Preliminary Study of the Impacts of Oak Seedling Survival on Investment Returns

Donald L. Grebner, Andrew W. Ezell, Deborah A. Gaddis, and Steven H. Bullard.[1]

ABSTRACT

Many landowners are establishing hardwood plantations to satisfy their investment goals. Unfortunately, little is known on how competition control affects initial stand survival and subsequent investment returns. This study examines three alternative competition control regimes for southern oak establishment. The analysis includes both before- and after-tax estimates of land expectation value for comparing alternatives. Our preliminary results suggest that greater returns can be achieved for southern oaks during both good and bad rainfall years using herbicides only for competition control.

INTRODUCTION

Non-industrial private landowners have varied objectives for managing their timberlands in the South. With the aid of federal and state government incentive programs, more landowners are investing in the establishment of hardwood plantations. The potential for this new resource may have a significant impact on plywood and furniture industries. There have been few studies on hardwood plantations from an economic or a biological perspective. To date, relatively little information is available regarding their growth and yield and before- or after-tax returns.

An important element of any feasibility study for establishing a hardwood plantation is seedling survival. Seedling survival depends on many factors that include biological, environmental, and operational elements. Biological elements include genetics and competition with herbaceous and woody species; environmental elements include temperature, rainfall, and other weather conditions; and operational elements include planting quality, location, timing, vegetation control, and pest control. These elements may have a positive or a negative impact on the final volume and value yield of a hardwood stand. This study focuses on the influence of competition control on seedling survival and investment returns in southern oak plantations.

Numerous studies have examined the economics of hardwoods including Deurr and Bond (1952); Bullard et al. (1985); and Niese and Strong (1992). Studies relevant to this one include Vasievich (1984); Hoover (1989); Ezell and Bullard (1997); Amacher et al. (1998); and Bullard and Straka (1998). However, few studies have examined hardwood seedling survival and the impacts of different regeneration practices on investment returns. Regeneration studies include Malac and Heeren (1979); Brodie (1982); Steiner (1987); Rich (1989); and Bullard et al. (1992).

In general, these studies indicate that little has been done with regard to evaluating the importance of vegetation control on investment returns for hardwood plantations. Hardwood regeneration has been examined from a financial and economic perspective, but no one has focused on expected initial survival. Goodson and Bullard (1997) indicate that few studies have been done in this area. The use of financial criteria, such as net present value and land expectation value in after-tax procedures, has been widely used in comparative analysis studies. Therefore, this study uses a similar analytical approach consistent with traditional practices but unique for its focus on expected first year survival of oak seedlings.

Under consideration are whether competition control plays a role in seedling survival and/or whether it affects investment returns for oak plantations in the South. The oak plantations are planted on abandoned agricultural land. The study will focus on competition control and its impact on first year survival of oak seedlings. Three different management practices will be compared and their impacts on seedling survival and investment returns evaluated. We will compare a no site preparation treatment to those that include disking only and herbicides only. Seedling survival information was obtained from various published and unpublished

[1] Authors are, respectively, Assistant Professor, Professor, Assistant Specialist, and Professor, Department of Forestry, Mississippi State University, Box 9681, Mississippi State, MS 39762. Approved for publication as Journal Article No. FO174 of the Forest and Wildlife Research Center, Mississippi State University. Our thanks are given to Drs. Stephen Grado and Keith Belli for constructive criticisms.

sources that apply to oak stands on abandoned agricultural fields in the South.

METHODS

This study compares a base case and two alternative management regimes for controlling vegetation during stand establishment. Land Expectation Value (LEV) on a before- and after-tax basis was used to evaluate the feasibility of these practices. Although the examples are hypothetical, scenarios reflect a realistic commercial design for the South. Land expectation value models were developed on a before- and after-tax basis. Three alternative management scenarios were also evaluated by competition control techniques, re-planting, and weather conditions.

The landowner is assumed to be an "investor" under the passive loss rules who expects to generate an eventual profit from the sale of timber. The initial afforestation investment is assumed to be partially covered by a federal or state cost-share program such as the Forestry Incentives Program (FIP) or a state program such as Mississippi's Forest Resource Development Program (FRDP). Under IRC § 126, cost-share payments such as the FIP are excludable from income. In this study, the landowner is assumed to exclude all cost-share payments from income, thereby avoiding payment of income tax and self-employment tax. Exclusion of income is not an option for some governmental cost-share programs such as the Conservation Reserve Program (CRP). Landowners must treat CRP rental payments and cost-share payments as ordinary income, including assessment of self-employment tax. This analysis does not apply to landowners using CRP and other similar programs ineligible for income exclusion.

