

## Evaluating Forest Management Intensity Among Major Landowner Groups In Mississippi: A Preliminary Analysis<sup>1</sup>

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**Abstract:** Timberlands in Mississippi are owned by a diverse group of landowners: industrial owners, timberland investment management organizations (TIMOs), non-industrial private forest (NIPF) landowners, and public landowners. The objectives of each type vary, resulting in different management of their properties. This variation influences the intensity of their management and harvest decisions, which in turn affects timber inventory. This paper evaluates and compares forest management intensity of the different landowner groups in Mississippi by looking at forest management activities and expenditures. The results indicate that different landowner groups differ in the management of their timberlands. Industrial landowners and TIMOs have similar management characteristics and manage their lands more intensively than the State and NIPF landowners. Intensive forest management is significantly influenced by size of ownership, proportion of pine plantation, and type of ownership.

**Key Words:** NIPF landowners, TIMOs, industrial landowners

### INTRODUCTION

As international and national demand for timber expands, southern U. S. forests are becoming an increasingly important source of timber. The decline in available timber inventory in the western U.S., due to federal and state regulations that have restricted harvests, has shifted a large portion of the United States demand for softwoods to the South. Thus, forest landowners in this region hold the key to the nation's supply of timber and intensive management of these forestlands will help meet this growing demand.

Intensive management has become an important aspect of forest management, especially on private timberlands. Improving timber markets and increasing timber prices make intensive management a profitable investment for landowners (Cubbage et al. 2002). Intensive forest management relies heavily on plantation establishment and is capital-intensive. It requires considerable capital investment in site preparation and planting (Guldin and Wigley 1998). Landowners engage in intensive forest management because of its productivity and economic advantages. With intensive management, return on investment is usually higher than with conventional forest management (Shiver 1998).

Timberlands in Mississippi are owned by a diverse group of landowners who have different objectives. Forest ownership objectives dictate the nature and intensity of forest management activities. Forest ownership in the United States is broadly categorized as publicly-owned and privately-owned. Public forestlands are under federal, state, county, municipal, and other local

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governmental ownership. Private forestlands are under the ownership of industrial and non-industrial landowners.

The study focuses primarily on private landowners because they control almost 70% of the total timberlands in the South (Powell et al. 1994). Therefore, they play a vital role in the long-term sustainability of the nation's timberlands. The amount and quality of timber outputs depend largely on how private timberlands are managed by these landowners (Alig and Wear 1992). Private landowners comprise a heterogeneous group that includes (1) industrial owners, (2) timberland investment management organizations (TIMOs), and (3) non-industrial private forest (NIPF) landowners. The objectives of each type vary, resulting in different management of their properties. This variation influences the intensity of their management and harvest decisions, which in turn affect timber inventory.

Despite the general recognition of differences in objectives among private landowners, little has been done to quantify and evaluate differences in management or investment (Newman and Wear 1993). A recent study enumerated the management activities and expenditures for TIMOs and industrial landowners (Rogers 2001). Similar information on NIPF landowners was collected for this study. Thus, necessary data are available to quantify the differences in management between these landowners.

This paper presents a preliminary analysis of the forest management intensity of different landowners groups in Mississippi. It compares forest management intensity of different landowner groups in Mississippi by examining their forest management activities and expenditures. Expenditure information indicates landowners' willingness to invest in timber production. A measure of landowners' capital investment in various silvicultural activities can be used in assessing forest management intensity level. Specifically, intensive forest management is associated with silvicultural practices such as site preparation, fertilization, planting and intermediate treatments. Greater application rates of these activities indicate more intensive management. All else equal, increasing levels of expenditures suggest increasing management intensity. This paper also examines the factors affecting intensive management in Mississippi timberlands.

## ***Methodology***

### **Data**

NIPF data was obtained from annual mail surveys conducted by the Social Science Research Center, Mississippi State University that addressed the annual forest management activities and expenditures of NIPF landowners in Mississippi. Rogers (2001) obtained similar information for industrial landowners and TIMOs in Mississippi.

