Forest Management Activities And Expenditures Of Mississippi NIPF Landowners: 1998-2000 Data[1]

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Abstract. Expenditures data provide a wealth of information with potential uses in a broad range of applications. Such data collected over time provide information about costs associated with forestland ownership, management practices implemented by NIPF landowners, and changes in management intensity over time. A survey of Mississippi NIPF landowners was conducted to determine their annual forest management expenditures for the period 1998-2000. Landowners were asked how much they spent on two major expenditure categories: (1) silvicultural expenses, which include site preparation, planting, and intermediate treatments; and (2) overhead expenses, which include property taxes, fees for professional services, routine expenses, hunting costs, and miscellaneous expenses. The resulting expenditures data were summarized in three ways: frequency of occurrence, mean expenditures per acre-owned for all respondents, and mean expenditures per acre treated for those respondents engaged in each activity. With the exception of property taxes, fewer than 12% respondents reported annual expenditures for any specific activity in any year during the survey period. Total expenditures for all respondents averaged $11.51/acre-owned. This represents an annual outlay of $146 million when extrapolated to the state level. Site preparation and planting represented the largest components of silvicultural expenses. Property taxes and miscellaneous expenses comprised the majority of overhead expenses.

Key Words: Silvicultural expenses, Overhead expenses, Property tax

INTRODUCTION

Long-term timber supply depends on the existing timberland base and on the extent of the investment or management intensity of non-industrial private forest (NIPF) landowners (Adams and Haynes 1991). Therefore, accurate estimates of timberland ownership and detailed information about forest management practices are necessary. Timber management intensity by these landowners constitutes one of the major uncertainties of timber supply modeling. Not surprisingly, management intensity and investment behavior can have a major impact on projected timber supply (Adams et al. 1982). However, little information is available on NIPF landowners' investment in forest management activities. While a number of studies have estimated the cost of various forest management practices (See Dubois et al. 1997, 1999, 2001), the actual dollar amounts invested by NIPF landowners are often not readily available. Arano et al. (2002) investigated the forest management activities and expenditures of NIPF landowners but did not determine treatment costs per acre or total acres treated.

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Expenditure information indicates landowners' willingness to invest in timber production. A measure of landowners' capital investment in various forestry activities, specifically in silvicultural activities, can be used in assessing forest management intensity level. Moreover, detailed information about expenditures incurred by private landowners over time will demonstrate how investments on private forestlands are distributed among various management or silvicultural activities and could provide useful benchmark information for landowners. Expenditures for various activities may also reflect landowner rankings of the relative profitability of various treatments and provide additional insights into landowner intentions. Finally, such information could also provide an estimate of the economic contribution of the different forestry activities to the state's economy.

This study examines the forest management activities and expenditures of NIPF landowners in Mississippi from 1998 to 2000. While expenditure data is collected annually, the analysis was limited to the three-year period because of differences in the sampling procedures and survey instrument used during the previous survey periods.

METHODS

Study Population

The study population consisted of NIPF landowners who own at least 20 acres of uncultivated lands in Mississippi. Uncultivated land refers to those rural land-uses other than agriculture, the majority of which are forest-related. The 20-acre threshold was chosen to eliminate non-forestry uses (e.g., home sites). Landowners who own less than 20 acres account for only 8.5% of the state's uncultivated acreage (Doolittle 1996).

Data

The Social Science Research Center at Mississippi State University conducted an annual mail survey of NIPF landowners to determine their annual forest management activities and associated expenditures for the period 1998-2000. Survey procedures followed Dillman's (1978) Total Design Method (TDM). At least 400 usable responses were targeted to achieve a 5% sampling error at a 95% confidence level.

The survey instrument was designed to elicit information from NIPF landowners about the area of forestland they own in Mississippi, their annual forest management activities and associated expenditures. Expenditures were grouped into two major categories: silvicultural and overhead expenses. Silvicultural activities included site preparation (mechanical treatments, chemical treatments, burning and fertilization), planting, and intermediate treatments (prescribed burning, fertilization, pruning, chemical release, pre-commercial thinning, and timber stand improvement). Overhead expenses included property taxes, fees for professional services (consulting forester, attorney, accountant, and surveyor), routine expenses (property line maintenance, protection, road maintenance, animal damage control, and supervision and administration), hunting costs (only costs associated with commercial hunting activities, e.g., leases, not personal hunting), and miscellaneous expenses (road construction, timber sales, others). Since the survey was designed to determine the cost per acre for the various treatments, the number of acres treated for the silvicultural activities was also elicited.

