

# FOREST MANAGEMENT INTENSITY OF NONINDUSTRIAL PRIVATE FOREST LANDOWNERS IN MISSISSIPPI: 1998-2006 DATA

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## Abstract

Mississippi's nonindustrial private forest (NIPF) landowners who owned at least 20 acres of forestland were surveyed annually from 1998 to 2006 to ascertain how intensively NIPF landowners managed their lands. Specifically, landowners were asked to report the number of acres treated and treatment costs for two broad categories of activities: (1) capital expenditures, which included site preparation, fertilization, regeneration, and road construction; and (2) expensed expenditures, which included property taxes, timber management costs, fees for professional services, routine expenses, hunting management costs and timber sale expenses. For each activity, the data were summarized in four ways: mean cost per acre treated; percentage of landowners engaged in the activity; mean cost per acre owned for all respondents and mean per acre owned for only those respondents who engaged in each activity. Analysis of variance (ANOVA) and regression analysis were used to study changes in forest management intensity over time. The results provided benchmark information on the costs and activities of NIPF landowners and can be particularly useful in the policy arena.

**Keywords:** NIPF landowners, forest management intensity, management expenditures, Mississippi

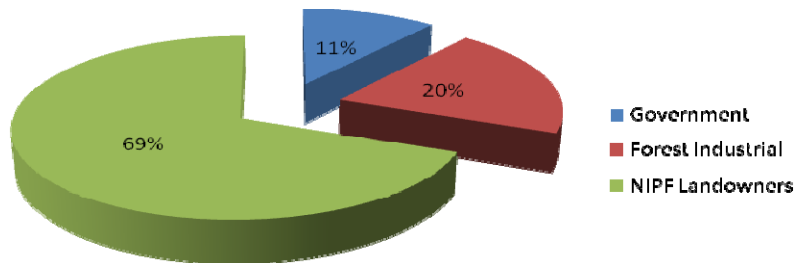
## Introduction

Forest landowners in the U.S. South play a vital role in satisfying the nation's increasing demand for timber. Growing international and national demands for timber, coupled with the decline in available timber inventory in the western U.S. due to federal and state regulations that restricted harvest, has shifted a large portion of the U.S. demand for softwood to the South (Arano et al. 2002). Southern forests supply half of the timber harvested in the U.S. and this share is rising (Smith et al. 2004). Accurate timber supply projections of southern areas are essential for policy and planning purposes in light of this increasing demand.

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Southern forests make up 28.7% of U.S. forestlands (Smith et al. 1999). Nearly 70% of these are owned by nonindustrial private forest (NIPF) landowners (Powell et al. 1994). Therefore, the accuracy of timber supply projections largely depends on assumptions made about NIPF landowner forest management behavior. The objectives and decisions of these landowners are critical to future timber supply. Forest management intensity and investment behavior by these landowners constitute major impacts on projected timber supply (Adams et al. 1982). In Mississippi, forests cover 18.6 million acres or 62 % of the state's land area and NIPF landowners own nearly 69% of these forests (Figure 1).



**Figure 1. Mississippi forestland by type of ownership**

There is limited information concerning NIPF landowner activities and expenditures over time. Various approaches for estimating forest management intensity have been used. See, for example, Adams et al. (1982) and Moffat et al. (1998). A series of articles reported south-wide costs for various silvicultural activities (Dubois et al. 1995, 1997, 1999, 2001). Recently, several studies have addressed the forest management activities of NIPF landowners, focusing on total expenditures for each activity (Arano et al. 2002), treatment costs per acre and total acres treated by timber investment management organizations (TIMOs) and industrial landowners (Rogers and Munn 2003). To our knowledge, however, no comprehensive study has been conducted that examines NIPF activities and expenditures over time.