These data sets contain information about the expenditures of private landowners on the different forest management activities as well as the number of acres treated for each activity in 1998 and 1999. Specifically, the data from these surveys include information on capital expenditures for mechanical site preparation, chemical site preparation, site preparation burning, fertilization, regeneration (planting), natural regeneration, road construction, and other capital expenditures; expensed cost items such as timber management costs, routine or on-going expenses, and fees for professional services; timber sale expenses; and hunting/wildlife management revenues and expenses. The data sets also contain information on ownership size, forest composition and timber harvest information.

Similar information was also obtained from public forest ownerships by Bonds (2002) and was used in this study. Specifically, expenditures data on Mississippi's 16th section lands

that are classified as forestland were collected. These are lands set aside by the State to generate revenues for Mississippi's public schools. The Mississippi Forestry Commission (MFC) has been mandated to manage these school trust (16th section) forestlands.

### *Methods*

Expenditures per acre owned on major categories of silvicultural activities were computed and compared among different landowner groups. T-tests were computed to test for significant differences between landowner groups using SAS<sup>®</sup> software.

A model was developed to examine factors that may account for differences in management behavior of the different landowner groups. Specifically, total silvicultural expenditures were modeled as a function of ownership type, ownership size, and forest composition (e.g., proportion of plantation pine).

Due to some differences in the nature of data collected from private and public landowners, two separate models were developed. The first model examined the factors related to intensive forest management among the private landowner groups only and the second model included both the private and public landowners. The first model was specified as:

$$\text{LNSILVI} = B_0 + B_1\text{PPINE} + B_2\text{LNACRE} + B_3(\text{TIMO}*\text{LNACRE}) + B_4(\text{INDU}*\text{LNACRE}) + \varepsilon$$

Where: LNSILVI = natural log of silvicultural expenditures per acre owned (\$/ac)  
 PPINE = proportion of pine plantation  
 LNACRE = natural log of total acres owned  
 TIMO = dummy variable for ownership type  
           = 1 if TIMOs, 0 otherwise  
 INDU = dummy variable for ownership type  
           = 1 if industrial, 0 otherwise  
 ε = error term

The model for both the private and public landowners was specified as:

$$\text{LNSILVI} = B_0 + B_1\text{LNACRE} + B_2(\text{TIMO}*\text{LNACRE}) + B_3(\text{INDU}*\text{LNACRE}) + B_4(\text{NIPF}*\text{LNACRE}) + \varepsilon$$

Where: LNSILVI = natural log of silvicultural expenditures per acre owned (\$/ac)  
 LNACRE = natural log of total acres owned  
 TIMO = dummy variable for ownership type

	= 1 if TIMOs, 0 otherwise
INDU	= dummy variable for ownership type = 1 if industrial, 0 otherwise
NIPF	= dummy variable for ownership type = 1 if NIPF, 0 otherwise
$\varepsilon$	= error term

The dependent variable was expressed in natural logarithm form to improve functional relationships and to correct for heteroskedasticity.

Proportion of pine plantation (PPINE) was included in first model to account for the impacts of forest type on how landowners manage their lands. The subdivision of timberland among different forest types is important from a timber production standpoint (Alig and Wear 1992) because differences exist in terms of productivity between types. This variable was not included in the private and public landowner model because information on the forest composition of the State's 16th section lands was not available.

To account for the impact of timberland ownership size on management intensity, the natural logarithm of ownership size (LNACRE) was included in both models. Previous studies have shown that ownership size is a key determinant of forest management investment among landowners (e.g., Webster and Stoltenberg 1959; Straka 1985; Hyberg and Holthausen 1989).

