased in 13 of 18 categories. Most increases were above the rate of inflation. For example, the cost of Scotch pine planting stock increased 55 percent (from \$139 to \$215 per 1,000 seedlings), and the cost of Douglas-fir planting stock increased 37 percent. Finally, the combination of stagnant prices and higher costs reduced the rates of return.

Conclusions

As we look at the costs and returns associated with the three Christmas tree species studied in this investigation, substantial differences are obvious. Fraser fir is a more profitable species to produce than Douglas-fir, and both of these species provide a greater return than Scotch pine. Better returns for both Fraser fir and Douglas-fir result from higher average selling costs and, for Fraser fir, higher per acre yields at the time of harvest. The total production costs are not substantially different among the three species, especially when rotations are nearly the same length.

When the results for Douglas-fir and Scotch pine are compared with similar data from the 1986 study, it is obvious that major increases occurred in several components of total production cost while average prices for harvested trees decreased. Additionally, the number of planted trees harvested per acre also declined. From these data it is not difficult to understand why total Christmas tree production in Michigan has declined since the 1986 survey was published.

Returns for Fraser fir are in sharp contrast to those for Scotch pine and Douglas-fir. Though total production costs are slightly higher, both the number of trees sold per acre and the average wholesale price are higher. Internal rates of return for Fraser fir are substantially greater than those for the other two species. It is logical that production of Fraser fir will continue to expand on appropriate sites in the state as long as the market remains strong and prices continue to be relatively high.

The most important cost component for any of the three species studied is the length of the rotation. Failure to harvest trees of marketable size in the shortest time possible adds a significant cost to production that is not usually recovered through receipt of a higher price. Growers are advised to utilize whatever production techniques and practices are available to maximize growth. Similarly, practices that increase the number of trees harvested per acre will also be profitable. Use of higher quality planting stock, more intensive management — including observance of quality shearing techniques, prompt identification and control of insect and/or disease problems, and intensive management of soil fertility and water — should all help improve growth rates and increase harvest yields. For species such as Scotch pine and Douglas-fir, some increase in future wholesale prices may occur, but it is more probable that growers will increase their profitability by producing more trees per acre in a shorter time period.

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