ALABAMA A&M AND AUBURN UNIVERSITIES

ALABAMA COOPERATIVE Extension SYSTEM

ANR-1132

Estimating Land Value for Growing Timber on Agricultural Land

Due to a lack of rain during the growing seasons and a reduction in both price and number of pounds of quota in recent years, many peanut and cotton farmers across the state (especially in southeast Alabama) have been forced to look for areas in which to cut costs and ways to diversify their operations. Some landowners are considering growing timber on some of their lands.

This publication presents a method for estimating land value if the land is converted from agricultural to forestry use. Pitfalls in the estimation procedure and factors that influence the rate of return on forestry investments are discussed. Hopefully, farmers and other landowners can use this information to make good land-use decisions.

How Much Is Your Land Worth Now?

Before considering changing land use to forestry, you need to know how much your land is worth in current use or in potential uses, such as development. You can find this out using comparable sales in your local market, or you can estimate it yourself. If your land has been used for crops and pasture and does not have real estate development potential, you can estimate your per-acre land value by dividing the per-acre net income (profit) from crops and pasture by your alternative annual interest rate as follows:

$$\text{land value (\$/acre)} = \frac{\text{annual net income (\$/acre)}}{\text{alternative annual interest rate}}$$

Annual net income equals total revenues minus total costs, including the costs of labor, machinery, seeds, fertilization, and other capital and materials. If you work for yourself, be sure to include your salary in the costs because you could use your labor and earn income doing something else. Because net income fluctuates over time, you need to use your average of the last few years in your estimation. If you rent your land, you can also use cash rent or crop-share rent as an alternative estimate of your annual net income.

The alternative annual interest rate is the annual rate of return that you as an investor seek on your investments. You could sell your land, settle up with the Internal Revenue Service, and make investments in CDs, government securities, stocks and bonds, and/or mutual funds. Generally speaking, a high rate of return is associated with high risk. For example, stock markets, measured as the S&P 500 Index, produced an average annual rate of return of 10.4 percent from 1960 though 1994. However, the rates of return were negative in 8 of the 25 years. Investing in long-term government bonds in the same period would have given you an average annual rate of return of 5.6 percent per year with less loss. After inflation of 3 percent, these returns (real returns, so-called) amount to 7.4 and 2.6 percent, respectively.

Example: Dothan farmer Mr. Joe's average annual net income in operating a peanut farm is $80 per acre for the last 5 years, and his alternative rate of return is 9 percent. Note that Joe's alternative interest rate includes inflation. Since the average annual inflation rate is about 3 percent, Joe's real interest rate is about 6 percent. Under normal circumstances (or assuming that history will repeat itself), his land is theoretically worth about $1,333 per acre ($80/0.06) if he continues his peanut operation.

Factors Influencing Forest Land Value

The interest rate affects your land value no matter what you use your land for. In addition, several other factors influence the land value for growing timber. These factors are timber growth and yield, stumpage prices, planting and management costs, cost share payments and taxes, and multiple-use opportunities such as hunting or recreational leases.

Growth and Yield

Before estimating revenues from selling timber, you need to first determine what kind and how much timber will be available for sale as the timber is harvested. The period of time from tree planting to final harvest is called a rotation. Tree growth in a rotation depends on the quality of the land. This is called *site quality* and is often referred to as the *site index*. Site index is the average height of the dominant and codominant (taller) trees at a designated age, usually 25 years for plantations.

To estimate the site index of your land, you can measure or estimate the average height of dominant and codominant trees in a pine plantation that is close to your land and resembles your land in quality (soils, aspect, and slope). Use Table 1 to locate the site index. Of course, you can also ask a professional forester about the site index of your land.

Example: In a 17-year-old loblolly pine stand, the average height of dominant and codominant trees is 45 feet. In Table 1 under the Age column, locate 15 and 20 years (17 is between 15 and 20). In the lines to the right of 15 and 20, find the two numbers nearest 45. The nearest numbers are 42 in line 15 and 52 in line 20, and they appear in the column 60. Therefore, the quality of the land is about site index 60.

Once you know the site index of your land and the species you want to plant, you could find expected timber yields from growth and yield tables. A popular species in Alabama is loblolly pine. Table 2 presents per-acre loblolly pine yield estimates.