The interaction terms in both models (i.e. acres owned nested in ownership type) represent the influence of size of ownership on silvicultural expenses within each landowner type, and thus, examines how each landowner type differs in terms of their responses to ownership size. The dummy variable for NIPF landowner category was excluded from the first model and the State dummy from the second model. Therefore, the estimated coefficient for the variable LNACRE represents the rate at which expenditures per acre owned change with the amount of acres owned for NIPF landowners. Similarly, the coefficient for LNACRE represents the rate for the State in the second model.

Initial inspection of the data showed that many landowners had no silvicultural expenses. In addition to examining the silvicultural spending of all the landowners in the sample, we also examined silvicultural spending of landowners who incurred expenses only. Therefore, the models were estimated in two ways: (1) using the full sample - including all landowners with zero and non-zero silvicultural expenses and (2) using the reduced sample - excluding landowners with zero silvicultural expenses. In all analyses, the 1998 and 1999 data sets were pooled because initial investigation showed that expenditures were not significantly different between the two years. The models were estimated using ordinary least squares regression (OLS).

## **Results**

### ***Private and Public Spending on Silvicultural Activities***

Silvicultural activities refer to those activities that directly contribute to the production of timber, either through enhancing timber growth or returns on timber sales. As such, these expenditures result in a direct return on investment. These include expenditures on site preparation, planting, and intermediate treatments. These are the activities that make up intensive forest management. There was a significant variation among the different landowner groups with respect to the amount of money invested in the different silvicultural activities (tables 1a and 1b). In general, industrial landowners and TIMOs spent more per acre owned on silvicultural activities than did State and NIPF landowners. Among the private landowner groups, TIMOs and industrial landowners had significantly higher spending on silvicultural activities compared to NIPF landowners, averaging \$11.03/ac-owned and \$13.32/ac-owned, respectively. NIPF landowners averaged \$3.83/ac-owned for silvicultural activities. The State spent an average of \$1.56/ac-owned on silvicultural activities. Intermediate treatments accounted for almost half of this total, averaging 0.78/ac-owned.

These results provide evidence regarding the hypothesis that landowner groups manage their lands differently as different management objectives are pursued. Because the primary objective of industrial landowners and TIMOs for owning timberland is to maximize profit through returns from timber production, they manage their lands more intensively as shown by their significantly higher investment per acre owned in intensive forestry activities. Intensive forest management results in higher timber productivity, which translates to higher profits. In the South, TIMOs and industrial holdings are the most intensively managed timberlands and intensity of management has increased dramatically for these groups (Siry 2002).

Management intensity is less pronounced in the State and NIPF land holdings. This behavior is not surprising in the case of NIPF landowners. Previous studies have shown that timberlands under the ownership of NIPF landowners are often managed less intensively (see Adams et al. 1992, Kurtz et al. 1993). While timber production can be one objective of

**Table 1a. Silvicultural expenses per acre owned of the private and public landowners in Mississippi (Full sample), 1998-1999.**

Activities	Landowner Groups			
	Industrial (n=31)	TIMO (n=10)	NIPF (n=1,035)	State (n=174)
	\$/ac-owned			
<b>Site Preparation</b>	5.05 <sup>a</sup>	6.53 <sup>a</sup>	2.02 <sup>b</sup>	0.78 <sup>c</sup>
Mechanical treatments	1.35 <sup>a</sup>	2.70 <sup>b</sup>	0.74 <sup>c</sup>	0.17 <sup>d</sup>
Chemical treatments	2.22 <sup>a</sup>	1.57 <sup>a</sup>	1.15 <sup>b</sup>	0.50 <sup>c</sup>
Burning	0.29 <sup>a</sup>	0.19 <sup>a</sup>	0.08 <sup>b</sup>	0.10 <sup>b</sup>
Fertilization	1.19 <sup>a</sup>	2.08 <sup>a</sup>	0.06 <sup>b</sup>	-
<b>Planting</b>	2.07 <sup>a</sup>	2.04 <sup>a</sup>	1.52 <sup>b</sup>	0.39 <sup>c</sup>
<b>Intermediate Treatments</b>	3.91 <sup>a</sup>	4.75 <sup>a</sup>	0.31 <sup>b</sup>	0.39 <sup>b</sup>
<b>Total</b>	11.03 <sup>a</sup>	13.32 <sup>a</sup>	3.83 <sup>b</sup>	1.56 <sup>b</sup>

Note: Means in a given row that have the same letter are not significantly different from each other at  $\alpha=0.10$ .

