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HOW ARE INVESTMENT RETURNS AFFECTED BY COMPETITION CONTROL AND SOUTHERN OAK SEEDLING SURVIVAL?

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Abstract—Increasing numbers of landowners are establishing hardwood plantations to satisfy their management objectives. Despite a dearth of research on competition control and its effects on initial hardwood plantation survival and investment returns, this study examines alternative competition control regimes for southern oak establishment. The analysis includes estimates of land expectation value for comparing alternatives. Our results suggest that greater returns can be achieved for southern oaks during both good and bad rainfall years, using methods that maximize survival through 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. 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 focused 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) and Niese and Strong (1992). Studies relevant to this one include Hoover and Vasievich (1989) and Ezell and Bullard (1997). However, few studies have examined hardwood seedling survival and the impacts of different regeneration practices on investment returns. Regeneration studies include Steiner (1987) and Bullard and others (1992).

In general, these studies indicate that little has been done to evaluate the importance of competition 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) indicated 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 focused on competition control and its impact on first year survival of oak seedlings. Three different management practices were compared and their impacts on seedling survival and investment returns evaluated. A no site-preparation treatment was compared to those that included disking only and herbicides only. Seedling survival information was obtained from various published and unpublished sources that apply to oak stands on abandoned agricultural fields in the South.

METHODS

This study compared a base case and two alternative management regimes for controlling vegetation during stand establishment. Land Expectation Value (LEV) on an 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 mid-South. Land expectation value models were developed on an after-tax basis. Three alternative management scenarios were also evaluated by competition control techniques and weather conditions.

The landowner was assumed to be an "investor" under the passive loss rules, who expected to generate an eventual profit from the sale of timber. The initial afforestation investment was 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 was assumed to exclude all cost-share payments from income, thereby avoiding payment of income tax and

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self-employment tax. Exclusion of income was 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 was conducted on a per-acre basis, the landowner was also assumed to have total afforestation expenses under $10,000 per year, which allows amortization of 95 percent of expenses not covered by the cost-share program.

Model Development

The after-tax analysis was conducted for comparative purposes; we followed Bullard and Straka (1998) where revenues, costs and the discount rate were 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 was one where a cost was deducted in its entirety in the year in which the cost occured. 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 was reduced by one-half the federal investment tax credit taken.

We assumed the landowner received 50 percent cost share from a government program to establish their oak plantations, although it is not uncommon to see 40 percent 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 was to convert the discount rate to an after-tax rate. We followed a procedure suggested by Bullard and Gunter (2000) which used an inflation rate. We assumed inflation to be 2.5 percent. Once all after-tax conversions were made, converted monies were discounted across time to calculate the after-tax land expectation value for each scenario. State income taxes were not considered in this analysis; the results were 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 were 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 were defined as below normal rainfall levels for the same time periods. In addition, we examined returns with and without re-plantings. Re-plantings were assumed to occur when seedling survival after 1 year was less than 50 percent of the original planting. An assumption made with regard to survival was 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 percent survival of planted seedlings was expected. A lower survival rate of 30 percent was expected for poor rainfall years. In addition to these differing weather conditions, this regime included a re-planting scenario.

Alternative 1: Disking only—This model incorporated site preparation, consisting of disking only, with seedlings hand-planted directly into old fields. During good weather conditions with adequate rainfall, 62.5 percent survival of planted seedlings was expected. A lower survival rate of 35 percent was expected for low rainfall years. In addition to these differing weather conditions, this regime included a re-planting scenario.

Alternative 2: Herbicides only—This model employed site preparation consisting of spraying herbicides with seedlings hand-planted directly into old fields. During good weather conditions with adequate rainfall, 85 percent survival of planted seedlings was expected. A lower survival rate of 70 percent was expected for low rainfall years.

DATA

Forest land managers have recognized the importance of competition control in pine survival and growth. A regional study established that grass and herbaceous broadleaf plants are the most serious competitors during the first 5 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* Marsh.), Ezell and Catchot (1997) found survival was increased 15-20 percent 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 percent, 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 percent range for Nuttall (*Q. nuttallii* Palmer) and cherrybark oak (*Q. pagoda* Raf.) while survival in the untreated areas ranged from 0 to 43 percent (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 the mid-South, this study used observational information for mixed oak stands on abandoned agricultural lands. Our approach was similar to the one used by Ezell and Bullard (1997). Although our analysis was concerned with returns from oak plantations, the yield estimates for mixed oak natural stands served as a basis for utilizing our estimated returns as a worst case scenario. Therefore, land expectation values presented in this paper were considered conservative estimates for the different types of vegetation controls implemented to improve seedling survival. We feel that this assumption was appropriate because plantations were assumed to be managed in a more intensive manner resulting in greater growth and yield.

Our models assumed that on a per acre basis, oaks will start to accumulate 350 board feet Doyle per year at age 25, and final harvest will be at age 50, leading to the accumulation of 8,050 board feet of volume per acre. In addition, we assumed one thinning at age 35 will yield 5 cords and 2,000 board feet Doyle per acre, and that 10 cords per acre will be cut during final harvest along with the 8,050 board feet 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 published and unpublished sources. In this analysis, a 6 percent real discount rate was used. Average costs per acre per activity in 2002 are reported in table 1.

Table 1—Average cost per acre by activity for Mississippi in 2002

Activity	$ per acre
Herbicide application	35
Disking	20
Seedlings[a]	109
Hand planting	47
Land use tax[b]	2
Annual management fees	2

[a] Seedling price is $0.25 per seedling and 435 seedlings planted per acre.
[b] Average per acre land-use tax for forest land in the Mid-South is approximately $2.

Price and Revenue Information

The price data used to compute harvest values were taken from Timber Mart South for 2002. In addition, it was assumed that landowners would be able to lease their land for fee hunting purposes at an average of $5.50 per acre per year. This is consistent with Jones and others (2001). Table 2 summarizes this information.

Table 2—Price and revenue information for standing timber and fee hunting in 2002

Species	Prices
Oak sawtimber	$302.00 per MBF Doyle
Hardwood pulpwood	$13.74 per cord
Hunting leases	$5.50 per acre per 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 after-tax results for the base case and alternative management regimes. For the base case during good rainfall years, expected stand establishment was better than in bad rainfall years, despite no control for competing competition. This results in a $165.21 difference in after-tax LEV between good and bad rainfall years. The after-tax LEV difference between disking and herbicide use and the no site preparation was $8.35 and $117.17 for good rainfall years and $11.17 and $193.81 for bad rainfall years.

Table 3—After-tax LEV per acre results for alternative management regimes

	No site preparation	Disking only	Herbicides only
	- - - - - - - - - -	-*dollars*-	- - - - - - - - -
Good rainfall year	185.45	193.79	302.62
Bad rainfall year	20.24	31.41	214.05

DISCUSSION

In general, greater vegetation control had an impact on an 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 incentive programs and prices.

An important issue 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 percent 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 8 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 to 2 percent 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 affected investment returns for oak plantations. The analytical approach utilized 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.

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