NIPF landowner behavior is different than forest industry behavior due to the multi-objective nature of NIPF ownership. NIPF landowners may not always respond to prices in the same way that forest industry does, and this makes predicting timber supply from NIPF land quite difficult (Amacher et al. 2003). Detailed information about forest management expenditures and activities incurred by NIPF landowners annually provide a wealth of information about expenses associated with forestland ownership, management practices implemented by NIPF landowners, and changes in management intensity over time. Landowners' expenditures on forest management activities reflect landowners' willingness to invest in timber production and can be used to measure management intensity. Changes in these expenditures over time reflect changes in management intensity and thus may prove useful in many different ways. Landowners need information about the distribution and magnitude of expenditures for various activities as benchmarks for their own management decisions. Timber supply modelers may use such data as inputs to conduct future timber supply projections. Policy makers utilize information concerning

practices being implemented, on how many acres, by whom, at what cost, and how often, in order to develop appropriate policies and legislation (Rogers and Munn 2003).

This study investigated forest management intensity of NIPF landowners in Mississippi from 1998 to 2006. The same sampling procedures and survey instruments and questionnaires were used each year. The objectives of the study were to determine:

- 1) amount of land owned and its composition by forest type;
- 2) mean cost per acre treated for silvicultural activities;
- 3) mean expenditures per acre owned annually (costs for silvicultural activities and overhead) for all respondents by activity groups and for those who engaged the activities; and,
- 4) changes in management intensity over time, trends by activity, and factors which contributed to the changes.

## **Methods**

### Data Collection

The survey instrument was designed by the Social Science Research Center, Mississippi State University, using Dillman's (1978) total design method. During the nine years, Mississippi NIPF landowners were surveyed to determine the intensity of their forestry management practices for the previous year. Samples were drawn annually from landowner address lists obtained from tax assessors' records for about 70 of 82 Mississippi counties. The number of available counties varied slightly from year to year. To eliminate as many non-forestry holdings as possible, the survey was limited to landowners who owned at least 20 acres of forestland. Although landowners who own less than 20 acres represent 59% of all forest landowners, they only account for 8.5% of the total forest area in Mississippi (Doolittle 1996).

The survey was designed to determine three types of information: (1) property data, (2) forest management activity data, and (3) expenditure data. Property data included acres owned, in total and by forest type, and ad valorem taxes. Information on forest management activities included activities implemented and the number of acres treated for each activity. Expenditure information was obtained for forest management activities and routine expenses associated with timberland ownership. Activities included mechanical site preparation, chemical site preparation, site preparation burning, fertilization, regeneration, road construction, and timber stand management. Routine expenses included property line maintenance, protection against fire, insects and diseases, road maintenance, animal damage control, as well as supervision and administration, fees for professional service (consulting foresters, accounts, attorneys, and surveyors), hunting management expenses, timber sale expenses and property taxes.

### Data Analysis

The data was summarized in four ways for each survey year and for the 9 year period: mean cost per acre treated; percentage of landowners who engaged in the activities; and mean cost per acre owned for all respondents and only those respondents who conducted each activity.

Annual costs per acre treated were computed for the various silvicultural treatments by dividing each landowner's expenditures by the number of acres treated. Only landowners who reported both expenditures and acres treated were included in the initial mean cost per acre calculation. Where landowners reported only acres treated or expenditures, the missing values were estimated using the mean cost per acre treated. Arithmetic means, not weighted means (weighted by the number of acres treated), were computed. Expenditures were not weighted by acres treated because doing so assumed that treatments costs of NIPF landowners that treated more acres were more representative than treatment costs of landowners that treated fewer acres. Overhead expenses were computed on per acre-owned basis, which were also arithmetic averages and not weighted by acres owned.

The responses to the annual surveys were pooled to calculate average annual expenditures over the 9-year period and used analysis of variance (ANOVA) to test for differences in responses (expenditures per acre owned) between treatments (year). Management activities were grouped into broader categories due to their relatively low frequency of occurrence in sub-categories. These categories included establishment, timber management, ad valorem taxes, overhead and total annual costs. Differences in management intensity between years were examined using ANOVA where expenditure per acre owned for all respondents was the dependent variable and the survey year was the treatment. Multiple comparison tests using Scheffe's method were employed because sample sizes varied from year to year (Kleinbaum and Kupper 1978). A general linear model that adjusted for unbalanced treatment effects was employed.

