UNIVERSITY OF FLORIDA
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Draft

Comparing Values of Timber Production to Agricultural Crop Production[1]

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Introduction

The purpose of this paper is to illustrate how to compare the financial returns of alternative land uses. Using current information, the alternatives illustrated in this paper are annual crops (cotton and watermelons) and timber (pines). These crops are commonly grown by private landowners in North Florida. Many factors go into a landowner's investment decision. This paper only considers financial analysis, namely the stream of financial costs and returns specifically associated with planting, growing and harvesting the crop. Other factors to consider include cash flow needs, the environmental and economic impacts on wildlife, water quality, soil conservation, aesthetics and other attributes important to the owner.

Methods

There are three steps in financial analysis- First you determine your inputs (costs) and outputs (benefits). Second, you determine their value and when they occur over time. Third, you conduct an analysis of the costs and benefits using decision criteria.

The most commonly used decision criteria is net present value (NPV) because it takes into account the time value of money. A dollar earned today is not the same as a dollar earned in twenty years. The NPV technique uses a discounting procedure for finding the present value of future sums. The procedure uses the interest rate (which is your cost of money) to bring back to the present each cost and revenue item that occurs over the rotation. The NPV is the present value of the expected future revenues minus the present value of the expected future costs, with the costs and returns discounted at the appropriate interest rate. Once the NPV is determined, one can compute two other important decision criteria, the Internal Rate of Return (IRR) and Equal Annual Equivalent (EAE).

When comparing land uses that have different investment time periods (cotton and watermelons are harvested annually, while timber takes many years to harvest) we need to have a common analysis period. The Equal Annual Equivalent (EAE) formula combines all costs and benefits into a single annual sum that is equivalent to all cash flows during an analysis period spread uniformly over the period. It can be viewed as the amount of an annual payment that will just pay off the NPV of an asset during its lifetime.

The calculations to determine EAE are carried out in two steps. First one derives the NPV using the following formula:

$$NPV = \text{Present value (PV) of revenues} - \text{PV of costs}$$

$$PV = \sum_t \frac{\$_t}{(1+i)^t},$$

1. This document is Draft, one of a series of the School of Forest Resources and Conservation, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. October, 1998. Please visit the FAIRS Web site at **http://hammock.ifas.ufl.edu**.
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where i = interest (discount) rate and t = number of years.
Using the NPV, the EAE is then calculated as:

$$EAE = NPV \times Annuity\ Factor,$$

$$\text{where the Annuity Factor} = \frac{i(1+i)^t}{(1+i)^t - 1}$$

Crop Production

Cotton and watermelons are annual crops. Their costs and returns do not have to be discounted since they occur in the same year. The estimated costs of producing an acre of watermelons and cotton for sandy soils in North Florida in 1998 are shown in the boxes on the right. One reason watermelons are more expensive than cotton is that they are irrigated. Land cost was not included in order to make net returns to land comparable with the annuities from pines.

Using expected "average" costs and prices[3] for watermelons and cotton in 1998 we did the following calculation on the right to determine net annual returns.

If we were only comparing watermelons and cotton, the results show watermelons are more profitable. Net annual returns after all costs are $121.10 per acre for watermelons. Cotton had a net annual loss of $-84.01 when all costs were accounted for. These values, the net returns for crops, are the EAE. Since averages were used in these calculations and yields and prices vary across land and management types, Tables 1 and 2 provide a range net returns for watermelons and cotton, respectively.

Timber Production

Unlike agricultural crops, forestry investments require a long range commitment of resources. Any long term investment has risks. A commonly used procedure for taking forestry risk into account is to make adjustments to the interest rate, also known as the discount rate. In this analysis, two different interest rates are used (4 and 7%). In addition, a landowner has a variety of management options on species selection and merchantable product. In this example we use slash pine since it is the most commonly grown tree species in North Florida, and there is a strong market for its products. Two different silvicultural regimes are shown to illustrate differences in returns using different production and harvest schedules. The two silvicultural regimes are: 1) a single harvest at age 20 years, and 2) a multiple harvest with a thinning at 15 years and final harvest at 25 years.

Watermelons Production per acre per year
(estimated for 1998)

Costs: Cash Expenses $1,023.75
Fixed Costs $ 115.15

Revenues = Yield x Price = $1,260
where Yield =18,000 lbs & Price = $0.07

Net annual returns = revenues-costs
Net returns above cash costs = $236.25
Net returns from fixed and cash costs =$121.10

Cotton Production per acre per year
(estimated for 1998)

Costs: Cash Expenses $482.18
Fixed Costs $ 91.83

Revenue = Yield x Price = $490
Where Yield = 700lbs & Price=$0.70

Net annual returns = revenues-costs
Net returns above cash costs = $7.82
Net returns from fixed and cash costs = $-84.01

Any investment analysis relies to some extent on assumptions. Due to the complexities of long term investments such as forestry many of these assumptions may be no better than educated guesses.