Table 1. Average Total Height in Feet of Dominant and Codominant Trees by Age and Site Index for Loblolly Pine Plantations

	Site Index (Age 25)				
Age	40	50	60	70	80
10	18	22	27	31	38
15	28	34	42	47	55
20	35	43	52	60	69
25	40	50	60	70	80
30	43	54	66	78	78
35	46	58	71	84	95

Source: McKee, Bill, and David Moorhead. 1986. Site, Stocking and Expected Yields of Loblolly Pine Plantations. Alabama Cooperative Extension System publication ANR-398.

Table 2. Per-Acre Loblolly Pine Yield Estimates

Site Index	Trees Per Acre Planted[1]	First Thinning[2]		Second Thinning[3]				Clear-Cut			
		Age	PW	Age	PW	CNS	STS	Age	PW	CNS	STS
		15	6.7					25	3.4	15.6	2.6
	681	15	6.7	23	2.1	5.6		30	1.2	7.1	5.5
		15	6.7	25	2.2	7.0		35	1.0	6.9	6.7
50											
		15	7.0					25	3.9	15.6	2.4
	778	15	7.0	23	2.2	5.4		30	1.3	9.6	4.4
		15	7.0	25	2.6	6.5		35	1.1	7.5	6.3
		15	15.3					25	2.1	13.2	7.0
	681	15	15.3	23	1.1	6.3	1.0	30	0.7	6.0	9.1
		15	15.3	25	1.1	7.7	4.2	35	0.6	5.3	10.7
60											
		15	15.7					25	2.3	13.9	6.4
	778	**15**	**15.7**	**23**	**1.4**	**7.2**		**30**	**0.7**	**6.0**	**9.2**
		15	15.7	25	1.5	7.4	1.2	35	0.6	5.7	10.6
		15	24.1					25	1.4	11.7	11.9
	681	15	24.1	23	0.7	5.3	5.5	30	0.6	4.9	12.7
		15	24.1	25	0.8	7.1	4.7	35	0.5	4.1	13.8
70											
		15	24.1					25	1.9	13.4	10.5
	778	15	24.1	23	1.2	7.5	2.1	30	0.6	5.0	12.6
		15	24.1	25	1.1	6.6	6.1	35	0.6	5.2	14.0

Source: McKee, Bill, and David Moorhead. 1986. Site, Stocking and Expected Yields of Loblolly Pine Plantations. Alabama Cooperative Extension System publication ANR-398.

[1]A first-year survival rate of 85 percent is assumed.

[2]Row selection thinning; one row out of six is harvested, with selection thinning on the remaining five rows. Residual basal area after thinning is 80 square feet per acre.

[3]Individual trees are selected for removal. Residual basal area after thinning is 80 square feet per acre. NOTE: PW = pulpwood harvested in cords per acre; CNS = chip and saw harvested in cords per acre; STS = sawtimber harvested in thousand board feet (MBF) per acre, Scribner log rule.

Stumpage Prices

Most landowners sell their timber on the stump (standing timber) to a timber dealer or manufacturer. Stumpage price is the value of the standing timber. To estimate timber sale revenue, you need to know what price to expect when you are ready to sell timber. Current stumpage prices can be obtained from your local markets through consultants or *Timber Mart-South,* a quarterly forest products market report available through your county Extension office or the Alabama Forestry Commission. Average Alabama stumpage prices for 1997 are presented in Table 3.

Unlike those of most other natural resources, real timber prices have appreciated constantly over the last 100 years (Clawson 1979). From 1977 to 1996, the rate of real price appreciation for pine pulpwood in Alabama was about 1.5 percent annually, and the rates for chip-n-saw and pine sawtimber were about 3.9 and 2.0 percent, respectively (Zhang 1998). Hardwood stumpage price appreciated even more than pine did. Remember that this is a real appreciation over and above the general inflation rate.

Example: Assuming conservatively that the real stumpage price increases at 1 percent annually, the real pulpwood price in southern Alabama is expected to be $33 \times (1+0.01)^{15} = 33 \times 1.16 =$ $38.3 per cord in 15 years. The real prices for sawtimber and chip-n-saw can be calculated in the same fashion. Table 4 presents the expected real prices for these three products in southern Alabama in 3 selected years assuming a 1 percent increase over time.

Planting and Management Costs

Investing in timber growing may involve preparing the site; planting; controlling herbaceous vegetation; thinning; protecting against fire, insects, and diseases; administering timber sales; and paying annual taxes. Not every timber grower will have all these expenses, but all will have some costs in growing timber. Such costs can be thought of as investments, or outlays, that must be made to grow certain kinds of timber in a certain way. An experienced forester can provide you with various forest management costs. Dubois et al. (1997) provided a current and historical summary of forest management costs in the Southern Coastal Plain.