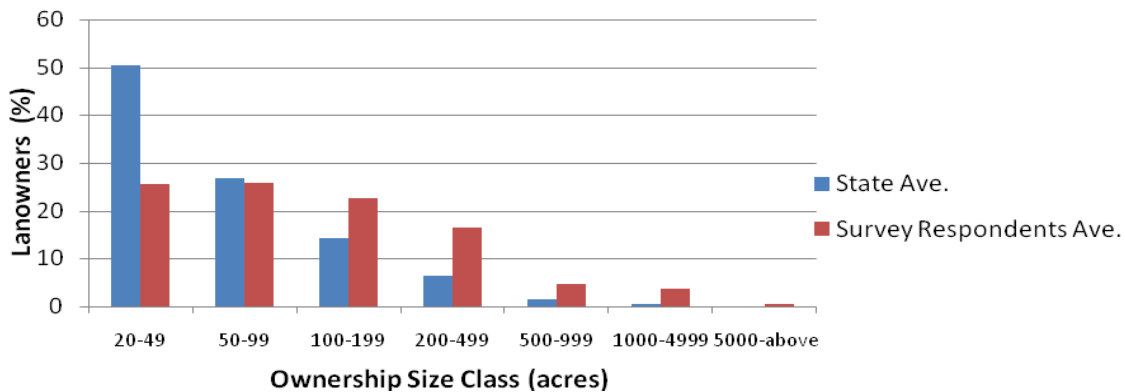
To examine differences in management intensity, for each of the five categorized management activities, we computed the average expenditures per acre owned for all respondents and tested for significant differences between years. To investigate trends in management intensity over time, a simple linear regression model (OLS) was employed. The dependent variable, expenditures per acre owned, was regressed over a proxy variable for time (corresponding to the 9 years in the study period), total acres owned, and percentage of ownership by forest type. Forest types were planted pine, natural pine, hardwood/pine and non-typed. In light of the small number of differences, we used the 0.1 significance level as the criterion for statistical significance.

## **Results**

The average annual response rate was 25%. In light of the low response rate, response bias was a concern. Comparison of the distributions of ownership size for the respondents and that for the statewide population of forestland owners indicated that the response rate varied by ownership size. Ownership size was, therefore, regressed on total expenditure per acre owned. However, no significant relationship was found. Thus, response bias with respect to ownership size is unlikely to bias the sample means (Figure 2).

### Property Data

The average ownership size over the 9 year study period was 278 acres (Table 1). The average area owned did not vary significantly over the study period. The median ownership size was 92 acres, which illustrated the under-representation of the smallest ownership class (20-50 acres) in



**Figure 2. Mississippi NIPF landowners by ownership size class**

our sample. Some ownerships in the sample were less than 20 acres, possibly because of the lag between the date when landowner lists were obtained and the date the surveys were conducted. Such landowners might have disposed of portions of their landholdings during the interim (Arano et al. 2002).

**Table 1. Forest area owned by Mississippi NIPF landowners, 1998-2006**

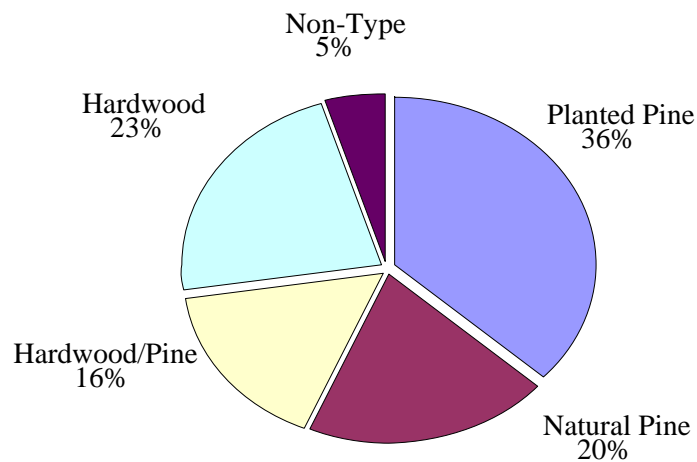
	1998	1999	2000	2001	2002	2003	2004	2005	2006	9 year
Mean	230 <sup>a*</sup>	260 <sup>a</sup>	287 <sup>a</sup>	352 <sup>a</sup>	243 <sup>a</sup>	229 <sup>a</sup>	340 <sup>a</sup>	273 <sup>a</sup>	274 <sup>a</sup>	278 <sup>a</sup>
Median	100	100	90	82	90	90	109	91	85	92
Minimum	1	0	20	20	20	20	20	20	20	20
Maximum	3837	15000	12000	97851	10000	6800	20000	16000	15000	97851

\*Annual means in a row with the same letter are not significantly different at  $\alpha = 0.05$ .

