Potential Effects of Wood Chip Mill Harvests on Economic Returns and Forest Management Practices of Nonindustrial Private Forest Landowners in North Carolina

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Abstract'

Four approaches were used to estimate the market effects of wood chip mills for nonindustrial private forest (NIPF) landowners. First, we used economic welfare analyses to estimate potential changes in consumer and producer surplus that might be attributed to increased stumpage demand created by wood chip mills. Better markets would consistently increase economic returns for both timber buyers and sellers, up to about $5 million per year more per 1% shift outward in the demand function. Forest industry (buyers) had higher benefits in absolute terms, while NIPF owners (sellers) had higher percentage benefits. Second, changes in actual returns in the 1990s were estimated using Timber Mart-South data and timber product output (TPO) measures of changes in harvest levels. NIPF owners had decreased returns from softwood stumpage sales. However, increasing hardwood pulpwood timber production and prices would have yielded incremental returns of $553,000 per year for NIPF owners. Two-thirds of the total value accrued to owners in the Coastal Plain, but the largest percentage increase per year (6.5%) was received for NIPF hardwood pulpwood harvests in the Mountains. Third, discounted cash flow analyses of potential returns with better markets for small pulpwood material were calculated. Higher total stumpage volumes and prices, coupled with shorter rotations for softwood timber, led to sawtimber production with a chip component having the greatest returns, followed by chipping the stand entirely at a shorter rotation, and last, production of sawtimber only. These alternatives generated internal rates of return (IRRs) of about 8 to 12%. The lower timber prices and long rotations for hardwoods generally yielded much lower investment returns, ranging from about 4% to 6% IRRs depending on the management regime. Even the addition of a wood chip component did little to increase these returns. Last, analyses of potential site preparation savings for regeneration on sites with less woody debris and harvest residuals indicated that NIPF owners could save up to $800,00 per year. These economic analyses suggest that better markets will benefit NIPF landowners and timber buyers, thus prompting increased harvests for chip wood.

NIPF LANDOWNER MOTIVATIONS

North Carolina has the largest number of private forest owners in the South with about 705,000, or 14% of the South's total. Of North Carolina's forest area, 76% is owned by nonindustrial private forest (NIPF) land owners (Johnson 1991). In the South, 75% of private forest owners own fewer than 20 acres. These owners control 12% of the region's forest land. Landowners holding over 100 acres number comprise only 5% of the total number, but control 54% of the region's forest land (Moulton and Birch 1995). Since 1978, the number of owners in the South has increased by more than one million (28%) (Birch 1996).

NIPF owners have many objectives for owning forest land. In the South, 38% stated that having the land as part of their residence was their main reason for owning forest land. Farm or domestic use was cited by 8% of the owners, while 16% cited recreation or aesthetics. Investment was cited by 12% and 4% cited timber production. On an area basis, 35% listed timber production as their major objective and 14% listed land investment (Moulton and Birch 1995). More than 60% of the acres in the South have timber production as their main or secondary objective and various commodity interests are important for over 75% of the southern land base. Emphasis on commodity production was directly related to tract size (Cubbage 1997).

Three NIPF landowner practices and their associated deterrents and incentives were examined in this component of the study--harvesting, reforestation and management. The research literature indicated that deterrents to harvesting included various landowner objectives, economics, and immaturity of timber. Factors encouraging timber harvesting included maturity of timber, attractive stumpage prices, and the desire to improve the remaining trees on the site.

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Research has found that reforestation is deterred by planting costs and the long wait until a return is realized on the investment of planting. Significant incentives for regeneration include cost sharing, technical assistance, and, among those owners with higher incomes, stumpage prices. Deterrents to timber management included a preference for nontimber outputs, a low potential return on timber, and a lack of information on the part of NIPF owners. Strong markets, favorable tax treatments, and the availability of technical assistance provided incentives to management.

ECONOMIC ANALYSES OF WOOD CHIP MARKET EFFECTS ON NIPFS

Four approaches were used to estimate the market effects that better markets for timber due to wood chip mills might have on nonindustrial private forest (NIPF) landowners. These included (1) analysis of the actual increases in stumpage returns (price changes times volume changes) for North Carolina NIPFs in the 1990s; (2) welfare analyses of potential changes in consumer and producer surplus; (3) discounted cash flow analyses of potential returns to timber investments with and without wood chip markets; and (4) potential site preparation for planted regeneration savings that could be realized from "cleaner" timber harvests attributable to wood chip production.

Incremental Stumpage Returns

Economic analyses were performed to assess the benefits to NIPF owners that could occur due to changes in markets that might be attributable to wood chip facilities or other factors. Based on historical data for the 1990s derived from Timber Mart South and Southern Pulpwood Production Reports (Norris; Schaberg, pers. comm.), NIPF owners have actually experienced decreased returns from softwood stumpage sales in the Mountains and Piedmont of North Carolina (Timber Mart-South Region 1) due to decreased stumpage prices in the 1990s. The average annual incremental return to NIPF softwood pulpwood stumpage returns statewide was $34,527, for an annual increase of 0.2% (Table 1).