The landowner is also assumed to take advantage of the investment tax credit for reforestation expenses (IRC § 48 (b) (1986)) and the accelerated amortization of reforestation expenses (IRC § 194). Investor status allows the landowner to deduct these expenses regardless of whether deductions are itemized. Since the analysis is conducted on a per-acre basis, the landowner is also assumed to have total afforestation expenses under $10,000 per year, which allows amortization of 95% of expenses not covered by the cost-share program.

Model Development

Both before- and after-tax analyses were conducted for comparative purposes. For the after-tax analysis, we followed Bullard and Straka (1998) where revenues, costs, and the discount rate are adjusted to an after-tax rate. After-tax revenues were calculated by multiplying the before-tax revenue by (1-*t*), where *t* is the marginal tax rate faced by an individual. After-tax costs are calculated in the same manner if they are considered expensed. Our definition of expensed costs is one where a cost is deducted in its entirety in the year in which the cost occurs. In forestry investments, reforestation expenses are typically considered capitalized costs, but the 8-tax year amortization schedule is implemented to deduct these costs earlier. The amortizable basis used in our analysis is reduced by ½ the federal investment tax credit taken.

We assumed the landowner would receive 50% cost share from a government program to establish their oak plantations, although it is not uncommon to see 40% in certain locales due to a high demand for these financial resources. The next step in conducting an after-tax analysis before using cash flow formulae is to convert the discount rate to an after-tax rate. (State income taxes are not considered in this analysis.) We follow a procedure suggested by Bullard and Gunter (2000) which uses an inflation rate. We assume inflation to be 2.5%. Once all after-tax conversions are made, converted monies are discounted across time to calculate the after-tax land expectation value for each scenario. State income taxes are not considered in this analysis; therefore, the results are after-tax with regards to federal income taxes only.

Management Regimes

The economic impact of competition control on seedling survival in oak plantations was examined by comparing three alternative management regimes. Each alternative was modeled by considering both good and bad rainfall years. Good years are defined as normal rainfall conditions in the South during the months of March, April, and May with intermittent showers during the summer months. Bad years are defined as below normal rainfall levels in the South for the same time periods. In addition, we examined returns with and without re-plantings. Re-plantings are assumed to occur when seedling survival after one year is less than 50% of the original planting. An assumption made with regard to survival is that poor establishment allows adequate areas with light, water, and nutrients to justify re-planting.

Base: No site preparation

This model assumed that no site preparation was conducted and that seedlings were hand planted directly into old fields. During good weather conditions with adequate rainfall, 60% survival of planted seedlings is expected. A lower survival rate of 30% is expected for poor rainfall years. In addition to these differing weather conditions, this regime includes a re-planting scenario.

Alternative 1: Disking only

This model incorporates site preparation consisting of disking only with seedlings being hand planted directly into old fields. During good weather conditions with adequate rainfall, 62.5% survival of planted seedlings is expected. A lower survival rate of 35% is expected for low rainfall years. In addition to these differing weather conditions, this regime includes a re-planting scenario.

Alternative 2: Herbicides only

This model employs site preparation consisting of spraying herbicides with seedlings being hand planted directly into old fields. During good weather conditions with adequate rainfall, 85% survival of planted seedlings is expected. A lower survival rate of 70% is expected for low rainfall years.

DATA

Forest land managers have recognized the importance of competition control in regard to pine survival and growth. A regional study established the fact that grass and herbaceous broadleaf plants are the most serious competitors during the first five years of pine growth and development. Since oak planting has not been studied to any comparable extent and expectations for oak seedling growth are less than for pine, the impact of competition on survival has received far less attention.

Three primary factors determining initial survival of planted oak seedlings are planting stock quality, planting job quality, and competition control. Obviously, control for the latter will be of little benefit if the two former criteria are the cause of mortality. However, seedling quality in terms of size and condition may be specified during the ordering process, and supervision can typically ensure an acceptable planting job. Given that good seedlings have been planted properly, the control of competing vegetation can have striking effects on first year survival. In a study involving six oak species (*Quercus spp.*) and green ash (*Fraxinus pennsylvanica*), Ezell and Catchot (1997) found that survival was increased 15-20% for all species by applications of herbicide prior to bud break. The research was completed during a growing season with normal precipitation for the area, and survival in the treated areas averaged 85-90%, depending on the species. An examination of the effect of competition control on oak seedlings during droughty years, found survival in treated areas remained in the 80-90% range for Nuttall (*Quercus nuttallii*) and Cherrybark oak (*Quercus falcata*) while survival in the untreated areas ranged from 0-43% (Ezell 2000). The impact of competition was enhanced by a severe drought at the research site during 1998 and 1999.