Since most farmlands are in good shape, you may not need to spend any money on site preparation. The seedling costs are about $25 per 800 (800 trees per acre is a good planting density in the state). Planting costs are about $40 per acre on cropland. One chemical treatment for vegetation control is expected to take place in year 5, and prescribed burning is expected to start at year 12 and continue on a 4-year cycle until final harvest. The annual management costs should be minimal and can be offset by the hunting lease income (see below).

Table 5 presents the expected management activities and costs in a single rotation. Since some costs (prescribed burning) are expected to increase faster (about 5 percent annually) than the annual rate of inflation, the real expected costs are adjusted accordingly. Other costs (vegetation control and consulting fees) are expected to change at roughly the same pace as inflation and need not be adjusted at all.

Cost-Share Payments and Taxes

About ten federal, state, and private cost-share programs are available to many landowners for tree planting and other forest-management activities such as wildlife habitat enhancement. The federal programs include the Forest Incentive Program (FIP), Stewardship Incentive Program (SIP), Conservation Reserve Program (CRP), Environmental Quality Incentive Program (EQIP), and Wildlife Habitat Incentive Program (WHIP). The state cost-share program is the Alabama Agriculture and Conservation Development Commission

Table 3. Average Alabama Pine Stumpage Prices for 1997

	Pulpwood (cord)	Chip-N-Saw (cord)	Sawtimber (MBF, Scribner)
Northern Alabama[1]	$31.79	$86.34	$346.00
Southern Alabama[1]	$33.01	$98.20	$389.50
Average	$32.40	$92.27	$367.75

Source: Timber-Mart South
[1]The dividing line can be drawn from Auburn to Prattville to Demopolis.

Table 4. Expected Southern Pine Real Stumpage Price Appreciation for Southern Alabama in 15, 23, and 30 years

Products	Current Price	Year	Compound Factor	Real Price
Pulpwood	$33	15	$(1+0.01)^{15}$=1.16	$38.30
		23	$(1+0.01)^{23}$=1.26	$41.50
		30	$(1+0.01)^{30}$=1.35	$44.50
Chip-n-saw	$98	23	1.26	$123.20
		30	1.35	$132.10
Sawtimber	$390	30	1.35	$525.70

Table 5. Expected Costs Per Acre for Pine Plantation Establishment and Management

Yr.	Activity[1]	Current Costs	Compound Factors	Expected Real Costs	Discounted Costs
1	Planting	$65	1	$65	$65
5	Herbaceous weed control	$54	1	$54	$54/1.338=$40
12	Prescribed burning[2]	$15	$(1+0.05)^{12}$=1.79	$27	$27/2.012=$13
15	Consulting fees for 1st thinning[3]			$60[1]	$60/2.396=$25
16	Prescribed burning	$15	$(1+0.05)^{16}$=2.18	$33	$33/2.540=$13
20	Prescribed burning	$15	$(1+0.05)^{20}$=2.65	$40	$40/3.207=$13
23	Consulting fees for 2nd thinning[3]			$95[1]	$95/3.819=$25
24	Prescribed burning	$15	$(1+0.05)^{24}$=3.24	$49	$49/4.048=$12
28	Prescribed burning	$15	$(1+0.05)^{28}$=3.92	$59	$59/5.111=$12
30	Consulting fees for final harvest[3]			$566[1]	$566/5.743=$99
				Total	$317

[1]No annual management costs are estimated. Hunting lease income is assured to equal annual management costs.

[2]Prescribed burning begins at age 12 and continues on a 4-year cycle until the end of the rotation.

[3]Consulting fees are 10 percent of the sale revenue. If you do not use a consulting forester, treat the costs as the costs of your own labor and time.

Program (AACDCP). A cost-share program administered by Alabama Power Company (the Openland Tree Planting Program) is also available to landowners to plant trees in open land. Although many landowners use these programs and receive sizable payments, there is no guarantee that you will be successful in obtaining these benefits. Therefore, we will assume that the landowner will absorb all forest establishment and management costs.

Landowners must pay property taxes, and the taxes are roughly equal whether the land is used to grow crops or trees. Forestry investment makes many landowners qualify for capital gains tax treatment. In addition, a federal reforestation tax incentive allows a 10 percent investment tax credit plus a 7-year amortization of $9,500 on the first $10,000 of qualified reforestation expenditures each year. This is available to virtually all landowners. Because of the wide range in individual tax brackets and alternative rates of return, this analysis will not include income tax issues. All results in this report are stated on a before-tax basis.