Analysis

To illustrate the frequency and distribution of forest management activities, the percentage of respondents who incurred expenditures for each forest management activity was computed. This percentage was computed for each survey year and for the three-year period.

Next, to illustrate the magnitude of forest management expenditures for NIPF landowners as a group, the sample means for the reported expenditures for each activity on a per-acre-owned basis for all respondents for each survey year were computed. In computing the mean, per-acre expenditures were weighted by the number of acres owned. The responses to the annual surveys were pooled to calculate average annual expenditures over the three-year period.

Sample means provide useful information about population-level expenditures, however, they do not necessarily provide useful information about treatment costs. Therefore, mean expenditures per acre treated for silvicultural activities and the mean expenditures per acre owned for overhead expenses were also computed. Mean expenditures for silvicultural activities were weighted by the number of acres treated and overhead expenses were weighted by the number of acres owned.

Expenditures were compared on the basis of frequency of occurrence as well as magnitude. Pairwise t-tests in SAS were used to determine whether management expenditures changed significantly over the study period using α=0.05 level of significance.

Expenditures were extrapolated to the state level to determine the economic contribution of forest management to the state's economy. Statewide estimates were computed by multiplying total expenditures per acre owned by the acres of Mississippi NIPF timberland in ownerships larger than 20 acres.

RESULTS

The mail surveys resulted in 1,605 usable responses for the three-year period, a 35% response rate. In light of the low response rate, there was a concern about response bias. Therefore, the distribution by ownership size of the respondents was compared to that of the statewide population of forestland owners (Figure 1). The smallest ownership size class (20-49 acres) is under-represented in the sample. In Mississippi, this ownership class owns less than 17% of the total NIPF area in ownerships 20 acres or larger. Nonetheless, the response bias by ownership size may potentially bias the survey results. Therefore, ownership size was regressed on per-acre expenditures and no significant relationship was found ($F=0.03$, $p=0.85$). Thus, although the survey response rate varies by ownership size class, this response bias is unlikely to bias the sample means calculated for this study.

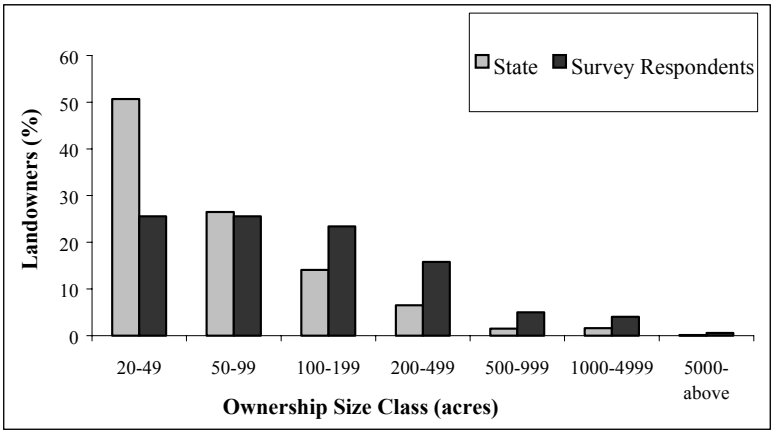

Figure 1. Comparison of the distribution of Mississippi NIPF landowners by ownership size class for survey respondents and the population of state landowners.

Forest Ownership

The average ownership size reported over the three-year study period was 261 acres (Table 1). This compares to an average ownership size of 99 acres for the statewide population (Doolittle 1996), again demonstrating the under representation of the smallest ownership size in the sample. The average area owned did not vary significantly over the study period.

Pine plantations constitute the largest forest type owned by NIPF landowners in Mississippi. The average acreage of pine plantations owned for the three-year study period was 76 acres, which represents 26% of total timberland area. Plantation pine was the largest forest type for each year.