Increasing hardwood pulpwood timber production and prices yielded incremental returns of $594,567 per year on average for NIPF owners, for an annual increase of 4.4%. Two-thirds of the total value accrued to owners in the Coastal Plain (Timber Mart-South Region 2), but the largest percentage increase per year (8.8%) was received for NIPF hardwood pulpwood harvests in the Mountains. The average annual total NIPF pulpwood returns for the entire state amounted to $35,804,623 and showed an average annual incremental increase of 1.7%.

	Area	Total	Incremental	% of Total
Softwood	**1: Pdmnt/Mtns**	$4,217,876	$-197,101	-4.7%
	2: **Coastal Plain**	17,970,151	231,628	1.3%
Total for Both Areas		22,188,027	34,527	0.2%
Hardwood	**1: Pdmnt/Mtns**	2,381,868	209,240	8.8%
	2: **Coastal Plain**	11,234,728	385,327	3.4%
Total for Both Areas		13,616,589	594,567	4.4%
State Total	**(All)**	**$35,804,623**	$629,094	1.7%

Table 1. Average Annual NIPF Pulpwood Returns, 1990-1997 (1990 Dollars)

Consumer and Producer Surplus

The potential impacts of shifts in demand in North Carolina timber markets were examined using economic welfare analysis in order to estimate benefits accrued to NIPF owners and forest industry. The price elasticities used for hardwood were 0.144 for supply (Siry et al. 1998) and-O.028 for demand (Nagubadi and Munn 1998). For softwoods, the elasticities were 0.23 for demand and -0.43 for supply (Newman 1987). Formulas for analysis were taken from Newman (1987).

Increased demand for timber consistently increased economic returns for both timber buyers and sellers. Forest industry (buyers) had higher benefits in absolute dollars, while NIPF owners (sellers) had higher percentage benefits. For softwoods, total welfare

benefits to both buyers and sellers increased about 1.7% for each 1% rise in demand. The increase in total welfare benefits to both buyers and sellers for hardwoods was about 2% per each 1% increase in demand. For example, for a 1% increase in demand for both softwood and hardwood pulpwood, total welfare benefits would increase by $6.4 million annually. These would amount to $5.0 million annually for consumers (forest industry; 74%) and $1.4 million for producers (NIPFs; 26%). Welfare benefits from hardwoods would generate the greatest increase, with 89% of the total increase from a 1% aggregate demand shift.

Discounted Cash Flow Analyses

Discounted cash flow returns to NIPF investment in timber production with and without chip components were computed using a 6% real interest rate. Returns were greater in the Coastal Plain than in the Mountains/Piedmont Timber Mart-South regions due to higher prices. Softwood timber management regimes were analyzed based on traditional sawtimber rotations of 30 years with and without a pulpwood and chipping harvest component, and a simple 18 year pulpwood/chipping rotation (Table 2). Higher timber prices and shorter rotations for softwood timber growing led to sawtimber production with a chip component having the greatest returns, followed by chipping the stand entirely at a shorter rotation, and last, production of sawtimber only. These alternatives generated internal rates of return (IRRs) of about 6% to 13%, with the latter figure corresponding to a harvest of sawtimber with a pulp component in the Coastal Plain.

Hardwoods were analyzed using an 80 year rotation with no thinning for both upland slope and ridge (Table 3) and wet flat forest types (Table 4). The lower timber prices and long rotations for hardwoods generally yielded lower investment returns than softwoods, ranging from about 4% to 6% IRRs on upland ridge sites and 4% to 7% on wet flat sites. In both hardwood forest types and price regions, production of pulpwood had the lowest rates of return. For wet flat sites, all sawtimber options had IRRs greater than 6%. Addition of a wood chip component to a sawtimber harvest did little to increase hardwood returns, raising IRR by less than 1%. Nonmarket values might influence total returns for both hardwoods and softwoods, but were not examined.

Management Regime	NPV ($)	EAI ($)	SEV ($)	B/C ratio	Payback Period (Yr)	Real IRR (%)
P20ch T1	85.90	7.49	124.82	2.21	20	10.74
P80wo T1	-7.43	-0.54	-8.99	0.96	No pay	5.80
P80ch T1	167.51	12.17	202.82	3.23	18	11.54
P20ch T2	113.92	9.93	165.54	2.60	20	11.73
P80wo T2	88.29	6.41	106.90	1.50	30	7.78
P80ch T2	276.60	20.10	334.92	4.69	18	13.13

P20ch = chip all @ 20 years
P80wo = thin to 80ft^2 BA @ 18 yrs & harvest @ 30 yrs with no pulpwood component
P80ch = thin to 80ft^2 BA @ 18 yrs & harvest @ 30 yrs with a pulpwood component
T1=TMS Region 1 (Mountains & Piedmont), T2=TMS Region 2 (Coastal Plain). Real Discount Rate = 6%

