Opportunities for
PULPWOOD
Growing Investment
in Southeastern Ohio

by

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and

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CONTENTS

THE SITUATION

ECONOMICALLY, southeastern Ohio is characterized by low incomes and surplus labor (fig. 1). Because of the general low level of economic activity, this region has been included in the President's Appalachian anti-poverty program. Investment capital is in short supply so projects promoting rural area development are geared to take full advantage of natural land based resources to improve the local economy. The region is blessed with an extensive and highly productive timber resource. Small investments in this resource can provide timber producing income needed to expand economic growth.

Unfortunately, very few of the region's woodland owners are investing in timber production. They have indicated timber growing for "home use" and "profit" as primary reasons for holding woodland, yet they have been reluctant to adopt timber management practices which would conceivably contribute to the achievement of these objectives. They list more rewarding activities, too long a time to grow a crop, and lack of technical know-how as the primary obstacles to investment (*Mendel 1965*).[1]

Any successful effort to persuade these individuals to practice timber management must deal directly with these obstacles. Woodland owners must be shown that investment in timber production is feasible from the standpoint of available time and capital resources. More importantly they must be convinced that such an investment will pay dividends at least equal to alternative investment opportunities and that investment returns can be realized within a reasonable period of time.

Growing hardwood trees for pulpwood offers an opportunity to overcome the objections which woodland owners have to managing their timber. Pulpwood growing is a relatively short-term venture requiring minimum investments of time, capital, and

[1] Names and dates in parentheses refer to literature cited, p. 22.

Figure 1. — The study area

technical know-how. Also, hardwood pulpwood is likely to have reliable local market outlets in southeastern Ohio for years to come. From 1960 to 1965 pulpwood production in the area has increased about 5 percent per year (*Kingsley and Dickson* 1967). The demand should continue to rise as pulpmills expand their productive capacities.

PURPOSE OF STUDY

The primary objective of this study is to evaluate management investment opportunities for growing pulpwood on various upland hardwood forest sites in southeastern Ohio.

With normal protection from fire, insects, disease, cattle and other destructive agents, hardwood timber, if left to grow, will develop into marketable pulpwood. However, forest management research has described an efficient system of management that will give greater pulpwood yields in a shorter period of time.

This investigation evaluates the economic desirability of employing this system.

The economic desirability of any timber producing project is measured by how much it adds to the value of a timber stand in relation to its cost and the length of time required to bring the stand to harvest. Annual compound interest rate of return is used as a means for gauging the economic desirability of the investment. Interest value measures the rate at which an investment grows toward the return it eventually generates.

Any pulpwood growing investment yielding a positive return is worthy of investment consideration. The incentive to invest will increase when the rate of return to pulpwood management approaches or exceeds the rate that can be earned in the owner's best financial alternative for capital investment.

DATA NECESSARY FOR INVESTMENT ANALYSIS

Three basic elements must be considered when evaluating the economic desirability of any investment in timber production:

(a) *Value* that the investment adds to a timber stand.

(b) *Cost* of the investment.

(c) *Time* required to realize a return on the investment.

Once this information is determined, the desirability of an investment in timber management can be measured and then compared with that of other investment opportunities.

Defining A System of Sound Silviculture

Timber management scientists have described a system of management designed to maximize timber yields by maintaining forest stands at the lowest level of stocking that will use all available growing space on a given forest site. The nature and timing of cultural treatments and timber harvests are described as part of the system.

Upland hardwoods are best suited to even-aged silviculture. They cannot be reproduced with good composition or growth in uneven-aged stands. After a stand of upland hardwood timber has been clearcut for industrial products (i.e., all trees down to 4 or 5 inches in diameter removed for sawlogs, pulpwood, charcoal wood, etc.), the general procedure for developing a new stand to maturity is *(U.S. Department of Agriculture 1962):*

(1) Make a *reproduction cutting* immediately after harvest. The purpose of this cutting is to provide the greatest number of desirable species and promote the most rapid growth of all species. Remove all residual trees more than two inches in diameter. If residual trees are left standing, their tops die back and the stems develop a mass of branches. Quality of these trees is low and they serve only to occupy space that would otherwise be filled with rapidly growing reproduction. Seed trees are not necessary for regeneration

—an adequate number of desirable seedlings will develop from seeds that have accumulated in the forest litter and from seedling sprouts of advanced reproduction.