**Table 1b. Silvicultural expenses per acre owned of the private and public landowners in Mississippi (Excluding landowners with zero silvicultural expenses), 1998-1999.**

Activities	Landowner Groups			
	Industrial	TIMO	NIPF	State
	\$/ac-owned			
<b>Site Preparation</b>	5.15 <sup>a</sup> (n=20)	6.53 <sup>a</sup> (n=10)	7.23 <sup>a</sup> (n=92)	1.45 <sup>c</sup> (n=82)
Mechanical treatments	1.46 <sup>a</sup> (n=14)	2.70 <sup>a</sup> (n=10)	9.93 <sup>b</sup> (n=34)	1.54 <sup>a</sup> (n=13)
Chemical treatments	2.31 <sup>a</sup> (n=17)	2.08 <sup>a</sup> (n=7)	5.28 <sup>b</sup> (n=48)	2.15 <sup>a</sup> (n=32)
Burning	0.32 <sup>a</sup> (n=13)	0.26 <sup>a</sup> (n=7)	0.69 <sup>a</sup> (n=33)	0.25 <sup>a</sup> (n=67)
Fertilization	1.58 <sup>a</sup> (n=7)	2.85 <sup>a</sup> (n=6)	2.78 <sup>a</sup> (n=15)	-
<b>Planting</b>	2.08 <sup>a</sup> (n=21)	2.07 <sup>a</sup> (n=9)	5.19 <sup>b</sup> (n=105)	0.91 <sup>c</sup> (n=56)
<b>Intermediate Treatments</b>	4.16 <sup>a</sup> (n=13)	4.75 <sup>a</sup> (n=10)	3.51 <sup>a</sup> (n=36)	0.86 <sup>b</sup> (n=64)
<b>Total</b>	11.04 <sup>a</sup> (n=23)	13.72 <sup>a</sup> (n=10)	10.58 <sup>b</sup> (n=158)	2.13 <sup>c</sup> (n=109)

Note: Means in a given row that have the same letter are not significantly different from each other at  $\alpha=0.10$ .

ownership, this may not often be the case. The objectives of NIPF landowners are more much complex considering that this landowner group is made up of a very heterogeneous group of individuals. In most cases, low management intensity is still the rule for many of these landowners. While intensive management may be accepted by the relatively few landowners whose primary goal is maximization of timber revenues (Porterfield and Moak 1977), this is not true for most of the landowners. As mentioned earlier, these landowners are much less uniform and more complex in their approaches to forest management as they pursue multiple objectives. They can be very intensive in their management like the TIMOs and industrial landowners or they can completely disregard forest management. "Doing nothing" may be thought to be both practical and cost effective by many of these landowners (Wicker 2002). Some of these landowners may perceive intensive forest management to be in conflict with recreation opportunities, scenic viewing, wildlife habitat and with other non-timber objectives. Landowners who value non-timber amenities are less likely to manage their timberlands intensively if it reduces these uses (Siry 2002).

The State's 16th section forest lands are mandated to be managed exclusively to generate revenue for Mississippi's public schools. This study suggests that the State's 16<sup>th</sup> section forest lands are managed less intensively compared to TIMOs and industrial lands. The Mississippi Forestry Commission has little incentive to manage these lands intensively because earnings from timber harvest go directly to the district school boards as public school funds. Only 15% of the timber receipts are placed in an escrow fund to cover the actual cost of forest management (MS Code, Sec. 29-3-47). The Commission may therefore be constrained by this escrow fund allocated by the school boards. While the Commission makes management recommendations for these lands, the district school boards make the final decision as to what activities can be performed.