Planted pine accounted for 36% of the acres owned by NIPF respondents in Mississippi (Figure 3) followed by hardwood (23%), natural pine (20%), and hardwood/pine (16%). Non-typed areas represented only 5% of total acres owned.

### Frequency of Occurrence

Most silvicultural activities occurred infrequently. Fewer than 18% of respondents conducted any specific activity in any year during the survey period (Table 2). Property taxes were reported by an average of 72% of landowners. Approximately 5.7% of landowners conducted mechanical site preparation, 5.4% conducted chemical site preparation and 4.0% conducted site preparation burns. Approximately 5.4% of landowners reported some type of timber management in any year; 17.8% of landowners incurred routine costs; and 11.50% of landowners incurred fees for professional services.



**Figure 3. Timberland composition by forest type for Mississippi NIPF landowners (1998-2006 average)**

**Table 2. Percentage of Mississippi landowners who incurred forest management expenditures, 1998-2006**

Expense category	1998	1999	2000	2001	2002	2003	2004	2005	2006	Ave.
%										
Stand Establishment	16.99	16.17	17.44	16.02	13.79	10.41	11.37	15.92	16.98	15.09
Mechanical Site Prep.	5.01	5.61	5.87	5.81	4.78	6.11	4.31	6.73	7.76	5.74
Chemical Site Prep.	4.79	5.45	7.08	5.11	6.99	4.07	4.51	6.28	3.98	5.42
Site Prep. Burning	4.36	4.46	5.53	3.87	3.13	2.71	2.35	4.71	5.03	4.04
Fertilization	2.61	1.32	1.90	0.88	1.84	1.81	0.98	1.79	2.10	1.66
Regeneration Plants	11.33	11.55	10.71	10.56	8.08	6.10	6.67	8.07	12.16	9.57
Timber Management	4.58	4.99	5.18	4.58	5.73	3.85	4.72	7.22	8.17	5.40
Prescribed Burning	1.53	2.31	2.59	2.28	2.90	1.34	1.96	3.80	4.20	2.54
Fertilization	1.31	1.32	0.86	0.35	0.18	0.67	0.39	0.45	0.84	0.71
Pruning	0.44	0.17	0.69	1.05	1.09	0.67	0.78	1.79	1.26	0.86
Chemical Release	1.31	1.49	1.21	1.05	2.17	1.34	1.57	2.46	2.10	1.61
Pre-commercial Thin	0.00*	0.44	0.66	0.00*	0.18	0.36	0.45	0.20	0.67	0.32
TSI <sup>†</sup>	1.31	0.67	1.04	1.40	1.46	0.45	1.18	0.90	2.53	1.21
Routing Expenses	13.51	17.28	17.79	17.61	15.44	12.67	17.06	27.13	22.22	17.79
Fees For Pro. Service	8.93	12.46	11.23	9.68	12.34	7.92	12.75	13.90	14.05	11.50
Timber Sale Expenses	5.66	4.79	4.66	3.68	4.17	2.68	2.75	3.58	3.98	4.02
Hunting Management	7.19	8.75	6.91	7.90	7.25	8.48	9.02	6.49	8.60	7.85
Ad Valorem Tax	53.16	64.29	75.82	72.71	76.29	73.08	77.65	77.35	76.94	71.95

\*None of the landowners in our sample reported pre-commercial thinning in year 1998 and 2001.

<sup>†</sup> Timber Stand Improvement.

Some of these percentages varied significantly over the survey period. Relative percentages are also informative, indicating how common various forest management practices are. For example, planting costs accounted for the majority of stand establishment expenditures reported and were incurred by 9.57% of the landowners over the study period. In contrast, site preparation costs were incurred by 5.2% of landowners. Agricultural conversions undoubtedly account for some of

the area planted but not site prepared (Arano et al. 2002). However, these numbers suggest that substantial areas were planted without any type of site preparation.