Yield Information

Given the lack of growth and yield information for oak plantations in Mississippi, this study used observational information for mixed oak stands on abandoned agricultural lands. Our approach is similar to the one used by Ezell and Bullard (1997). In this study, the estimates of oak yields were obtained through personal communication with Dr. John Hodges formerly of Mississippi State University and Anderson-Tully Company. Although our analysis is concerned with returns from oak plantations, the yield estimates for mixed oak natural stands serve as a basis for utilizing our estimated returns as a worst case scenario. Therefore, land expectation values presented in this paper are considered conservative estimates for the different types of vegetation controls implemented to improve seedling survival. We feel that this assumption is appropriate because plantations are assumed to be managed in a more intensive manner resulting in greater growth and yield (Malac and Heeren 1979).

Our models assumed that on a per acre basis, oaks will start to accumulate 350 bd ft Doyle per year at age 25 and final harvest will be at age 50 leading to the accumulation of 8,050 bd ft of volume per acre (Dr. John Hodges, pers. commun. 2000). In addition, we assumed one thinning at age 35 will yield five cords and 2000 bd ft Doyle per acre, and that 10 cords per acre will be cut during final harvest along with the 8,050 bd ft. per acre of sawtimber. A lack of empirical growth and yield data prohibited the use of either maximum mean annual increment or financial criteria to determine the optimal rotation age.

Cost Information

Cost information used in this study was collected through personal communication with Mississippi Forestry Commission personnel. In this analysis, a 6% real discount rate was used. Average costs per acre per activity for Mississippi in 2000 are reported in Table 1.

Table 1. Average cost per acre by activity for Mississippi in 2000.

Activity	$/acre
Herbicide application	35
Disking	15
Seedlings[a]	109
Hand planting	47
Land use tax[b]	2
Annual management fees	2

[a] Seedling price is $0.25/seedling and 435 seedlings planted/acre.

[b] Average per acre property tax for forest land in Mississippi is approximately $2.

Price and Revenue Information

The price data used to compute harvest values were taken from Timber Mart South. Mississippi Region 1 data were averaged for the last three quarters of 1999 and the first quarter of 2000. Averaging was performed for oak sawtimber and hardwood pulpwood. In addition, it was assumed that landowners would be able to lease their land for fee hunting purposes at an average of $5.50/acre/year. This is consistent with Jones et al. (2001). Table 2 summarizes this information.

Table 2. Price and revenue information for standing timber and fee hunting in Mississippi in 2000.

Species	Prices
Oak sawtimber	$305.28/MBF Doyle
Hardwood pulpwood	$13.88/cord
Hunting leases	$5.50/acre/year

RESULTS

To compare the returns for competition control using alternative management regimes, land expectation value was calculated for each regime given the before-stated assumptions. Given the growth and yield assumptions, these results should be viewed as conservative estimates for the different management practices during both good and bad rainfall years. Table 3 presents before-tax results.

Table 3. Before-tax LEV per acre results for alternative management regimes.

	No site preparation ($)	Disking only ($)	Herbicides only ($)
Good rainfall year	17.53	8.19	45.76
Bad rainfall year	(60.77)	(63.58)	6.62
Bad rainfall year; re-planting	(93.41)	(94.97)	--

Table 3 displays the results for the base case and alternative management regimes. For the base case during good rainfall years, expected stand establishment is better than in bad rainfall years, despite no control for competing competition. This results in a $78.30 difference in before-tax LEV between good and bad rainfall years which suggests that a remedy for negative LEVs due to low expected survival is to replant immediately and reoccupy the site by maintaining adequate stocking. However, replanting after a bad rainfall year reduces the before-tax land expectation value per acre by $32.64. The after-tax land expectation value estimates in Table 4 show similar trends.

Table 4. After-tax LEV per acre results for alternative management regimes.