Table 1. Average acres of timberland owned by NIPF respondents in Mississippi, 1998-2000.

Year	Planted Pine	Natural Pine	Mixed	Hardwood	Non-Typed	Total*
1998	64.53[a]	52.74[a]	45.53[a]	55.41[a]	17.67[a]	240.87[a]
1999	74.16[a]	48.56[a]	49.08[a]	68.34[a]	13.42[a]	258.17[a]
2000	87.84[a]	66.52[a]	49.78[a]	62.64[a]	11.55[a]	281.22[a]
3-Yr. Average	76.35	56.22	48.34	62.73	13.94	261.56

Note: Annual means in a given column that have the same letter are not significantly different from each other at α=0.05.

*Acres owned under different forest types do not add up to total acres reported because some landowners failed to report acres owned under each forest type and reported total acres owned only.

Frequency of Occurrence

Most silvicultural activities occurred infrequently (Table 2). This is also the case with overhead expenses (Table 3). With the exception of property taxes, fewer than 11% of respondents reported annual expenditures for any specific activity in any year during the survey period.

Silvicultural Expenses

On average, approximately 16% of the landowners incurred silvicultural expenses each year of the survey period (Table 2). Site preparation and planting were the most frequently occurring silvicultural activities. Approximately 10% of landowners spent money on these activities each year. Among site preparation activities, chemical site preparation was the most commonly reported while fertilization was the least common.

Intermediate treatments were the least common silvicultural activities. Approximately 3% of landowners incurred intermediate treatments each year of the survey period.

Table 2. Percentage of NIPF respondents in Mississippi who incurred silvicultural expenses, 1998-2000.

Expense Category	---------- Year ----------			
	1998	1999	2000	3 Yr. Average
	----------(percentage)----------			
Site Preparation	8.99[a]	8.81[a]	10.70[a]	9.53
Mechanical treatments	2.90[a]	3.60[a]	3.50[a]	3.36
Chemical treatments	4.27[a]	4.92[a]	6.49[a]	5.30
Burning	2.92[a]	3.39[a]	4.39[a]	3.61
Fertilization	2.02[a]	1.02[a]	1.75[a]	1.56
Planting	9.66[a]	10.51[a]	9.65[a]	9.97
Intermediate Treatments	2.70[a]	4.07[a]	3.33[a]	3.43
Prescribed burning	0.67[a]	1.86[b]	1.40[ab]	1.37
Fertilization	0.90[a]	1.19[a]	0.70[a]	0.93
Pruning	0.22[a]	0.17[a]	0.35[a]	0.25
Chemical release	0.90[a]	1.02[a]	0.88[a]	0.93
Pre-commercial thinning	0.00[a]	0.17[a]	0.35[a]	0.19
Timber stand improvement	0.22[a]	0.34[a]	0.53[a]	0.37
Total	14.61[a]	15.76[a]	16.14[a]	15.58

Note: Annual means in a given row that have the same letter are not significantly different at α=0.05.

Overhead Expenses

Most of the landowners incurred overhead expenses. Approximately 72% of landowners had this type of expense (Table 3). This relatively high percentage is attributed to the property taxes that landowners are required to pay regardless of whether they conduct any forestry activity or not. In fact, fewer than 10% of landowners incurred expenditures for any specific activity each year.

Approximately 65% of the respondents reported paying property taxes on their forestland during the survey period. Several respondents noted that they were unable to determine what portion of their tax bill was due to forestland versus agricultural land and therefore could not report the taxes paid on forestland. In counties where joint ownership of agricultural and forestland is prevalent, this would affect the number of non-responses.

Over the study period, an average of 11% of landowners reported paying fees for some type of professional service. Consulting foresters were the professionals most commonly used by landowners.

There was a significant increase in the percentage of landowners incurring routine expenses from 1998 to 2000. Property line maintenance and road maintenance were the most frequently occurring in this category. Supervision and administration was the least common expenditure.

Table 3. Percentage of NIPF landowners in Mississippi who incurred overhead expenses, 1998-2000.

