Tradeoffs in Loblolly Pine Plantation and White-Tailed Deer Management in the Middle Coastal Plain[1]

by

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Abstract

Silvicultural applications focus on timber production, habitat production, or a combination of both. Thinning, prescribed burning, and herbicide applications are common silvicultural applications used on loblolly pine (Pinus taeda) plantations in the southern United States. The tradeoffs associated with multiple-use management focusing on the production of white-tailed deer (Odocoileus virginianus) habitat in Mississippi's Middle Coastal Plain using thinning, prescribed burning, and herbicide applications on loblolly pine plantations are examined from an ecological and monetary standpoint. Thinning and prescribed fire favorably impact the quality and quantity of available browse for white-tailed deer. Increased intensities of thinning and prescribed burning, above levels needed to maximize timber production, further increase the amount of quality habitat available. Some herbicide applications may also increase levels of quality deer browse available. The Land Expectation Value (LEV) of pine plantations managed at this level may be decreased if only costs and timber revenues are considered. However, a decrease in available lands managed intensively for white-tailed deer habitat offers opportunities for increased lease payments for managers controlling such lands. When LEVs were calculated using American Cyanamid Optimal Reforestation Manager (ACORM™), compensatory lease payments ranged from $0.00 to $24.75 per acre, depending on the site index and discount rate chosen. When LEVs were derived using Cutover Loblolly Plantation Model (MSUGY©), compensatory lease payments ranged from $0.00 to $7.15 per acre, depending on the site index and discount rate chosen. Studies concerning lease payments in Mississippi reveal that realized lease payments on a per acre basis are more comparable to those compensatory lease payments suggested by MSUGY. Lease payments, when included in LEV calculations, will offset to some degree losses in timber revenue.

INTRODUCTION

Historically, production of commodity products has been the primary goal of forest management. Sawlogs, peeler logs, pulpwood, poles, and piling are examples of primary commercial forest products. These outputs are traded in the marketplace and valued in dollars. Forests also provide traditional, non-market outputs such as clean air and water, recreation, and game and non-game wildlife.

Foresters, particularly public land foresters, actively manage forestlands for the production and consumption of many products besides timber. This practice is commonly referred to as multiple-use management. Non-industrial private forest landowners are increasingly turning to this type of management for their land holdings. Individual landowners need information concerning qualitative and quantitative impacts associated with multiple-use management.

Multiple-use management requires trade-offs between competing forest uses (Ripley and Buffington 1974). Forest landowners have been led to believe that these tradeoffs, namely the improvement of wildlife habitat, will adversely affect timber output and, therefore, profit maximization. Forest managers have been led to make decisions oriented toward maximizing profits inasmuch as tradition has led them to believe that wildlife habitat enhancement can only be achieved at the expense of timber production (McKee et al.1983).

Managing land for timber flow and wildlife populations presents a number of challenges for foresters. Wildlife has ecologic, aesthetic, recreational, and monetary benefits and values. In the southeastern United States, maintaining adequate habitat requirements for such species as white-tailed deer (Odocoileus virginianus), eastern wild turkey (Meleagris gallapavo silvestris), northern bobwhite quail (Colinus virginiana), and migratory game birds is a major concern for land managers (McArthur

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1997). This study focuses on the monetary and ecologic trade-offs between timber outputs and habitat outputs for white-tailed deer. Silvicultural tools considered include thinning, prescribed burning, and herbicide applications. These applications are commonly used in the southeastern United States. A more detailed version of this study can be found in Carley (1999).

OBJECTIVES

The primary objective of this study is to provide landowners with up-to-date information on the potential monetary value of their timberland investments. Recent increases in pine stumpage prices, advancements in herbicide technologies, and a decreased supply of lands available for hunting leases warrant this current investigation.