Multiple-Use Opportunities

Forests provide many nontimber benefits, including wildlife, outdoor recreation, clean water, and scenic beauty. Some of these may have economic value to the landowner. Currently, the average price for hunting lease is about $3.00 per acre. If you have a tract of timberland large enough for hunting lease (150 acres), the income from the lease is usually sufficient to cover annual management costs. Other nontimber benefits are not considered in this analysis.

How Much Is Your Land Worth if You Plant Southern Pine Trees?

Now you are ready to calculate the value of your land for forestry use. Using data from the first complete rotation,

land value = discounted revenue
– discounted management cost
– reforestation cost

where

$$\text{discounted revenue} = \frac{\text{stumpage price} \times \text{timber volume}}{\text{compound factor}}$$

and

$$\text{discounted management cost} = \frac{\text{management cost}}{\text{compound factor}}$$

Example: Joe's real discount rate is 6 percent (9 percent nominal – 3 percent inflation). His land has a site index of 60 feet. He plans to plant 778 loblolly pines per acre, to thin the forest at ages 15 and 23, and to clear-cut at age 30. The real price of stumpage is expected to change at about 1 percent annually during the 30-year rotation.

From Table 2, locate site index 60 and 778 trees per acre, you will find that Joe should expect to harvest 15.7 cords of pulpwood per acre at age 15; 1.4 cords of pulpwood and 7.2 cords of chip and saw at age 23; and 0.7 cords of pulpwood, 6 cords of chip-n-saw, and 9.2 thousand board feet of sawtimber at age 30. Multiplying the volumes by expected real prices (last column of Table 4) and adding up across products gives the total revenue for ages 15 ($601), 23 ($945), and 30 ($5,660).

Since money received in the future has to be discounted to the present, you need to find a compound factor (the equivalent of $1 at present in 15, 23, and 30 years, using a discount rate). Table 6 presents the compounding factors at discount rates of 3, 6, 9, and 12 percent. In Table 6, you will find the compound factors are 2.396, 3.819, and 5.743 for ages 15, 23, and 30 for an interest rate of 6 percent. Dividing each revenue by the appropriate compound factor gives you the present value of the

Table 6. Compound Factors: Value of $1 (Computed Annually) at the End of a Period of N Years Earning R% Annual Interest

3%	6%	Years	9%	12%
1.030	1.060	1	1.090	1.120
1.060	1.123	2	1.188	1.254
1.092	1.191	3	1.295	1.404
1.125	1.262	4	1.411	1.573
1.159	1.338	5	1.538	1.762
1.194	1.418	6	1.677	1.973
1.229	1.503	7	1.828	2.210
1.266	1.593	8	1.992	2.475
1.304	1.689	9	2.171	2.773
1.343	1.790	10	2.367	3.105
1.384	1.898	11	2.580	3.478
1.425	2.012	12	2.812	3.895
1.468	2.132	13	3.065	4.363
1.512	2.260	14	3.341	4.887
1.557	2.396	15	3.642	5.473
1.604	2.540	16	3.970	6.130
1.652	2.692	17	4.327	6.866
1.702	2.854	18	4.717	7.689
1.753	3.025	19	5.141	8.612
1.806	3.207	20	5.604	9.646
1.860	3.399	21	6.108	10.803
1.916	3.603	22	6.658	12.100
1.973	3.819	23	7.257	13.522
2.032	4.048	24	7.911	15.178
2.093	4.291	25	8.623	17.000
2.156	4.549	26	9.399	19.040
2.221	4.822	27	10.245	21.324
2.287	5.111	28	11.167	23.883
2.356	5.418	29	12.172	26.749
2.427	5.743	30	13.267	29.959
2.813	7.686	35	20.413	52.799
3.262	10.285	40	31.409	93.050
3.781	13.764	45	48.327	163.987
4.383	18.420	50	74.357	289.002
5.082	24.650	55	114.408	509.320
5.891	32.987	60	176.031	897.596

total net revenues for the first rotation—$1,497.

Now you need to figure out the present value of the management costs or the discounted management costs. Table 5 gives the expected costs for pine plantation establishment and management and years in which the activity will be carried out. Notice again that the expected real cost for prescribed burning has increased about 5 percent more than the rate of inflation has, and the costs for herbaceous weed control and consulting fees increase at about the same rate as inflation. Therefore, compound factors have been used to adjust the expected real costs. Dividing the expected real costs by the appropriate compound factors (6 percent interest) gives the discounted establishment and management costs (the last column of Table 5). The total discounted establishment and management costs for the first rotation are $317.