(2) Approximately ten years after the reproduction cutting make a *pre-commercial thinning.* Select potential crop trees on a 15- to 20-foot spacing and release only those that need it. This spacing should provide acceptable stocking by the time the trees average 4 to 5 inches in diameter.

(3) As stands develop to merchantable size, make periodic *commercial thinnings* to keep crop trees growing rapidly. No thinning should reduce stand density below the point where the site can be fully utilized. Once a stand is in a condition to fully utilize the site, the timing and amount of thinning will depend primarily on productivity of the forest land. On better sites growth response after thinning will be greater, so thinning cycles will normally be shorter and thinning yields larger than on poorer sites.

(4) *Harvest* with a clear-cutting when the stand reaches maturity.

Reproduction cuttings and pre-commercial thinnings are management cost operations and represent the investment phase of the system. No marketable material would be harvested for sale from these cuttings. The calculation of returns on this investment is based on the difference between timber yields from managed stands and the yields that could be obtained from untreated stands grown over the same period of time.

For purpose of this study, managed stands are considered mature for pulpwood crops when the diameter of the trees in the stand average 10 inches d.b.h.[2]

[2] Hardwoods 11.0 inches d.b.h. and larger are called sawtimber. Sound trees of this size usually have quality characteristics suitable for higher value products such as lumber logs, veneer logs and cooperage stock.

Determining Physical Timber Yields

At the Northeastern Forest Experiment Station, studies are underway to determine precise estimates of potential yields from managed hardwood stands on various upland forest sites. Results will be available in the future. In the meantime, data based on preliminary results of this research have been prepared and made available for use. These data are presented in Table 1.

Yield information is shown for site index[3] 40 through site index 80, the full range of commercial forest land productivity classes common to southeastern Ohio. Site 40 is rated the lowest class of land capable of producing commercial crops of timber, site 80 the highest.

Research completed by G. Luther Schnur provides estimates of timber volume expected to accumulate in untreated stands of even-aged upland hardwoods. Figure 2 presents this information in graphic form.

A casual comparison of the data shown in Table 1 and Figure 2 reveals that yields from managed stands are considerably greater than those from unmanaged stands grown over the same period of time. For example, Table 1 shows that a managed stand of hardwoods on site 60 will yield a cumulative volume of 38 cords of pulpwood in 48 years. Figure 2 indicates that without treatment the same stand can be expected to accumulate only 25 cords of marketable pulpwood volume during this same period of time. (See fig. 2—intersection of dotted line and site 60 yield curve.) It is this difference in yield that provides the basis for computing added value of investing in pulpwood management on site 60.

Estimating Treatment Costs and Yield Values

A meaningful calculation of economic desirability requires that physical estimates of input and return be transformed to

[3] Site index—A classification of forest land in terms of inherent capacity to grow crops of industrial wood. Site index is expressed in terms of the height in feet that dominant trees, growing under natural conditions, will attain at age 50.

Table 1. — *Recommended cutting and estimated yields from well-stocked, even-aged stands of upland hardwood managed for pulpwood*

Kind of Cutting	Average Stand Diameter (inches)	Average Stand Age (years)	Average Volume Per Acre[1]: Before this cut	This cut	After this cut (cords)	Cumulative cut
ALL SITES						
Reproduction Cutting	0	0	0	0	0	0
Pre-commercial Thinning	1 to 3	10	0	0	0	0
SITE CLASS 40 (10-year cutting cycle)						
Commercial Thinning	6	40	9	3	6	3
Commercial Thinning	8	50	17	4	13	7
Harvest Cut	10	60	23	23	0	30
SITE CLASS 50 (9-year cutting cycle)						
Commercial Thinning	6	36	11	4	7	4
Commercial Thinning	8	45	19	5	14	9
Harvest Cut	10	54	26	26	0	35
SITE CLASS 60 (8-year cutting cycle)						
Commercial Thinning	6	32	14	5	9	5
Commercial Thinning	8	40	22	6	16	11
Harvest cut	10	48	27	27	0	38
SITE CLASS 70 (7-year cutting cycle)						
Commercial Thinning	6	28	18	6	12	6
Commercial Thinning	8	35	22	7	15	13
Harvest cut	10	42	28	28	0	41
SITE CLASS 80 (6-year cutting cycle)						
Commercial Thinning	6	24	18	6	12	6
Commercial Thinning	8	30	24	7	17	13
Harvest cut	10	36	29	29	0	42

Source: Unpublished technical field guide prepared recently by Samuel F. Gingrich of the Northeastern Forest Experiment Station for Soil Conservation Service foresters.