	No site preparation ($)	Disking only ($)	Herbicides only ($)
Good rainfall year	185.45	193.79	302.62
Bad rainfall year	20.24	31.41	214.05
Bad rainfall year; re-planting	(7.31)	(12.10)	--

The before-tax land expectation values for disking only in Table 3 have a similar trend compared to the base case for good and bad rainfall years. The lower expected survival for bad rainfall years decreases the land expectation value estimates by $71.77 per acre. The added cost of replanting after bad rainfall years further reduces the before-tax LEV estimates by $23.20 per acre. However, when comparing disking only to the base case, the before-tax LEV estimate decreases by $9.34 per acre. The after-tax values are higher for disking due to the greater amount of initial seedling survival. In Table 4, the after-tax differences are approximately $8.34 per acre during good rainfall years and $11.17 per acre during bad rainfall years.

The application of herbicides only to control vegetative competition improves expected initial survival compared to the previously mentioned management regimes. The higher survival expected from using only herbicides reflect higher before-tax and after-tax land expectation values per acre for good and bad rainfall years. In good rainfall years, the before-tax LEV for this management practice is $28.23 and $37.57 per acre higher for doing nothing and disking only. In bad rainfall years, the before-tax LEV for this management regime is $67.39 and $70.20 per acre higher for doing nothing and disking only. The after-tax land expectation value results in Table 4, for herbicide only practices, are higher than for the previously mentioned regimes. For instance, the after-tax LEV for herbicides only is $108.83 greater than disking only for good rainfall years and $182.64 higher after bad rainfall years.

DISCUSSION

In general, greater vegetation control has an impact on both before-tax and after-tax land expectation values for the studied management practices. However, there are many factors that may affect the results of this study. In this discussion, we address the importance of growth and yield information, incentive programs, and prices.

Several key issues concerning the growth and yield data used in this study need to be highlighted because of their importance to oak plantation returns. The dearth of published yield information for oaks on abandoned farmlands necessitated using an expert opinion. The expected volumes in board feet Doyle began accumulating in year 25 to year 50. Given that these yield estimates are for natural mixed oak stands, the reader should be cautious in interpreting the results in this study. In general, plantations are more intensively managed than natural stands. Their management prescriptions may include vegetation control, fertilization, and the planting of genetically improved growing stock. All of these factors may improve the growth and yield of plantations over natural stands. Therefore, the results in this study suggest that improved growth and yield information may show higher investment returns for oak plantations on either a before- or after-tax analysis.

Other important issues affecting hardwood plantation returns are federal and state incentive programs and state tax credits. State incentive programs, such as the Forest Resource Development Program in Mississippi, provide financial assistance and technical support to landowners. Unfortunately, given high demand for these monetary resources, not all programs can offer 50% cost share for site establishment. If actual cost shares are less than those assumed for this study, then hardwood investment returns would be lower when considering either before- or after-tax calculations. In addition, high demand forces landowners to add their names to a waiting list, which in no way guarantees that funds will be awarded. However, landowners who live in a state with a reforestation tax credit have another alternative for receiving financial assistance. For instance, in Mississippi, the state legislature recently enacted a law providing private landowners a $10,000 life time tax credit for reforestation. This credit neither prevents a landowner from claiming the federal investment tax credit nor prevents amortization of reforestation expenses for eight tax years. Programs like this can greatly improve the investment return of hardwood plantations.

Last is the role that prices and interest rates have on an investor's decision to invest in oak plantations. LEV estimates are very sensitive to changes in prices and discount rates. Higher discount rates lower LEV estimates while lower rates increase these estimates. The after-tax discount rate used in this analysis is lower than the before-tax rate, which increases the LEV estimates. The discount rate used by the investor will greatly influence the decision to establish an oak stand. In addition, many investors assume a 1-2% real appreciation of stumpage prices over the rotation. This will improve LEV estimates making the oak plantation investment more attractive.

CONCLUSIONS

In summary, the goal of this study was to examine the role competition control plays in seedling survival and whether or not it affects investment returns for oak plantations. The analytical approach utilized before- and after-tax land expectation value estimates to conduct a comparative analysis of different management regimes. The management regimes incorporated different competition control procedures that yielded different seedling survival during good and bad rainfall years. The results suggested that to control competition and maximize returns, management regimes should spray herbicides only despite good or bad rainfall years after initial stand establishment.

An important consideration when evaluating investment returns generated from this study is the conservative growth and yield estimates. They serve as a worst case scenario. Applying intensive management techniques to the stand will have a significant impact on returns. In addition, planting genetically improved seedlings, implementing fertilization, and pest control programs should improve investment returns. Finally, future research should evaluate other alternative management regimes that affect oak seedling survival. Future work should include comparisons with sub-soiling and herbicides in combination with rotary mowing.

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