Therefore, the expected present value of per-acre profit for planting pine trees in 30 years is calculated as follows:

$$\$1,497 - \$317 = \$1,180$$

Since you could use the land for continuous rotation (that is, you get $1,180 every 30 years) forever, the total land value is:

$$\$1,180 + 1,180 \div 1.06^{30} + 1,180 \div 1.06^{60} + \ldots$$
$$= 1,180 \div (1 - 1.06^{-30}) = \$1,428$$

Pitfalls in Estimating Forest Land Value

As you see, estimating the value of land used in timber production can be complicated, primarily because of the long growing period for timber and the associated time value of money—a dollar spent or received today is not equal in present value to a dollar to be spent or received in the future. There are two major pitfalls in estimating forest land value.

First, some people use the stumpage price or interest rate improperly in estimating the total revenue and costs. Stumpage prices can be nominal or real, as can interest rates. You can use the real stumpage price and real interest rate, as in the above example, or the nominal stumpage price and the nominal interest rate. To use the latter method, you have to add inflation in your forecast of stumpage prices. You should not, however, use real stumpage prices and nominal interest rates. Some people unfamiliar with forestry take today's stumpage price as the future stumpage price and today's interest rate, which includes inflation, to calculate forest land value. Estimating forest land value this way may often end up with a conclusion that forestry investments are not profitable. This method is incorrect and should be avoided. On the other hand, using nominal prices and real interest rates will greatly exaggerate the return on forestry investments.

Second, the real stumpage prices and some management costs are increasing faster than the rate of inflation is. In the previous example, the future real appreciation of stumpage price (price appreciation above inflation) and rising costs of prescribed burning are considered. Had we not considered the real price appreciation of stumpage and the rising real costs of prescribed burning, the land value would have been $954 per acre, a far cry from $1,428 per acre.

Other Factors Influencing Investment in Forestry

Growing timber rather than crops has its drawbacks. Some of them are real, and others are perceived. The real drawbacks are irregular revenues and possible option costs. A perceived drawback is the physical risk of forests. Finally, the "endowment effect" makes some farmers stick with agricultural enterprises longer than basic economics would justify.

Irregular Revenues

Unlike an agricultural operation which hopefully brings a landowner income every year, revenues from forestry investments often begin more than 10 years after trees are planted and will recur only periodically until final harvest. Unless you have a sufficiently large forestry operation (more than 300 acres) and well-distributed age classes of timber, you will have some years without timber revenue. However, this should not be a problem if your primary income is not from forestry operation.

Option Costs

Because of the long production period of forestry, landowners could hardly change their operation before the timber is mature once committed to forestry. This is a so-called "option cost." However, this cost may not be real or large because landowners can sell their young plantations or lease them unless they want total control of their lands. The markets for timberland sales or leases are very active in Alabama and other southern states. In addition, this seeming cost can sometimes be beneficial because landowners can have the option of holding timber for a growing season or more to wait for favorable prices to minimize income tax liabilities.

Physical Risk of Forests

Contrary to popular belief, forests possess a relatively low physical risk or loss due to fire, insects, and disease. Established forests have a higher level of stress tolerance than most crops do. Fire, insects, and disease currently affect slightly over 2 million of the more than 200 million acres of southern forests annually. A stand of trees is seldom totally destroyed, and damaged trees frequently have value. This is particularly true for well-managed forests. Diversification among stand ages and parcel locations further reduces physical risks in most cases. Regular thinning can greatly reduce the risk of southern pine beetle, one of the major causes of timber loss in Alabama.

Endowment Effect

People often value an asset they have held for a period of time more than the market is willing to pay for it. This is the so-called "endowment effect." Some owners who have been using their land for agriculture for years may find it hard to give up agricultural land use even if growing timber is more profitable.

Research studies clearly indicate the financial rewards of changing some agricultural land to forestry use. Landowners who intend to invest in forestry can obtain forest management assistance from consulting foresters, industry foresters, or public foresters from the Alabama Forestry Commission, the Natural Resources Conservation Service (NRCS), or the Alabama Cooperative Extension System (ACES). A list of consulting foresters can be obtained from your county Extension office or local Alabama Forestry Commission office. For landowners with internet access, Web sites, such as the one developed by the Auburn University School of Forestry Private Forest Management Team (www.prmt.org), can provide useful information.

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Daowei Zhang, *Extension Forester,* Assistant Professor, Forestry, Auburn University

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