[1] Volume of merchantable wood to a 4" top.

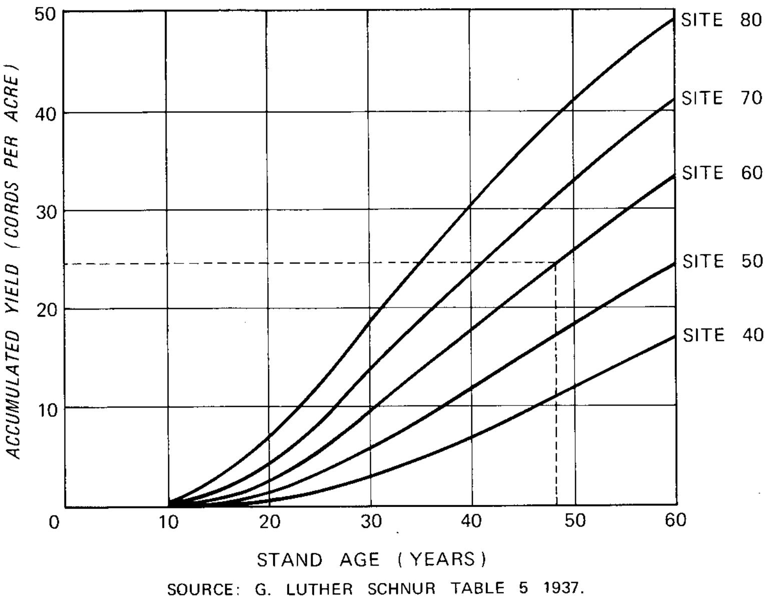

Figure 2. — Accumulated yields in unmanaged, fully stocked, even-aged stands of upland hardwood

a common basis for comparison. In this study, investment costs and yield returns are expressed in units of dollars per acre.

The actual costs of reproduction cuttings and pre-commercial thinnings will depend on the amount of clean-up work needed to get the forest site into a desirable condition for new stand development and growth. Empirical data concerning these costs are not available for southeastern Ohio. So, three reasonable levels of variable costs were assumed and compared in making the investment analyses—cost options of $15 per acre, $10 per acre, and $5 per acre were used.

The value of added returns resulting from management was appraised in terms of stumpage income per acre. Reliable projections of future stumpage prices were not available; so prices based on current stumpage values in Ohio were developed. Current prices range from $1.50 to $3.00 per cord (*U.S. Dept. of Agric. 1965*). Assume that these prices increase at a compound interest rate of 1.5 percent per year. Then, 40 years hence (the approximate time required for site 80 stands to reach maturity) pulpwood stumpage would sell for an average price of about $4 per cord, and 60 years hence (the time required for site 40 stands to reach maturity) the price would average about $5 per cord.

For purposes of computing yield returns in this study, four alternative levels of stumpage prices were considered—$2, $3, $4, and $5 per cord. Prices were held constant for the investment period. In other words, if the price of pulpwood was set at $5 per cord, then all future yields were valued at $5 per cord.

A TECHNIQUE FOR MEASURING INVESTMENT POTENTIAL

As we stated earlier, the economic desirability of a timber management project is measured by how much the project adds to the value of a timber stand in relation to its cost and the length of time required to bring the stand to harvest. Compound interest values are used to measure the rate at which an investment grows toward the return it eventually generates. The amount and timing of both costs and returns are taken into account.

The general formula for computing the rate of return for a single investment (C) yielding a single added value (R_n) in n years is:

$C\ (1 + i)^n = R_n$

C, n and R are known; solve for i

The following is a hypothetical problem: if \$5.00 were invested at compound interest, what would the rate of interest have to be to realize an added value of \$75, 40 years hence. Substituting these values in the above equation:

$\$5.00\ (1 + i)^{40} = \$75.00$

And rearranging terms:

$$(1+i)^{40} = \frac{\$75.00}{\$\ 5.00} = \$15.00$$

Then by consulting the 40-year line in a $(1 + i)^n$ interest table:

$i = 7.0$ percent

We are concerned with evaluating the desirability of projects having more than one cost and yielding more than one return during the investment period. The general formula for computing internal rate of return for any project having a series of annual investments generating a series of anual returns is *(Marty, et al 1966):*

$$C_1(1+i)^n + C_2(1+i)^{n-1} + C_3(1+i)^{n-2} \ldots + C_{n-1} + (1+i)^2 + C_n(1+i) = R_1(1+i)^{n-1} + R_2(1+i)^{n-2} \ldots + R_{n-1}(1+i) + R_n$$

It is assumed that all costs occurring during a given year are incurred at the beginning of the year and all returns occurring during a given year are assumed to have accrued at the end of the year.