#### Average Expenditures of Silvicultural Activities

Stand establishment costs averaged \$71.61/acre treated (Table 3). Mechanical and chemical site preparation treatments averaged \$90.55/acre treated and \$67.70/acre treated, respectively. Site preparation burning averaged \$18.68/acre treated.

**Table 3. Mean cost per acre treated for Mississippi NIPF landowners who incurred the expenses, 1998-2006**

Expense Category	1998	1999	2000	2001	2002	2003	2004	2005	2006
\$/acre									
Stand Establishment	49.93	52.15	64.45	85.34	89.15	77.83	52.21	83.47	100.11
Mechanical Site Prep	39.00	57.01	106.43	77.31	96.00	114.52	22.41	92.86	142.72
Chemical Site Prep	63.30	65.7	71.11	71.42	66.12	63.54	63.06	71.98	73.05
Site Prep Burning	13.01	11.44	22.69	19.97	25.53	14.31	11.52	11.45	38.23
Fertilization	29.38	22.25	34.18	33.26	18.19	28.92	25.56	38.67	25.78
Regeneration Plant	58.00	62.83	70.61	81.57	66.76	79.66	85.71	94.04	75.05
Timber Management	21.99	22.12	46.09	24.94	35.03	32.57	34.83	59.09	54.06
Prescribed Burning	8.60	7.32	6.99	8.97	8.06	17.38	7.51	9.55	26.73
Fertilization	21.41	32.52	15.43	31.25	10.00	19.26	32.50	119.2	10.56
Pruning	10.15	80.00	120.82	17.75	20.54	28.13	71.62	57.23	30.63
Chemical Release	32.94	45.95	49.37	60.65	74.63	70.19	76.97	68.66	76.52
Thinning	0.00	20.00	225.00	0.00	350.00	37.25	0.00	0.00	100.62
TSI*	15.41	12.23	27.73	28.56	32.69	52.50	3.92	69.79	81.81
Total Cost	47.30	47.47	62.27	64.50	79.48	72.33	49.98	78.19	96.96

\* Timber Stand Improvement.

Regeneration costs averaged \$73.64/acre treated. Timber management costs averaged \$37.23/acre treated. Timber stand improvement and pruning averaged around \$40.00/acre treated, while chemical release averaged \$63.65/acre treated and pre-commercial thinning averaged \$138.86/acre treated, which is relatively high compared with other researchers' results. Landowners may conduct multiple silvicultural activities on the same acres, so detailed data as mechanical site preparation, chemical site preparation and planting cannot be simply added into categorized silvicultural practices as stand establishment and timber management costs.

#### Average Expenditures for Landowners Who Incurred the Expenses

To provide better estimates of actual forest management expenditures landowners were likely to incur, we computed average annual expenditures per acre owned for respondents who engaged in activities. This method is suitable for property level activities such as fees for professional services, routine costs and property taxes (ad valorem taxes). Over the survey period, capital

expenditures averaged \$31.89/acre owned, while overhead expenses averaged \$13.57/acre owned and property taxes averaged \$4.97/acre owned (Table 4).

**Table 4. Mean expenditures per acre owned for Mississippi NIPF landowners who incurred the expenses, 1998-2006**

Expense Category	1998	1999	2000	2001	2002	2003	2004	2005	2006
\$/acre									
Stand Establishment	21.54	21.68	26.02	29.67	39.82	23.70	18.70	29.15	39.00
Mechanic Site Prep	11.06	20.73	27.51	17.67	13.5*	19.36	3.48	19.97	24.89
Chemical Site Prep.	13.49	13.30	23.01	18.60	17.01	11.10	16.20	17.91	10.37
Site Prep. Burning	3.85	2.86	3.00	6.07	5.50	0.79	1.16	3.19	11.20
Fertilization	8.20	4.64	6.66	16.18	4.69	5.81	8.33	10.06	6.81
Regeneration Planting	18.45	13.41	14.60	22.71	18.76	13.60	17.00	22.81	24.30
Others	27.69	13.83	29.87	18.80	19.30	31.80	27.00	17.06	28.00
<b>Capital Expenditures</b>	29.34	22.58	34.80	30.81	36.82	32.20	26.50	32.32	41.60
Timber Management	7.46	4.36	15.80	4.78	13.24	6.36	6.31	31.21	13.00
Overhead Expenses	17.48	15.18	13.70	12.30	12.00	12.20	10.60	12.45	16.80
Routine Expenses	5.60	4.71	9.15	5.96	4.52	5.35	6.23	7.97	13.10
Fees for Prof. Service	6.84	8.30	9.93	10.83	7.68	8.15	7.49	9.11	9.30
Timber Sale Expenses	38.81	41.12	15.79	21.89	26.38	20.4	14.60	13.71	5.45
Hunting Expenses	4.29	4.74	3.10	4.04	3.30	16.00	5.29	4.96	7.56
Property Taxes	2.82	4.40	4.26	4.74	4.88	5.45	5.51	5.72	6.52
<b>Expense Expenditures</b>	9.36	9.98	9.83	8.80	9.32	8.75	9.34	13.40	13.40