DESCRIPTION OF STUDY AREA

This study will be confined to the Middle Coastal Plain province, which encompasses approximately 6.5 million acres in southern Mississippi. The Middle Coastal Plain is formed from marine and fluvial sediments. Relatively gentle topography, high sand composition, and a warm, wet climate characterize the Middle Coastal Plain (Hodgkins et al. 1979). The region is bounded to the west by the deep loess province, to the north by the upper or hilly coastal plain, and to the south by the coastal flatwoods. The western boundary of Alabama forms the eastern boundary of that portion of the Middle Coastal Plain found in Mississippi. The average frost-free period across the Middle Coastal Plain ranges from 230 to 270 days, and the province receives 55 to 60 inches of rain per year (Pettry 1977). The Middle Coastal Plain province can be divided into four major sub-regions: the Southern Loam Hills, the Southern Clay Hills, Major Floodplains, and Minor Floodplains (Hodgkins et al. 1979).

METHODS

Land Expectation Values (LEV) were calculated for three hypothetical sites typical to the Middle Coastal Plain.

$$\text{LEV} = a / [(1 + i)^n - 1]$$

where:

a = net value received every n years in perpetuity,
n = years between annuity payments, and
i = interest rate, expressed as a decimal percent.

LEV formulas make several critical assumptions (Straka and Bullard 1996). First, the values of all costs and revenues are identical for all rotations. Second, all costs and revenues are compounded to the end of the rotation to get the future value of one rotation. This value will be the amount received every *n* years. Third, the land will forever be forested. Last, regeneration costs must be considered at the beginning of each rotation. Land value does not enter into the calculation, because land value is being derived from this procedure.

LEVs for each scenario were calculated using real, before-tax discount rates of 5, 7, and 9 percent. These rates were chosen because they cover the variability experienced in historical real rates of return. Inflation was assumed to be zero, and no real increases in stumpage prices were assumed. Stumpage prices were chosen to reflect actual prices paid to landowners in the study area during the winter of 1998. The prices chosen for pine sawtimber, chip-n-saw, and pulpwood were $450 per MBF Doyle, $95 per standard cord, and $30 per standard cord, respectively (Daniels 1999). Administration costs were assumed to be $3.00 per acre per year (Watkins and Munn 1998). All stands were assumed to be established using 605 trees per acre (Balmer and Williston 1974). For most situations in the South, spacings resulting in the planting of 600-700 seedlings per acre have advantages over closer spacings by lowering planting costs while providing similar levels of fiber production (Balmer and Williston 1974).

Three site indices were chosen to represent poor, average, and excellent production potential in the Middle Coastal Plain (Hodgkins et al. 1979). At a base age of 25 (50) years the chosen indices were 47 feet (75), 57 feet (90), and 67 feet (105).

Two growth and yield models were used to estimate LEVs. American Cyanamid Optimal Reforestation Manager (ACORM™) is a financial analysis software package used to evaluate the impact of herbicide applications on loblolly pine plantations. Herbicide application prescription, timing, and intensity was altered to contrast the LEVs of plantations managed solely for maximum wood production and plantations managed for increased habitat production. Comprehensive competition control was modeled using tank mixes, while habitat was enhanced using an Arsenal® (imazapyr) only application. ACORM allows users to choose soil types and competition characteristics. Sandy soils and competitive species such as blackberry were chosen to be included in the model to reflect typical Middle Coastal Plain habitats.

Cutover Loblolly Plantation Model© (MSUGY) is a growth and yield computer program used to illustrate the impacts of thinning on wood production and, consequently, LEV (Matney 1996). Thinning intensities were altered to contrast the LEVs of plantations managed solely for wood production and plantations managed for increased habitat production through thinning. Twenty-five percent row thinnings were used to model high levels of wood production while 50% row thinnings were used to enhance habitat. Prescribed burning was included in all scenarios.

A compensatory lease rate was calculated in all cases for both models. These yearly lease payments, on a per acre basis, represent the dollar amount that a landowner would have to realize in perpetuity to fully compensate for revenues lost to habitat production.