Land

Land value is not included since we are interested only in the annual return to the timber resource. Land alone is considered a good investment because of rising prices. Whether land is purchased or already owned, timber production is considered another investment and should be treated differently.

3./ Estimated revenue and cost data from the North Florida Research and Education Center, Marianna, FL

Table 1. Net returns to WATERMELONS at various yields and prices (Total production costs: $1,100)					
Yield (lbs)	Price per pound				
	$0.04	$0.06	$0.08	$0.10	$0.12
10,000	-$700	-$500	-$300	-$100	$100
13,000	-$580	-$320	-$60	$200	$460
16,000	-$460	-$140	$180	$500	$820
19,000	-$340	$40	$420	$800	$1,180
22,000	-$220	$220	$600	$1,100	$1,540

Table 2. Net returns to COTTON at various yields and prices. (Total production costs: $500)				
Yield (lbs.)	Price per pound			
	$0.60	$0.64	$0.68	$0.72
550	-$170	-$148	-$126	$-104
650	-$110	-$84	-$58	-$32
750	-$50	-$20	$10	$40
850	$10	$44	$78	$112

Stand Establishment Costs

The major costs in establishing a pine plantation are preparing the site, buying the seedlings and planting services. Since this analysis is being used as a guide to compare a forestry investment with an annual crop it is assumed that the land was previously occupied with row crops (i.e., an old field). Therefore, no costs are incurred for site preparation. Costs included are contract planting and seedling costs ($80 per acre).

If site preparation is needed it may range from $100-$300 per acre. This amount would be added to the establishment costs.

Annual Costs

After planting, a landowner incurs annual management costs associated with property taxes and managing the land. Management costs may consist of firebreak maintenance and periodic prescribed fire. The landowner receives agricultural classification for tax purposes. A $6 per acre per year figure is used in this paper to cover annual costs.

Cost Share Programs

Several federal and state reimbursement programs may be available to help offset the cost of establishing and managing a forestry investment. To keep the analysis simple, we assume that cost share funds are not used.

Tax Treatment (reforestation tax credits and capital gains exclusion)

Unlike watermelons and cotton pines have some important tax advantages. Landowners can deduct up to $10,000 over 7 years for reforestation expenses. Also timber sales are recognized as capital gains, which exempts 60% of the return from federal income tax. For comparison purposes before-tax analysis is carried out.

After-tax analysis would make the forestry investment look more profitable.

Tree Growth and Yield

The volume of wood that can be grown on an acre of land during a given time period depends upon many factors such as site quality, quality of seedlings, use of herbicides to reduce competition, and use of fertilizers to increase soil fertility. In this comparison we use a typical site quality (Site Index 60) found in North Florida. We also assume that 800 trees per acre are planted. In the multiple sale example, after thinning the residual stand supports a basal area of 60 square feet per acre. Predicted yields were obtained from a growth and yield model developed by Clutter and Jones (1980).

Current and Future Stumpage Prices

The prices paid for trees as they stand in a forest (stumpage price) varies considerably. Some factors that affect the price include the product sold, the location of the stand, the terms of the contract, and the season of logging. We obtained the most current stumpage prices from the Timber Mart South price report (1st quarter 1998). Pulpwood was $50 per cord, chip-n-saw was $90 per cord, and sawtimber was $357 per thousand board feet. These prices are relatively high compared to historical values. Since the prices already tend to be high we use the current prices in this analysis, and do not assume future price increases.

Single harvest example

A slash pine stand is grown for 20 years and then clear-cut. A time line for this example is shown in Figure 1 below. At 20 years 30 cords of pulpwood are harvested for a total of $1,500.

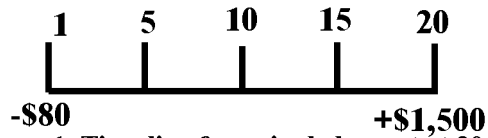

Figure 1. Time line for a single harvest at 20 years. Not shown are year 1-20 costs of $6/yr.

Using a 4% interest rate, the following steps are carried out:

1. Calculate the Present Value (PV) of the costs:
   a) Establishment costs of $80 occur in 1st year (no discounting)

   b) Annual costs of $6 occur every year. The formula for the present value of a terminating annual series is:

In this example:

$$\text{Present Value (PV) of terminating annual series} = a\frac{(1+i)^t - 1}{i(1+i)^t}$$

$$PV = \$6\left[\frac{(1+.04)^{20}-1}{.04(1+.04)^{20}}\right] = \$6\left[13.590\right] = \$82$$

PV of costs are $80 + $82 = $162.