But few timber management projects have costs and returns occurring every year. Such was the case with the management system employed in this study. It included two management costs and three yield returns occurring at different periods of time in the development of a stand. Also, five land productivity classes were considered. The formulas for computing rates of return for each of these five productivity classes were as follows:

Site 40: $C_R(1+i)^{60}+C_{PT}(1+i)^{50}=R_{CT_1}(1+i)^{20}+R_{CT_2}(1+i)^{10}+(RHC-RHC_N)$

Site 50: $C_R(1+i)^{54}+C_{PT}(1+i)^{44}=R_{CT_1}(1+i)^{18}+R_{CT_2}(1+i)^{9}+(RHC-RHC_N)$

Site 60: $C_R(1+i)^{48}+C_{PT}(1+i)^{38}=R_{CT_1}(1+i)^{16}+R_{CT_2}(1+i)^{8}+(RHC-RHC_N)$

Site 70: $C_R(1+i)^{42}+C_{PT}(1+i)^{32}=R_{CT_1}(1+i)^{14}+R_{CT_2}(1+i)^{7}+(RHC-RHC_N)$

Site 80: $C_R(1+i)^{36}+C_{PT}(1+i)^{26}=R_{CT_1}(1+i)^{12}+R_{CT_2}(1+i)^{6}+(RHC-RHC_N)$

Where:

C_R is the cost of reproduction cuttings

C_{PT} is the cost of pre-commercial thinnings

R_{CT_1} is the net return from the first commercial thinning

R_{CT_2} is the net return from the second commercial thinning

$(RHC\text{-}RHC_N)$ is the difference between returns from the final harvest of a managed stand and returns that would be forthcoming from harvesting an unmanaged stand grown over the same period of time

The exponents of the $(1 + i)$ terms indicate the number of years until final harvest.

Solving for "i" in each case requires a process of successive approximations in which various values for "i" are substituted in the above formulas until one is found that satisfies the equation. Consider, for example, the calculation of internal rate of return for a site 70 stand, assuming treatment costs of $5 per acre and yields valued at $4 per cord. A schedule of investment and return for this project can be tabulated as follows:

Investment	Return
1. \$5/acre reproduction cutting at age 0	1. First commercial thinning at age 28 6 cords/acre at \$4/cord=\$24
2. \$5/acre pre-commercial thinning at age 10	2. Second commercial thinning at age 35 7 cords/acre at \$4/cord=\$28
	3. Harvest cut at age 42 $(RHC - RHC_N) = \$4(28\text{-}26) = \$8$

Again, the formula for computing internal rate of return for site 70 is:

$$C_R(1+i)^{42}+C_{PT}(1+i)^{32}= R_{CT_1}(1+i)^{14} +R_{CT_2}(1+i)^{7}+ (RHC-RHC_N)$$

Substituting values from the above schedule gives:

$$\$5(1+i)^{42}+\$5(1+i)^{32}=\$24(1+i)^{14}+\$28(1+i)^{7}+\$8$$

The process of solving this equation can be started by using any interest rate. If seven percent is tried the equation becomes:

$$85.720 + 43.576 = 61.884 + 44.962 + 8.000$$
$$129.296 \neq 114.846$$

Since the cost side of the equation is greater than the return side, the interest rate of 7 percent must be too high. Trying 6 percent gives:

$$57.785 + 32.267 = 54.262 + 42.101 + 8.000$$
$$90.052 \neq 104.363$$

Now the cost side of the equation is less than the return side. Obviously, the 6 percent interest rate is too low. This process is continued until a balancing rate is found. In this case the rate was 6.5 percent.

Since five site productivity classes, three cost options, and four yield values were considered in this study, the economic desirability of 60 project opportunities representing a wide range of site, cost and return combinations could be measured and compared. Obviously, long-hand interest rate computations using a method of successive approximation would be costly and time consuming.