#### Average Expenditures for All Respondents

To illustrate the magnitude of forest management expenditures for NIPF landowners as a group, we computed the sample means for all the reported expenditures for each forest management activity on a per-acre-owned basis for all respondents every year.

Over the survey period, total annual expenditures averaged \$14.4/acre owned (Table 5). Annual capital expenditures averaged \$6.6/acre owned, while overhead expenses averaged \$3.63/acre owned for all respondents. Property taxes are NIPF landowners' most frequent and greatest expenditures, which accounted for 40% of expensed expenditures on average. Regeneration planting averaged \$1.77/acre owned, which is 70% of total stand establishment expenditures.

#### Differences and Trends between Years

The ANOVA F-test confirmed that expenditures per acre owned differed among years (Table 6). For timber management, ad valorem tax and total annual cost, the null hypotheses that expenditures per acre owned did not differ over the study period was easily rejected with P-values of 0.0028, 0.0001 and 0.0762 respectively. However, expenditures per acre owned for



**Table 5. Mean cost per acre owned for Mississippi NIPF landowners, 1998-2006**

<b>Expense Category</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>
<b>\$/acre</b>									
Stand Establishment	3.74	3.54	4.62	4.81	5.51	2.48	2.12	4.61	6.63
Mechanical Site Prep.	0.55	1.17	1.62	1.03	2.65	1.19	0.15	1.34	1.94
Chemical Site Prep.	0.65	0.73	1.63	0.95	1.19	0.45	0.73	1.12	0.41
Site Prep. Burning	0.17	0.13	0.17	0.23	0.17	0.02	0.03	0.15	0.56
Fertilization	0.21	0.06	0.13	0.14	0.09	0.11	0.08	0.18	0.14
Regeneration Planting	2.09	1.56	1.56	2.40	1.52	0.83	1.13	1.84	2.96
Others	2.41	1.40	3.10	1.92	1.70	2.45	2.86	2.03	3.76
<b>Capital Expenditures</b>	<b>6.09</b>	<b>4.93</b>	<b>7.65</b>	<b>6.67</b>	<b>7.20</b>	<b>4.91</b>	<b>4.99</b>	<b>6.67</b>	<b>10.23</b>
Timber Management	0.34	0.22	0.82	0.22	0.76	0.24	0.3	2.25	1.04
Overhead Expenses	3.81	4.08	3.76	3.23	2.96	2.42	2.94	4.41	5.04
Routine Expenses	0.76	0.81	1.63	1.05	0.7	0.68	1.06	2.16	2.91
Fees for Prof. Service	0.61	1.03	1.11	1.05	0.95	0.65	0.95	1.27	1.31
Timber Sale Expenses	2.20	1.91	0.74	0.81	1.12	0.55	0.40	0.49	0.22
Hunting Expenses	0.24	0.32	0.28	0.32	0.20	0.54	0.52	0.49	0.60
Property Taxes	1.50	2.83	3.23	3.45	3.73	3.98	4.28	4.42	5.02
<b>Expense Expenditures</b>	<b>5.65</b>	<b>7.14</b>	<b>7.81</b>	<b>6.89</b>	<b>7.41</b>	<b>6.65</b>	<b>7.52</b>	<b>11.01</b>	<b>11.07</b>
<b>Total Annual Cost</b>	<b>11.74</b>	<b>12.12</b>	<b>15.48</b>	<b>13.57</b>	<b>14.13</b>	<b>11.23</b>	<b>12.53</b>	<b>17.71</b>	<b>21.16</b>

stand establishment and overhead did not differ over the study period. Therefore, a simple linear regression was used to test for trends over time, but was only applied to timber management, ad valorem tax and total annual costs.