### **Factors Affecting Forest Management Intensity**

Landowner groups differed in their investment in silvicultural practices, with the TIMOs and industrial landowners managing more intensively compared to the non-industrial and State landowners. Factors accounting for these differences were evaluated using ordinary least squares regressions.

In model 1, the proportion of plantation pine (PPINE) was highly significant and positively related to silvicultural expenses, indicating that the proportion of plantation pine is an important factor influencing silvicultural expenses (table 2). Higher proportion of plantation pines leads to higher silvicultural spending per acre owned. This suggests that there are greater opportunities for intensive management as the proportion of pine plantation increases. Siry (2002) also reported that intensive forest management is commonly associated with pine plantations. Total acres owned (LNACRE) and the associated ownership interaction terms were also significant and positively related to silvicultural expenses. These variables represent the influence of ownership size on silvicultural expenses within each landowner group. Looking at the full sample (i.e. including those with zero expenditures), there is a tendency to invest more in intensive forestry activities as size of holdings increases for all landowner groups. Large operations invest more in silvicultural activities per acre owned. Previous studies have shown that ownership size is a significant factor that influences landowners' forest management decisions (Greene and Blatner 1986, Hyberg and Holthausen 1989, Birch 1997). Holmes (1986) found a positive relationship between ownership size and the rate of application of intermediate

treatment activities. Landowners with smaller holdings are less likely to invest in these activities because fewer management options are available in smaller tracts.

Table 2. Regression analysis results for the full sample (standard errors in parenthesis)

<b>Dependent Variable - natural log of silvicultural expenses per acre owned</b>		
<b>Variables</b>	<b>OLS Estimates</b>	
	<b>Model 1</b> (n=1,076)	<b>Model 2</b> (n=1,250)
Constant	-0.51** (0.12)	-0.49** (0.12)
PPINE	0.70** (0.09)	-
LNACRE	0.15** (0.03)	0.13** (0.02)
TIMO*LNACRE	0.09** (0.03)	0.14** (0.03)
INDU*LNACRE	0.04** (0.02)	0.09** (0.02)
NIPF*LNACRE	-	0.05** (0.01)
<b>R<sup>2</sup></b>	0.17	0.12
<b>F-stat</b>	56.07	41.97

\*\*significant at  $\alpha=0.01$

Model 1 - Private landowners only

Model 2 - Private landowners and State

The model including State ownerships (model 2) was statistically significant as were all the variables in the model. All the variables were positively related to silvicultural expenses. These variables explain the influence of size of holdings on silvicultural expenses within each landowner type. As with the previous regression, these results indicate that landowners with larger holdings tend to invest more per acre owned on silvicultural activities. This is true for all the landowner groups. The sign of the coefficients indicates that the TIMOs and industrial landowners tend to spend increasingly more as size of holdings increases compared to NIPF landowners and the State.

Table 3 presents regression results for landowners who spent money on silvicultural activities. Landowners who incurred no silvicultural expenditures were therefore excluded from the sample. The proportion of pine plantation and size of ownership are important factors influencing silvicultural expenses for landowners incurring silvicultural expenses. Proportion of pine plantation was significant and positively related to silvicultural expenses. Ownership size was a significant determinant of silvicultural spending for all landowner groups but is inversely related to spending per acre owned in contrast to the model estimated using all landowners. As ownership size becomes larger, spending per acre decreases. This could be attributed to economies of scale. The relationship between ownership size and silvicultural spending is more pronounced among NIPF landowners compared to TIMOs and industrial landowners. This



difference is statistically significant when comparing NIPF landowners and TIMOs ( $F=13.46$ ,  $p=0.0003$ ) as well as NIPF landowners and industrial landowners ( $F=12.41$ ,  $p=0.0005$ ). However, the interaction terms for TIMOs and industrial landowners are not significantly different ( $F=0.34$ ,  $p=0.56$ ), which suggests that these two landowners might be behaving the same way. The effect of ownership size is less pronounced for both of these groups. One possible reason for this is that the scale of operation of these landowners might be sufficiently large that additional economies of scale are minimal. Therefore, the reduction in their average expenses as ownership size increases becomes less apparent.