Expense Category	----------Year ----------			
	1998	1999	2000	3 Yr. Average
	----------(percentage)----------			
Property Taxes	**53.48[a]**	**64.41[b]**	**75.61[c]**	**65.36**
Fees for professional services	**9.21[a]**	**12.54[b]**	**11.23[ab]**	**11.15**
Consulting forester	**3.37[a]**	**5.42[b]**	**5.09[ab]**	**4.74**
Attorney	**1.35[a]**	**3.39[b]**	**2.46[ab]**	**2.49**
Accountant	**4.04[a]**	**4.24[a]**	**4.56[a]**	**4.30**
Surveyor	**3.15[a]**	**3.73[a]**	**2.81[a]**	**3.24**
Routine Expenses	**13.93[a]**	**17.46[b]**	**18.07[b]**	**16.70**
Property line	**9.00[a]**	**9.15[a]**	**9.47[a]**	**9.22**
Protection	**4.27[a]**	**4.92[a]**	**4.56[a]**	**4.61**
Road maintenance	**8.31[a]**	**8.64[a]**	**9.82[a]**	**8.97**
Animal damage control	-	**3.73[a]**	**4.21[a]**	**3.97**
Supervision and administration	**2.25[a]**	**3.22[a]**	**1.93[a]**	**2.49**
Hunting Costs	**5.84[a]**	**6.95[a]**	**9.30[b]**	**7.48**
Miscellaneous Expenses	**13.03[a]**	**11.69[a]**	**12.63[a]**	**12.40**
Road construction	**5.39[a]**	**5.25[a]**	**5.43[a]**	**5.36**
Timber sales	**5.84[a]**	**4.58[a]**	**4.74[a]**	**4.98**
Others	**4.49[a]**	**4.24[a]**	**4.91[a]**	**4.55**
Total	**61.35[a]**	**72.88[b]**	**79.47[c]**	**72.02**

Note: Annual means in a given row that have the same letter are not significantly different at α=0.05.

Few landowners incurred expenditures related to wildlife management. On the average, only 7% of landowners incurred hunting expenses associated with fee hunting endeavors each year during the study period. A higher percentage of landowners incurred miscellaneous expenses, averaging approximately 12% during the study period.

Mean Expenditures for all Respondents

Over the survey period, total annual expenditures averaged $11.50/acre-owned. Silvicultural expenses in 1999 and 2000 were significantly higher compared to 1998 (Table 4). Overhead expenses in 2000 were significantly higher than those incurred by landowners in 1998 and 1999 (Table 5).

Silvicultural Expenses

Total silvicultural expenses averaged $4.27/acre-owned during the 3-year survey period. Landowners spent the most on site preparation and planting and the least on intermediate treatments. All the major categories showed a significant variation in expenses over the study period. However, there were no significant variations across years for most of the sub-categories.

Expenditures for site preparation averaged $2.10/acre-owned for all respondents. Chemical treatments accounted for more than half of this total. Planting expenses represented the second largest component of silvicultural spending, averaging $1.80/acre-owned. Annual expenditures on intermediate treatments averaged $0.39/acre-owned.

Overhead Expenses

Over the study period, total overhead expenses averaged $7.24/acre-owned for all respondents (Table 5). Overhead expenses comprise the majority of landowner expenditures.

Table 4. Average silvicultural expenditures per acre owned for all NIPF respondents, Mississippi, 1998-2000.

Expense Category	Year			
	1998	1999	2000	3 Yr. Average
	($/acre- owned)			
Site Preparation	1.46[a]	2.42[b]	2.24[b]	2.10
Mechanical treatments	0.21[a]	1.12[b]	0.46[c]	0.63
Chemical treatments	1.07[a]	1.20[a]	1.52[a]	1.29
Burning	0.07[a]	0.08[a]	0.16[b]	0.11
Fertilization	0.10[a]	0.02[b]	0.10[a]	0.07
Planting	1.49[a]	1.54[a]	2.25[b]	1.80
Intermediate Treatments	0.21[a]	0.38[b]	0.51[b]	0.39
Prescribed burning	0.01[a]	0.06[b]	0.03[ab]	0.03
Fertilization	0.06[a]	0.14[b]	0.04[a]	0.08
Pruning	0.01[a]	0.01[a]	0.03[a]	0.02
Chemical release	0.13[a]	0.16[a]	0.07[a]	0.12
Pre-commercial thinning	0.00[a]	0.001[a]	0.03[a]	0.01
Timber stand improvement	0.003[a]	0.01[a]	0.31[b]	0.13
Total	3.14[a]	4.31[b]	4.99[b]	4.27

Note: Annual means in a given row that have the same letter are not significantly different at α=0.05.