RESULTS

Estimated Land Expectation Values as calculated by ACORM and derived from MSUGY are presented in Tables 1-6. Maximum LEVs represent one acre managed to maximize Net Present Value without any consideration for habitat improvement. Multiple-use LEVs represent one acre managed to enhance habitat quality and quantity. Compensatory Lease Payments indicate the perpetual yearly revenue a landowner would have to receive from sources such as hunting leases to fully compensate for timber revenues forgone to produce better wildlife habitat.

Tables 1-3 summarize the ACORM outputs. The presence of zero ($0) indicates that, at the described hypothetical discount rate and/or site index, timber production does not have a positive net present value.

Table 1. Estimated LEV per acre using ACORM™ with a 5% discount rate

	Site Index, Base Age 25 (50)		
	47(75)	**57(90)**	**67(105)**
Maximum LEV	$390	$1,336	$2,064
Multiple-use LEV	$292	$880	$1,569
Compensatory Lease Payment	$4.90	$22.80	$24.75

Table 2. Estimated LEV per acre using ACORM™ with a 7% discount rate

	Site Index, Base Age 25 (50)		
	47(75)	**57(90)**	**67(105)**
Maximum LEV	$79	$619	$1,007
Multiple-use LEV	$47	$374	$741
Compensatory Lease Payment	$2.24	$17.15	$18.62

Table 3. Estimated LEV per acre using ACORM™ with a 9% discount rate

	Site Index, Base Age 25 (50)		
	47(75)	**57(90)**	**67(105)**
Maximum LEV	$0	$274	$506
Multiple-use LEV	$0	$137	$356
Compensatory Lease Payment	$0.00	$12.33	$13.50

Tables 4-6 summarize the LEV outputs based on MSUGY. Stand and stock tables from MSUGY outputs give thinning and final harvest yields. These yields were used to derive LEVs. The presence of zero ($0) indicates that, at the described hypothetical discount rate and/or site index, timber production does not have a positive net present value.

Table 4. Estimated LEV per acre using MSUGY© with a 5% discount rate

	Site Index, Base Age 25 (50)		
	47(75)	**57(90)**	**67(105)**
Maximum LEV	$268	$502	$774
Multiple-use LEV	$195	$394	$631
Compensatory Lease Payment	$3.65	$5.40	$7.15

Table 5. Estimated LEV per acre using MSUGY© with a 7% discount rate

	Site Index, Base Age 25 (50)		
	47(75)	**57(90)**	**67(105)**
Maximum LEV	$81	$211	$368
Multiple-use LEV	$51	$165	$305
Compensatory Lease Payment	$2.10	$3.22	$4.41

Table 6. Estimated LEV per acre using MSUGY© with a 9% discount rate

	Site Index, Base Age 25 (50)		
	47(75)	**57(90)**	**67(105)**
Maximum LEV	$0	$71	$169
Multiple-use LEV	$0	$52	$142
Compensatory Lease Payment	$0.00	$1.71	$2.43

DISCUSSION

Land Expectation Values are maximized with intensive silvicultural applications. Under all parameter combinations (i.e., discount rate and site index combinations), intensive silvicultural applications produced higher LEVs than regimes that improved habitat. Using ACORM, maximum LEVs ranged from $0 to $2,064/acre, while multiple-use LEVs ranged from $0 to $1,569/acre under identical circumstances. Herbicide mixtures used to control all competing vegetation maximize LEVs because of increased wood production, but severely decrease habitat quality. Using MSUGY, maximum LEVs ranged from $0 to $714/acre, while multiple-use LEVs ranged from $0 to $571/acre under identical circumstances. Applications of light thinnings will generate higher levels of wood flow, and thus higher LEVs, but will decrease habitat quality when compared to heavier thinnings.