For that reason, this phase of the study was completed on electronic computers using a modified version of a computer program for interest rate computation developed by Row *(Row 1963)*.

LIMITATIONS OF RETURN VALUES

Before analyzing study results, we should recognize two major limitations of using monetary rates of return to appraise the economic desirability of projects.

First, estimates of financial return to timber production may not always be the most important criterion for gauging the desirability of a timber management project. Forested lands yield a continuous flow of products and services other than timber. Included are such benefits as scenic value, water yield and conservation, and wildlife habitat which are often difficult to measure in dollar terms. The introduction of a system of timber management, such as that described in this study, will affect these other values. No attempt was made here to consider such effects.

Secondly, computed *absolute* values of financial return to timber production are based on assumed conditions of land productivity, timber yield, investment cost, stumpage price, and product marketability. Assumptions about present and future conditions may not be precise. And even if they are, it is not likely that the conditions described and evaluated to determine financial rates of return will apply to each and every situation encountered in the field.

Thus, it is not likely that an exact rate of return can be calculated for any given situation. We have examined a wide range of possible alternative conditions, thereby increasing the probability that the investment potential for any given situation can be approximated.

EVALUATION OF INVESTMENT OPPORTUNITIES

Rates of financial return for the 60 opportunity classes considered are presented in Table 2. On the better sites more pulpwood can be grown in a shorter period of time. Therefore, the site 80—$5 cost—$5 per cord income option produces the *highest* rate of financial return, 8.8 percent. Conversely, the site 40—$15 cost—$2 per cord income option produces the *lowest* rate of return and, in fact, the rate of return computed for this opportunity class is negative.

Thus, for all practical purposes, the rates of financial return computed for the 60 opportunity classes considered in this study range from a high of nearly 9 percent to a low of zero. The difference in absolute rate of return between one opportunity class and another is a result of disparate interactions of investment costs and yield returns over time.

We noted earlier the limitations to using absolute estimates of financial yield, such as those shown in Table 2, as direct measures of investment return. The *primary* value of these statistics is to provide a means for ranking the relative financial desirability of the several investment opportunity classes considered.

A glance at the absolute values of financial return shown in Table 2 reveals that some of the opportunity classes evaluated in this study are not worthy of consideration as investments. Pulpwood growing, even though short term relative to other forms of timber production, is still a 35 - 60 year venture involving risk and uncertainty, and woodland owners do have alternative investment opportunities.

Each woodland owner has in mind a level of return below which he would not consider an investment in forestry. This figure will vary from owner to owner. Nineteen of the 60 opportunity classes evaluated in this study produced absolute values of 4.0 percent return or greater. These are tabulated in Table 3 in descending order of their economic desirability as investments.

The values and rankings in Tables 2 and 3 give us a basis for discussing the relative influence of site productivity and levels of cost and return on investment potential.

Seven of the 19 opportunity classes listed in Table 3 occur on site 80 and six occur on site 70. Only three of the 24 opportunity classes evaluated for site 40 and 50 (Table 2) produce return values of 4 percent or greater. These occur only under projected conditions of low cost and high return.

Table 2. — *Rate of investment return from growing crops of hardwood pulpwood for stated levels of cost and income by site productivity classes*

Treatment cost level, per acre	Stumpage income level, per cord (Dollars)			
	2	3	4	5
Dollars	*Percent*	*Percent*	*Percent*	*Percent*
		SITE CLASS 40		
5	2.1	3.0	3.6	4.1
10	0.6	1.4	2.1	2.5
15	—	0.6	1.2	1.7
		SITE CLASS 50		
5	2.4	3.5	4.3	4.9
10	0.7	1.7	2.4	3.0
15	—	0.7	1.4	2.0
		SITE CLASS 60		
5	2.9	4.2	5.1	5.8
10	0.8	2.0	2.9	3.6
15	—	0.8	1.7	2.3
		SITE CLASS 70		
5	4.0	5.5	6.6	7.4
10	1.5	2.9	4.0	4.8
15	—	1.4	2.5	3.3
		SITE CLASS 80		
5	4.8	6.6	7.8	8.8
10	1.7	3.5	4.8	5.8
15	0.1	1.7	3.0	4.0

Table 3. — *Ranking of opportunity classes in descending order of their economic desirability as investments*[1]

Opportunity Class			Rate of Return
Site	Treatment Cost/Acre	Stumpage Return/Cord	
	Dollars	*Dollars*	*Percent*
80	5	5	8.8
80	5	4	7.8
70	5	5	7.4
80	5	3	6.6
70	5	4	6.6
80	10	5	5.8
60	5	5	5.8
70	5	3	5.5
60	5	4	5.1
50	5	5	4.9
80	10	4	4.8
80	5	2	4.8
70	10	5	4.8
50	5	4	4.3
60	5	3	4.2
40	5	5	4.1
80	15	5	4.0
70	5	2	4.0
70	10	4	4.0

[1] Investment alternatives producing a return of less than 4 percent are not listed.