Table 5. Average overhead expenditures per acre owned for all NIPF respondents, Mississippi, 1998-2000.

Expense Category	Year			
	1998	1999	2000	3 Yr. Average
	($/acre-owned)			
Property Taxes	**1.50[a]**	**2.50[b]**	**3.15[c]**	**2.49**
Fees for professional services	**0.64[a]**	**1.23[b]**	**1.21[b]**	**1.07**
Consulting forester	**0.44[a]**	**0.91[b]**	**0.73[b]**	**0.72**
Attorney	**0.03[a]**	**0.12[b]**	**0.25[b]**	**0.15**
Accountant	**0.06[a]**	**0.07[ab]**	**0.10[b]**	**0.08**
Surveyor	**0.11[a]**	**0.13[a]**	**0.13[a]**	**0.12**
Routine Expenses	**0.92[a]**	**0.80[a]**	**0.66[a]**	**0.76**
Property line	**0.20[a]**	**0.19[a]**	**0.24[a]**	**0.21**
Protection	**0.10[a]**	**0.08[ab]**	**0.05[b]**	**0.08**
Road maintenance	**0.20[a]**	**0.21[a]**	**0.20[a]**	**0.21**
Animal damage control	-	**0.08[b]**	**0.11[b]**	**0.10**
Supervision and administration	**0.43[a]**	**0.23[a]**	**0.05[b]**	**0.21**
Hunting Costs	**0.29[a]**	**0.28[a]**	**0.20[a]**	**0.25**
Miscellaneous Expenses	**4.83[a]**	**1.71[b]**	**2.10[b]**	**2.66**
Road construction	**2.09[a]**	**0.49[b]**	**0.44[b]**	**0.89**
Timber sales	**1.36[a]**	**1.08[a]**	**0.74[a]**	**1.02**
Others	**1.38[a]**	**0.16[b]**	**0.92[a]**	**0.76**
Total	**8.17[a]**	**6.52[b]**	**7.31[b]**	**7.24**

Note: Annual means in a given row that have same letter are not significantly different at α=0.05.

Miscellaneous expenses represented the largest component of this category while hunting expenses represented the smallest. Property taxes, fees for professional services, and miscellaneous expenses varied significantly over the survey period. Overall, overhead expenses in 2000 were significantly higher compared to those in 1998 and 1999.

Annual property taxes averaged $2.49/acre-owned for all respondents. Expenditures for professional services averaged $1.07/acre-owned for all respondents. Consulting forester fees were the largest component representing more than half of the amount spent on professional services.

Routine expenses averaged $0.76/acre-owned. Property line maintenance, road maintenance, and administration and supervision were the largest components of routine expenses. Annual hunting costs averaged $0.25/acre-owned during the 3-year period. Miscellaneous expenses were the largest component of overhead expenses. In total, these expenditures averaged $2.66/acre-owned for all respondents.

Total Expenditures

NIPF respondents in Mississippi spent an average of $11.51/acre-owned for forestry activities during the 3-year survey period. Overhead expenses represent the largest component of landowners' total expenditures on forestry activities. Approximately 63% was spent on overhead activities. Only 37% was spent on silvicultural activities. Intermediate treatments only comprise 3% of total spending. When extrapolated to the state level, NIPF landowners' forest management expenditures represent an annual outlay of $146 million for the 12,695,073 acres of timberland in Mississippi in ownerships larger than 20 acres (Doolittle 1996).

Mean Expenditures of Landowners Engaged in Management Activities

Silvicultural Expenses

Site preparation expenditures averaged $57.24/acre-treated (Table 6). Per acre expenditures on chemical treatments were substantially greater than other site preparation activities. Planting averaged $66.45/acre-treated over the 3-year survey period. Intermediate treatments averaged $33.60/acre-treated.

Table 6. Average silvicultural expenditures per acre treated for NIPF respondents who incurred the expense, Mississippi, 1998-2000.