**Table 3. Regression analysis results for the reduced sample (standard errors in parenthesis)**

<b>Dependent Variable - natural log of silvicultural expenses per acre owned</b>		
<b>Variables</b>	<b>OLS Estimates</b>	
	<b>Model 3</b> (n=191)	<b>Model 4</b> (n=300)
Constant	3.25** (0.33)	3.49** (0.29)
PPINE	0.92** (0.24)	–
LNACRE	-0.23** (0.06)	-0.31** (0.04)
TIMO*LNACRE	0.11** (0.04)	0.22** (0.03)
INDU*LNACRE	0.08** (0.03)	0.22** (0.03)
NIPF*LNACRE	–	0.19** (0.02)
<b>R<sup>2</sup></b>	0.11	0.39
<b>F-stat</b>	7.78	46.85

\*\*significant at  $\alpha=0.01$

Model 3 - Private landowners only

Model 4 - Private landowners and State

All the variables in model 4 (private and State) were significant and ownership size was inversely related to silvicultural expenses. These results also indicate that landowners with larger holdings tend to have lower per acre expenditures for silvicultural activities. This trend is true for all the landowner groups. The effect of ownership size is more pronounced for the State compared to the private landowner groups. For instance, a 1% increase in ownership size reduces spending by 0.31% for the State, 0.20% for the NIPF group, 0.12% for the industrial group, and 0.09% for the TIMOs. An F-test comparing the difference between the coefficients of the interaction terms for TIMOs and industrial landowners indicates that they are not statistically different ( $F=0.79$ ,  $p=0.37$ ).

#### **IV. Discussion**

The long-term sustainability of the nation's timberlands depends largely on the forest management activities of the different timberland landowner groups. Intensive management by these landowners is important in ensuring the adequate flow of wood in the nation's timber economy. However, these landowners are very heterogeneous and they exhibit different forest management behavior. This study provides evidence that landowner groups differ in the management of their timberlands. Industrial landowners and TIMOs have similar management characteristics. In general, these two landowner groups manage more intensively than the State and NIPF landowners. Industrial landowners use their timberlands to produce timber in order to support their wood-processing facilities. They consider their timberland as an important factor of production that is needed to achieve their primary goal of maximizing profit. While TIMOs do not produce timber to support wood processing facilities, they consider timber investment as one major component of their diversified portfolio and their main objective is also to maximize profit. NIPF landowners manage less intensively and differ significantly from TIMOs and industrial landowners. These landowners are very heterogeneous and therefore manage their lands less uniformly. Their actions are much more complex as they pursue multiple objectives. The Mississippi Forestry Commission also manages Mississippi's 16th section forest lands less intensively because its management decisions may be constrained by the escrow funds allocated by the school district boards.

The preliminary analyses presented in this study suggest that, in general, intensive forest management is influenced by size of ownership, proportion of plantation pine, and types of ownership. These factors only account for some of the differences in management intensity among the different landowner groups. While this study provided an important insight into the forest management behavior of the different landowner groups in Mississippi, future research should focus on classifying these landowners more definitively to provide more accurate information on the differences in their behavior. For instance, how nontimber benefits of forest management come into play when landowners make decisions to intensively manage their lands is an important question that warrants investigation. There is also a need to further investigate the functional relationships of the models presented in this study. The results of the regression models show that only a small proportion of the variation in management intensity is explained by the independent variables included in the model. Moreover, there might be a need to explore other models (e.g., Tobit regression) that are more appropriate when majority of the dependent variable have zero values, as the case in this study. These suggestions will be explored further as the study progresses.

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