Fourteen of the 19 top ranking opportunity classes include the treatment cost option of $5 per acre. When treatment costs range as high as $15 per acre, only one opportunity class produces a financial return value as great as 4 percent. That one occurs on the best site and only when the highest projected stumpage return value of $5 per cord is assumed.

When projected stumpage prices reach $5 per cord, eight of the opportunity classes evaluated in the study produce rate of return values of 4 percent and greater. If prices do not exceed the $2 per cord level, only two opportunity classes produce values as great as 4 percent and these occur on the better sites and under the low treatment cost assumption.

In general, it can be said that the most lucrative investment possibilities occur on sites 70 or better when treatment costs are less than $10 per acre and projected stumpage values exceed $3 per cord. If stumpage prices remain low over the investment period and treatment costs are high, none of the opportunity classes evaluated in this study appear favorable. In fact, when treatment costs are as high as $15 per acre and stumpage values

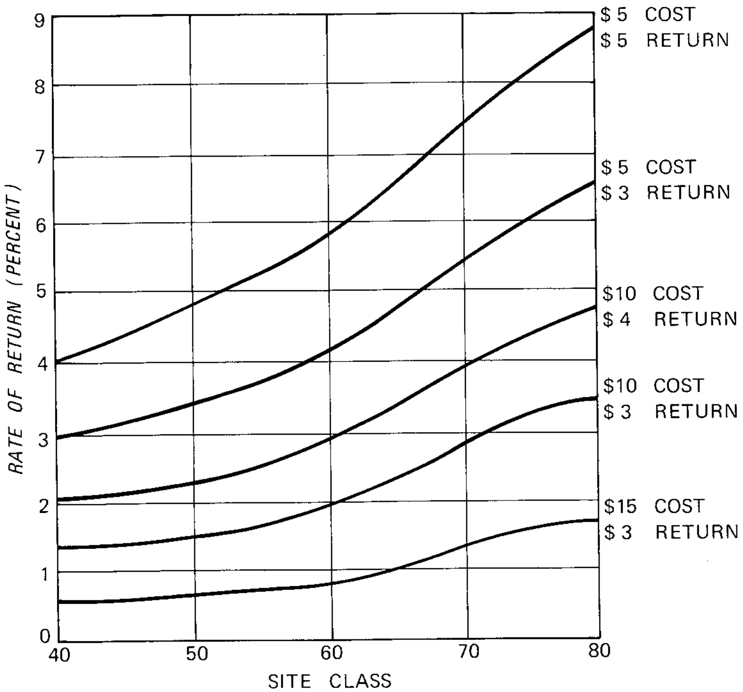

Figure 3. — Rate of return by site class for a range of assumed treatment cost-stumpage return conditions

are $2 per cord, negative or zero returns result on all except the best site. Under these conditions, the woodland owner who wishes to grow pulpwood would be better off (from a financial standpoint) to let it grow in unmanaged stands.

Figure 3 illustrates the level of returns produced on various sites under five of the 12 possible cost-return combinations considered in this study. The set of cost-return conditions used in Figure 3 were selected to depict the range of relevant investment possibilities.

QUESTIONS IMPORTANT TO INVESTMENT DECISION MAKING

"How much can I afford to invest?" "What approximate rate of return can I expect to earn?" "What kind of price must I get to make the investment worthwhile?" Answers to these questions can be critical to the individual's investment decision making.

The set of formulas shown on page 11 of this paper can be utilized to produce approximate answers to these questions. Take for example the question, "How much can I afford to invest?"