Expense Category	Year						
	1998		1999		2000		3 yr. Average
	$/acre	n	$/acre	n	$/acre	n	
Site Preparation	47.91[ab]	40	60.99[a]	52	58.51[b]	61	57.24
Mechanical treatments	46.22[a]	13	112.59[b]	21	72.12[b]	20	88.17
Chemical treatments	72.42[a]	19	58.16[b]	29	80.15[a]	37	69.68
Burning	9.06[a]	13	10.14[a]	20	14.89[a]	25	12.05
Fertilization	32.15[a]	9	28.00[a]	6	47.76[a]	10	38.11
Planting	48.18[a]	43	66.62[a]	62	73.92[c]	55	64.45
Intermediate Treatments	32.41[a]	12	27.20[a]	24	40.77[a]	19	33.60
Prescribed burning	12.31[a]	3	8.69[a]	11	8.11[a]	8	9.09
Fertilization	29.61[a]	4	39.93[b]	7	18.84[c]	4	30.78
Pruning	13.64[*]	1	80.00[*]	1	197.83[*]	2	50.00
Chemical release	45.20[a]	4	64.75[a]	6	56.82[a]	5	56.15
Pre-commercial thinning	-	-	20.00[*]	1	57.67[*]	2	53.24[*]
Timber stand improvement	42.88[*]	1	11.72[a]	2	64.03[b]	3	54.23
Total	46.56[a]	65	56.03[b]	93	61.52[b]	92	56.12

Note: Annual means in a given row that have the same letter are not significantly different at α=0.05.

*Not enough observation to compare.

Overhead Expenses

Annual overhead expenses per acre owned averaged $8.45 for those landowners who incurred any type of overhead expense (Table 7). This is roughly 17% higher than the total annual overhead expenses reported for all respondents. Differences for specific management activities were substantially greater. Except for fees for professional services and routine expenses, overhead expenses changed significantly across years for each expense category and in total.

Property taxes averaged $2.42, $3.20, and $3.57/acre-owned in 1998, 1999, and 2000, respectively, for landowners reporting such taxes. Fees for professional services averaged $3.51/acre-owned. Consultant and surveyor fees were substantially greater than for any other professional services. Landowners who incurred routine expenses spent an average of $2.38/acre-owned for the 3-year survey period. Property line maintenance, road maintenance, and supervision and administration were the most expensive activities under this category. Hunting expenses averaged $1.76/acre-owned. Miscellaneous expenses averaged $8.45/acre-owned.

Table 7. Average overhead expenditures per acre owned for NIPF respondents who incurred the expense, Mississippi, 1998-2000.

Expense Category	Year						
	1998		1999		2000		3 Yr. Average
	$/acre	n	$/acre	n	$/acre	n	
Property Taxes	**2.42[a]**	238	3.20[b]	380	3.57[b]	431	3.20
Fees for professional services	2.66[a]	41	4.53[a]	74	3.17[a]	64	3.51
Consulting forester	**4.34[ab]**	15	**5.52[a]**	32	**2.44[b]**	29	**3.61**
Attorney	**0.32[a]**	6	**1.08[a]**	20	**1.72[a]**	14	**1.24**
Accountant	**0.51[a]**	18	**0.52[a]**	25	**0.47[a]**	26	**0.49**
Surveyor	**0.98[a]**	14	**2.26[a]**	22	**1.73[a]**	16	**1.61**
Routine Expenses	**2.96[a]**	62	**2.29[a]**	103	**2.10[a]**	103	**2.38**
Property line	**0.78[a]**	40	**1.21[a]**	54	**1.20[a]**	54	**1.06**
Protection	**1.07[a]**	19	**1.12[a]**	29	**0.46[b]**	26	**0.81**
Road maintenance	**0.94[a]**	37	**1.05[a]**	51	**1.17[a]**	56	**1.06**
Animal damage control	-	-	**0.87[a]**	22	**1.00[a]**	24	**0.95**
Supervision and administration	**4.62[a]**	10	**3.61[a]**	19	**1.83[a]**	11	**3.67**
Hunting Costs	**2.20[a]**	26	**3.84[a]**	41	**0.92[b]**	53	**1.76**
Miscellaneous Expenses	**16.16[a]**	58	**7.16[ab]**	69	**5.30[b]**	72	**8.45**
Road construction	**16.77[a]**	24	**4.01[b]**	31	**5.63[ab]**	31	**8.35**
Timber sales	**7.15[a]**	26	**8.19[a]**	27	**3.11[b]**	27	**5.46**
Others	**17.33[a]**	20	**3.92[b]**	25	**4.42[b]**	28	**6.64**
Total	**10.85[a]**	273	**7.41[b]**	430	**8.06[ab]**	453	**8.45**