We then made a comparison between each pair of annual means using Scheffe's multiple comparison tests. There were 36 comparisons for the nine years (Table 7). For property tax, the mean for year 2006 is the highest and the mean for year 1998 is the lowest. The means for year 2001 was not statistically different from that of year 2002, 2003, 2004 and 2005. For total annual cost, the mean of year 2006 was also the largest, while the means of years 1998, 1999, 2001, 2002, 2003, and 2004 were not significantly different.

Timber management expenditures, property taxes and total annual cost varied by years based on the pair-wise tests. Property taxes, timber management costs and total annual costs significantly increased over the study period (Table 8).

Not surprisingly, the main factor that affected stand establishment costs was the percentage of ownership of planted pine because planted pine can respond well to intensive management during planting. Planted pine also contributed to expenditures per acre owned of property tax and total annual expenditures.

**Table 6. ANOVA table of average expenditures per acre owned for Mississippi NIPF landowners, 1998-2006**

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-value	P-value
Stand Establishment					
Between Years	8	7953.8	994.2	1.2	0.3238
Within Years	4608	3972128.0	862.0		
Total	4616	3980081.7			
Timber Management					
Between Years	8	1631.7	204.0	2.9	0.0028
Within Years	4606	320070.0	69.5		
Total	4614	321701.8			
Overhead					
Between Years	8	2588.8	323.6	0.6	0.7927
Within Years	4617	2562432.2	555.0		
Total	4625	2565020.9			
Ad Valorem Tax					
Between Years	8	4048.5	506.1	9.5	<0.0001
Within Years	4618	246955.9	53.5		
Total	4626	251004.4			
Total Annual Cost					
Between Years	8	40308.2	5038.5	1.8	0.0762
Within Years	4596	13017011.9	2832.3		
Total	4604	13057320.1			

**Table 7. Multiple comparison tests of average expenditures per acre owned for Mississippi NIPF landowners, 1998-2006**

	Stand establishment	Timber management	Overhead	Property tax	Total annual cost
Year	Mean	Mean	Mean	Mean	Mean
1998	3.67 <sup>a</sup>	0.34 <sup>ab</sup>	3.81 <sup>a</sup>	1.50 <sup>c</sup>	11.74 <sup>b</sup>
1999	3.54 <sup>a</sup>	0.22 <sup>b</sup>	4.08 <sup>a</sup>	2.83 <sup>bc</sup>	12.05 <sup>b</sup>
2000	4.55 <sup>a</sup>	0.82 <sup>ab</sup>	3.76 <sup>a</sup>	3.23 <sup>b</sup>	15.48 <sup>ab</sup>
2001	4.75 <sup>a</sup>	0.22 <sup>b</sup>	3.32 <sup>a</sup>	3.40 <sup>ab</sup>	13.57 <sup>b</sup>
2002	5.51 <sup>a</sup>	0.76 <sup>ab</sup>	2.96 <sup>a</sup>	3.73 <sup>ab</sup>	14.12 <sup>b</sup>
2003	2.48 <sup>a</sup>	0.24 <sup>b</sup>	2.42 <sup>a</sup>	3.99 <sup>ab</sup>	11.23 <sup>b</sup>
2004	2.12 <sup>a</sup>	0.30 <sup>b</sup>	2.94 <sup>a</sup>	4.28 <sup>ab</sup>	12.52 <sup>b</sup>
2005	4.64 <sup>a</sup>	2.25 <sup>a</sup>	4.41 <sup>a</sup>	4.42 <sup>ab</sup>	17.71 <sup>ab</sup>
2006	6.63 <sup>a</sup>	1.04 <sup>ab</sup>	5.04 <sup>a</sup>	5.02 <sup>a</sup>	21.16 <sup>a</sup>

\*Annual means in a column with the same letter are not significantly different at  $\alpha = 0.05$ .