Suppose that a woodland owner contemplates growing pulpwood on site 70 land under the system of management described in this study. Let us further assume that he wants to earn at least a 4 percent compound rate of return on his investment and that he expects stumpage prices to average about $4 per cord over the investment period (42 years for site 70). An approximation of the maximum amounts he can invest in reproduction cuttings and precommercial thinnings can be derived from the formula:

$$C_R(1+i)^{42} + C_{PT}(1+i)^{32} = R_{CT_1}(1+i)^{14} + R_{CT_2}(1+i)^{7} + (RHC - RHC_N)$$

Where:

$i = 0.04$

$R_{CT_1} = 6$ cords/acre @ \$4/cord = \$24

$R_{CT_2} = 7$ cords/acre @ \$4/cord = \$28

$RHC - RHC_N = \$4(28\text{-}26) = \$8$

Solving the equation for treatment costs gives a value of $9.93 per acre.

Thus the maximum amount that can be invested in each of the practices of stand establishment and precommercial thinning, under the conditions described, is approximately $10 per acre.

Table 4. — *Optimum stand treatment costs per acre for stated levels of expected rate of return and estimated stumpage prices, by site productivity classes*

Estimated stumpage price per cord	Expected return (Percent)			
	2	4	6	8
Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
		SITE CLASS 40		
2	5.13	2.10	0.89	0.39
3	7.70	3.15	1.33	0.58
4	10.27	4.20	1.77	0.77
5	12.84	5.25	2.22	0.97
		SITE CLASS 50		
2	5.92	2.76	1.32	0.64
3	8.87	4.14	1.98	0.96
4	11.83	5.52	2.63	1.28
5	14.79	6.90	3.29	1.61
		SITE CLASS 60		
2	6.75	3.56	1.90	1.03
3	10.12	5.33	2.85	1.54
4	13.50	7.11	3.80	2.06
5	16.87	8.89	4.75	2.57
		SITE CLASS 70		
2	8.59	4.97	2.90	1.71
3	12.88	7.45	4.35	2.56
4	17.18	9.93	5.79	3.41
5	21.47	12.41	7.24	4.26
		SITE CLASS 80		
2	9.42	5.95	3.78	2.42
3	14.13	8.93	5.67	3.62
4	18.84	11.90	7.56	4.83
5	23.55	14.88	9.45	6.04

The same technique can be used to answer questions concerning any of the variables contained in the investment equations, i.e., stumpage prices, investment rates of return and treatment costs. The estimator needs only to approximate reasonable values for all variables except one and then solve for that unknown.

Table 2 can be used as a guide for answering the questions, "What approximate rate of return can I expect to earn?" Assume that a woodland owner is thinking about installing the system of management described in this study on site 60 and he expects treatment costs to average $10 per acre and stumpage prices to average $4 per cord. A look at Table 2 indicates he might

Table 5. — *Minimum stumpage prices per cord for stated levels of expected rate of return and treatment costs, by site productivity classes*

Estimated treatment cost per acre	Expected return (Percent)			
	2	4	6	8
Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*
		SITE CLASS 40		
5	1.95	4.77	11.28	29.03
10	3.90	9.53	22.56	58.06
15	5.84	14.30	33.84	87.09
		SITE CLASS 50		
5	1.76	3.62	7.59	15.57
10	3.53	7.25	15.19	31.14
15	5.29	10.87	22.78	46.72
		SITE CLASS 60		
5	1.48	2.81	5.26	9.73
10	2.96	5.62	10.53	19.46
15	4.44	8.44	15.79	29.19
		SITE CLASS 70		
5	1.17	2.01	3.46	5.86
10	2.33	4.03	6.93	11.73
15	3.50	6.04	10.39	17.59
		SITE CLASS 80		
5	1.06	1.68	2.64	4.14
10	2.12	3.36	5.29	8.28
15	3.18	5.04	7.93	12.42

expect a rate of return on his investment of approximately 3 percent.

Tables 4 and 5 have been prepared as guides for answering respectively, the questions, "How much can I afford to invest?" and "What kind of price must I get to make the investment worthwhile?"

CONCLUSION

This paper has evaluated opportunities for investing in a system of hardwood pulpwood production in southeastern Ohio. Estimates of financial rate of return were calculated for 60 options encompassing a wide range of possible investment alternatives.

Absolute values of financial return ranged from negative to 8.8 percent. The best investment possibilities occur on site index 70 or better land when treatment costs are less than $10 per acre and projected stumpage prices exceed $3 per cord.

Results of this study can be logically applied to other areas in the Central Hardwoods Region where conditions of timber productivity, woodland owner attitudes toward timber growing, and pulpwood market availability are similar.

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