General trends can be identified through analysis of the growth and yield results derived from ACORM and MSUGY. As site index increases, LEVs increase, all else constant. ACORM suggests increasing per acre LEV ranges from $0 to $390, $274 to $1,336, and $506 to $2,064 for site indices 47, 57, and 67, respectively. MSUGY suggests increasing per acre LEV ranges from $0 to $208, $38 to $442, and $136 to $714 for site indices 47, 57, and 67, respectively. As interest rates increase, LEVs decrease, all else constant. ACORM suggests decreasing per acre LEV ranges from $390 to $2,064, $79 to $1,007, and $0 to $506 for discount rates 5%, 7%, and 9%, respectively. MSUGY suggests decreasing per acre LEV ranges from $208 to $714, $38 to $325, and $0 to $136 for discount rates of 5%, 7%, and 9%, respectively. As site index increases, habitat production becomes increasingly costly. ACORM suggests that using a 5% discount rate, compensatory lease payments increased from $4.90 to $24.75 as site index increased from 47 to 67. As interest rates increase, habitat production becomes increasingly affordable. Higher interest rates decrease the present value of future cash flows. This means that the opportunity costs of lost revenues to habitat production are lower at higher interest rates than at lower interest rates. MSUGY suggests that at site index 57, compensatory lease payments decreased from $5.40 to $1.71 as the discount was raised from 5% to 9%.

The range of suggested LEVs for all site indices and discount rates ranges from 0$ to $2,064. Actual per acre prices paid for bare land fall within this range within the Middle Coastal Plain, though prices paid are influenced by many factors other than potential timber production and habitat quality.

Discrepancies exist between the estimations of Land Expectation Values derived with ACORM and MSUGY. ACORM suggests that if a landowner requires a 5% real rate of return and can buy site index 57 acreage, they should be willing to pay $1,336 per acre if timber production is to be maximized. Under the same conditions, MSUGY suggests that only $442 could be paid. ACORM and MSUGY suggested per acre compensatory lease payments ranging from $0.00 to $24.75 and $0.00 to $7.15, respectively. Jones et al. (1998) found that in Mississippi, realized lease payments on a per acre basis are more comparable to those compensatory lease payments suggested by MSUGY.

Differences in the purpose and intended use of ACORM and MSUGY exaggerate their differences in production estimates. American Cyanamid, a chemical sales company, distributes ACORM. Its purpose is to encourage the purchase and use of American Cyanamid chemicals such as Arsenal. Growth and yield projections yield relatively high LEVs (Bullard and Honea 1997). This creates a seemingly impressive impact on plantation production when those chemicals are used. In contrast, MSUGY was created by an educational institution, Mississippi State University. The data used to create MSUGY is relatively old and was compiled from young plantations, most less than ten years of age. Therefore, its primary use is growth and yield estimation in plantations up to ten years of age.

ACORM was used to model different intensities of herbicide applications, while MSUGY was used to model different thinning regimes. When using ACORM, herbicide applications that most effectively controlled all competing vegetation were used when LEV was to be maximized. This was accomplished through the use of tank mixes. On the other hand, the use of Arsenal alone theoretically allows blackberry, as well as many legumes, to coexist with crop trees within the plantation. This increased competition decreases the production of the plantation but also increases the available browse produced within the plantation. When using MSUGY, LEVs were maximized when row thins were performed at a 25% intensity. When intensities were increased to 50%, plantation production decreased while browse production would theoretically increase.

The consideration of tax credits and tax costs was left out of this analysis for simplicity's sake. Generally speaking, Land Expectation Values are higher when taxes are considered than when tax consideration is omitted. Compounding impacts the benefits received from income tax breaks for regeneration costs during the early years of investments. This will have a larger effect on present value than taxes that must be paid from harvest revenues that occur at the end of the rotation.

CONCLUSIONS

Land managers should consider monetary and ecologic issues when applying silvicultural tools. In some situations, lease payments may increase due to increased habitat quality. This may be due to increased opportunities for quality hunting experiences on those lands with increased habitat quality. Silvicultural applications that increase habitat quality and quantity may be monetarily justified in those situations. When LEVs were calculated using ACORM, compensatory lease payments ranged from $0.00 to $24.75 per acre, depending on the site index and discount rate chosen. When LEVs were derived using MSUGY, compensatory lease payments ranged from $0.00 to $7.15 per acre, depending on the site index and discount rate chosen.

Certainly habitat production should be a priority when ecologic impacts are considered. As stewards of the land, managers must make decisions based on factors other than financial considerations.

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