**Table 8. Results of regression analysis on mean expenditures per acre owned for Mississippi NIPF landowners, 1998-2006**

	<b>Stand Establishment</b>	<b>Timber Management</b>	<b>Overhead</b>	<b>Property Tax</b>	<b>Total Annual Cost</b>
Variable	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Intercept	-95.84451	-245.90558*	-80.66954	-661.25576*	- 1282.59295*
Year	0.04939	0.12307*	0.04207	0.33154*	0.64632*
Total Acres	-0.00001	0.00005	-0.00002	-0.00004	-0.00005
%Planted Pine	6.39426*	0.48987†	0.28472	1.99716*	9.56389*
%Natural Pine	-2.05664†	0.14525	-0.26455	1.56267*	-0.27233
%Hardwood/Pine	-1.69261	-0.20119	-0.70843	0.64140†	-1.23580
%Non-typed	1.04992	0.67723	2.91969†	1.26990*	8.23803*
r <sup>2</sup>	0.0099	0.0026	0.0009	0.0285	0.0079
r <sup>2</sup> -adjusted	0.0087	0.0013	-0.0004	0.0272	0.0066
F-test	7.6900	2.0300	0.7100	22.5100	6.1100

\*Significant at the 5 percent level.

†Significant at the 10 percent level.

## Discussion

The study examined forest management intensity of NIPF landowners in Mississippi during the period 1998-2006. Expenditures and activities data provided a wealth of information with potential uses in a broad range of applications. A substantial portion of expenditures required by timberland ownership are “nonproductive”, as illustrated by the relatively high overhead expenses per acre owned for all respondents. Expenditures also reflected an informal ranking of timber management activities. Focusing strictly on stand establishment activities, it was clear that landowners viewed planting as the most important timber management activity. Over half the money spent on timber management was spent on planting.

The study also illustrated an interesting aspect of investing in forestland. Expenditures can vary dramatically depending on the activities a landowner undertakes. Expenses such as regeneration costs and timber sale costs, which were directly related to timber production, either through enhancing timber growth or returns on timber sales, accounted for more than half of the total annual expenditure per acre owned. On average, property taxes represented 40% of the expensed expenditures per acre owned and 25% of the total annual expenditures per acre owned for all respondents during the survey period. From a policy perspective, it is interesting to note that property taxes are NIPF landowners’ greatest annual expenditure.

Most forest management expenditures occurred infrequently. NIPF landowners with smaller and fragmented holdings have the fewest management options (Conner and Hartsell 2002), which could be one of the reasons why most landowners do not engage in forest management. Fewer than 18% of respondents reported annual expenditures for any specific activity in any year during the survey period. Even when activities were grouped into broad categories, such as stand establishment, timber management cost, fees for professional service and routing expenses, the percentage of respondents incurring expenditures in these aggregated categories was still relatively low. This is, however, consistent with the long term nature of forestry (*e.g.*, a stand of forest is only regenerated once a rotation or about every 35 years).

Expenditures information may prove useful in predicting timber supply. All else being equal, greater expenditures indicate more intensive forest management. Hence, periodically monitoring forest management related expenditures might provide indicators of future timber supply trends. For example, constant expenditures over years (adjusted for inflation) suggest relatively consistent timber supply in the future. While NIPF landowners are not as actively involved in intensive management as industrial owners, these findings suggest some potential problems for future timber availability in the South. Intensive management of NIPF timberlands is needed to substantially reduce future timber scarcity (Provencher 1990).

Finally, the information provided by this study can be particularly useful in the policy arena. Repeated studies over time provided insight into changes and trends of forest management intensity in a cost efficient manner. Policy makers need accurate information concerning NIPF landowners' forest management intensity (*e.g.* what practices are being implemented, on how many acres, by whom, and at what cost) in order to develop appropriate policies as incentive means or legislation. For state owned many NIPF landowners as Mississippi, such policies and legislation may have impacts on rural economies. Property tax policies, as a specific example, may be influenced by accurate expenditure information. This study has shown that surveying landowners is an effective method for obtaining low-cost, reliable and current forest practices information that can be used for landowners, policy makers, timber supply modelers, and other public uses.

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