2. The present value of the returns are:

$$PV = \frac{\$1500}{(1+.04)^{20}} = \frac{\$1500}{2.19} = \$685$$

3. The NPV = $685-$162 = $523

4. The EAE is:

$$EAE = NPV\left[\frac{i(1+i)^t}{(1+i)^t - 1}\right] = \$520\left[0.7358\right] = \$38$$

On an annual basis the value of the this investment is $38 per acre per year.

Multiple Harvest example

In this example a planted slash pine stand is thinned to 60 square feet of basal area per acre at 15 years and clear-cut at 25 years. At age 15, 8 cords per acre of pulpwood are harvested for a revenue of $400. At final harvest, 23 cords per acre are cut for a total revenue of $1,240 ($925 for pulpwood, $315 for chip-n-saw). The following is the time line for this example.

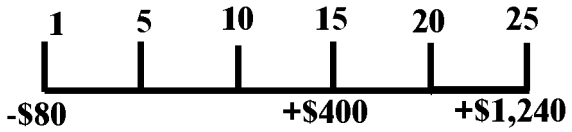

Figure 2. Time line for a multiple harvest.

As in the previous example the same four steps are used to calculate the EAE.

1. Calculate the Present Value (PV) of the costs:
   a) Establishment costs of $80 occur in 1st year (no discounting)
   b) Annual costs of $6 occur every year. Using the terminating annual series formulas we have:

$$PV = \$6\left[\frac{(1+.04)^{25}-1}{.04(1+.04)^{25}}\right] = \$6\left[15.622\right] = \$94$$

The PV of total costs are $80+$94 = $174

2. Calculate the PV of revenues.

a) At 15 years we receive $400/acre

$$PV = \frac{\$400}{(1+.04)^{15}} = \frac{\$400}{1.8} = \$222$$

b) At 25 years we receive $1240/acre

$$PV = \frac{\$1240}{(1+.04)^{25}} = \frac{\$1240}{2.67} = \$465$$

The PV of total revenues are $222+$465 = $687

3. Calculate the NPV.

NPV = $687-$174 = $513

4. Calculate EAE.

$$EAE = NPV\left[\frac{i(1+i)^{t}}{(1+i)^{t}-1}\right] = \$456\left[0.06401\right] = \$33$$

On an annual basis the multiple harvest timber investment provides $33 of return per acre per year.

Using a 4% interest rate, the single harvest example provides a higher net return than the multiple harvest. Landowners interested in intermediate returns (from thinnings) instead of waiting the full rotation may find the multiple harvest more attractive since the net difference was not very large.

Table 3 shows the results using both a 4% and 7% interest rate. As the interest rate increases, the NPV and EAE will decrease.

Interpreting the results

Table 4 shows that net annual returns from the timber production are very competitive to net returns from crop production.

Net returns for timber ranged from $19-38 per acre per year. For watermelons the net return was $121, while the net return for cotton was negative. Current market conditions can greatly affect returns. For example, Table 1 shows that returns from watermelons can be very profitable if yields and prices are high. If a landowner needs annual cash flows, timber may not be the best decision. However, this analysis did not consider the multiple revenue sources available from timber production, including hunting leases, Christmas trees and pine straw. Including these revenue sources may make timber production a more attractive investment than annual crops. In addition landowners can receive revenues for timber production from government cost share programs such as the Conservation Reserve Program.

Conclusion

Landowners must make decisions about how to use their land and its resources. One of the objectives of the paper was to show landowners how to use current economic and production information to analyze an investment decision. To be as realistic as possible, this paper used current information on prices and costs. The results one gets will change depending on the market conditions. However, the process and steps involved in analyzing financial costs and returns will remain the same. The material is not presented to promote or discourage investments in timber production.

Reference

Clutter J.L. and E.P. Jones, Jr. 1980. Prediction of growth after thinning of old-field slash pine plantations. USDA Forest Service, SE-217.

Table 3. Timber scenarios at different interest rates.

	MULTIPLE HARVEST		SINGLE	Net Cost/Return
	4% Discount rate	7 % Discount rate	4% Discount rate	7 % Discount rate
Establishment costs	$80	$80	$80	$80
PV of annual costs	$94	$70	$82	$64
PV of total costs	$174	$250	$162	$144
PV of revenues	$686	$373	$685	$388
NPV	$513	$223	$523	$244
EAE (Annual net returns)	$33	$19	$38	$23

Table 4. Comparing average net returns for 1998.

	Single harvest rotation	Multiple harvest rotation	Watermelon	Cotton
1998 average net return	$19-$38	$23-$38	$121	$-84