Note: Annual means in a given row that have the same letter are not significantly different at α=0.05.

DISCUSSION AND CONCLUSIONS

Most forest management expenditures occur infrequently. A majority of landowners are not engaged in forestry-related activities in any given year. With the exception of property taxes, fewer than 11% of respondents reported annual expenditures for any specific activity in any year during the survey period. This is 4% less than those reported by Arano et al. (2002). Even when expenditures were aggregated into broader categories, the percentage of respondents incurring expenditures in these broad categories in any given year remained below 20%. These low

percentages suggest that little has changed since Dutrow and Kaiser's (1984) assessment of the investment opportunities in forestry. One possible reason for these low percentages is the nature of NIPF timberland holdings. Timberland holdings by NIPF landowners are predominantly in smaller tracts and are fragmented. Landowners with smaller, fragmented holdings have limited management options (Conner and Hartsell 2002). While NIPF landowners do not manage as intensively as industrial owners, these findings may suggest some serious problems for future timber availability in the South. Provencher (1990) reported that intensive management of NIPF timberlands is needed to substantially reduce future timber scarcity. This is particularly important because NIPF landowners control the majority of timberlands in the South.

Frequency of activities provides information on how private lands are being managed, which has an important bearing on their productivity (Thomas 1998). For example, planting and site preparation costs were the most common silvicultural expenditure reported, averaging 10% of the landowners over the study period. In contrast, expenditures on intermediate treatments were incurred by only 3.43%. Site preparation and planting activities are both considered intensive forest management practices (Dubois 1999).

Expenditures also reflect an informal ranking of forestry activities. Focusing strictly on activities directly related to timber growing, landowners view site preparation and planting as the most important silvicultural activities. A little over 90% of the money spent on silvicultural activities was spent on these two activities. In contrast, intermediate treatments (e.g. timber stand improvement, pruning) account for less than 10% of total silvicultural expenses. This provides evidence that landowners believe it more profitable to spend money on site preparation and planting compared to other silvicultural activities.

This study also illustrates an interesting aspect of investing in forestland. Only 43% of annual expenditures are directly related to timber production, either through enhancing timber growth or returns on sales. The remaining expenditures do not generate a direct return on investment in that they do not result in increased growth or increased returns on timber sales. These expenditures averaged $6.52/acre-owned annually and account for 57% of total expenditures. Over a rotation, these amounts are substantial and may reduce the attractiveness of forestland investments, particularly for those investors concerned about cash flow requirements. These expenditures as a proportion of total expenditures have risen 12% since the 1995-1997 survey (Arano et al. 2002). Total expenditures have also risen by approximately 19% since the last study, averaging $9.68/acre-owned in the 1995-1997 study versus $11.51/acre-owned in this study. This trend indicates that most of the increase in landowner spending is due to increases in the non-productive costs associated with forest land ownership and not because landowners are managing more intensively. This provides evidence that non-productive costs will continue to constitute the majority of landowner expenses and may make timberland investment increasingly less attractive to landowners.

Forest management expenditures may provide a useful tool in timber supply modeling. Annual expenditures data provide a relative measure of management intensity over time and, as this study has demonstrated, are relatively easy to obtain. Such information collected annually in a consistent format and adjusted for inflation would provide a measure of changes in management intensity over time. Even without further refinement, this information would signal timber supply modelers when fundamental changes in management intensity occur, thus triggering investigations to identify the nature of the changes that are occurring. With further research, it may be possible also to establish a more direct relationship between expenditures and forest

productivity. In that case, expenditures information could be included as a determinant of timber supply in timber market models.

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