Table 2. Softwood Discounted Cash Flow (DCF) Analysis Results Per Acre

Management Regime	NPV ($)	EAI ($)	SEV ($)	B/C ratio	Payback Period (Yr)	Real IRR %
HslPuO T1	-20.16	-1.22	-20.35	0.32	No pay	4.04
HslStO T1	-13.91	-0.84	-14.04	0.53	No pay	4.93
HslStP T1	-5.58	-0.34	-5.63	0.81	No pay	5.65
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	No pay	[illegible]

HslPuO = harvest @ 80 yrs. all volume in pulpwood
HslStO = harvest @ 80 yrs. all volume in sawtimber
HslStP = harvest @ 80 yrs. sawtimber and residual in pulpwood
Tl=TMS Region 1 (Mountains & Piedmont), T2=TMS Region 2 (Coastal Plain). Real Discount Rate = 6 %

Table 3. Hardwood DCF Analysis Results. Upland Slope and Ridge Stands. Per Acre

Management Regime	NPV ($)	EAI ($)	SEV ($)	B/C ratio	Payback Period (Yr)	Real IRR (%
HwfPuO T1	-15.57	-0.94	-15.72	0.47	No pay	4.74
HwfStO T1	12.55	0.76	12.67	1.42	80	6.58
HwfStP T1	21.89	1.33	22.19	1.74	80	6.90
HwfPuO T2	-17.63	-1.07	-17.80	0.40	No pay	4.46
HwfStO T2	19.02	1.15	19.20	1.64	80	6.81
HwfStP T2	25.46	1.54	25.70	1.86	80	7.01

HwfPuO = harvest @ 80 yrs. all volume in pulpwood
HwfStO = harvest @ 80 yrs. all volume in sawtimber
HwfStP = harvest @ 80 yrs. sawtimber and residual in pulpwood
Tl=TMS Region 1, T2=TMS Region 2 (Mountains & Piedmont), T2=TMS Region 2 (Coastal Plain). Real Discount Rate = 6%

Table 4. Hardwood DCF Analysis Results, Wet Flat Stands, Per Acre

Site Preparation Savings

Potential savings in site preparation prior to planting could occur if less woody debris and harvest residuals made for cleaner harvests. These potential savings on NIPFs were calculated on the assumption that more intensive wood chip harvests would eliminate site preparation costs (Table 5). The number of acres artificially regenerated each year (Johnson 199 1, table 22) was multiplied by the percent of area harvested for pulpwood going to chip mills (Schaberg 2000) to estimate the maximum potential savings that might be attributed to wood chipping. More than 7,000 acres would be regenerated each year according to this assumption, at an average savings of $122 per acre (Dubois et al. 1999). The Mountain forest survey unit received the least potential benefit while both of the Coastal Plain survey units garnered more than $135,000 each year in savings. The Piedmont region received the highest benefit, with savings of $440,000. At the state level, the maximum potential annual savings in site preparation associated with cleaner harvests amounted to $808,690. If fewer (or more) acres were chipped than the 1999 wood chip data indicated, then this potential savings would be proportionately less (or greater).

NC Forest Inventory and Analysis Survey Unit	Southern Coastal Plain	Northern Coastal Plain	Piedmont	Mountains
Acres Artificially Regenerated	17,566	18,554	18,393	2,597
% of Acres Going to Pulp	%40			
% of Acres Going to Chip Mills	16%	15%	49%	75%
Avg. Cost Mech. Site Prep./Acre	$122.14			
Art. Regenerated Pulp Acres to Chip Mills	1,124	1,113	3,605	779
Savings	$137,000	$136,000	$440,000	$95,000
State Total	$808.690			

Table 5. Annual Potential Site Preparation Savings from Cleaner Wood Chip Sites

CONCLUSIONS

NIPF owners as a group do not act solely as producers of timber products, but also as consumers of forest values. However, a majority of NIPF forest area in the South is held by persons with interests in timber production. The results of an economic welfare analysis indicated that an increase in demand for timber by timber buyers would encourage an increase in production on those acres held by persons with commodity interests. A 1% shift outward in the demand curve would yield more than $6 million in welfare benefits, and generate the largest incremental benefit that wood chip markets could provide for NIPF owners. Forest industry (wood consumers) would receive about 75% of this benefit, and about 89% of the increase in welfare benefits would be generated by hardwood demand shifts. NIPF owners would receive about $1.4 million dollars annually in additional benefits from a shift outward in demand of 1%. The exact amount of increase in demand due to improved chip markets is indeterminate, but it probably would be less than 5% at most.

In neither the softwood nor the hardwood market did production of pulpwood provide the highest return per acre, but production of pulpwood provided significantly greater returns than production of sawtimber alone in softwood markets and added to the value of the harvest in both markets. However, the total incremental value that a pulpwood (wood chip) component added to net present values (NPVs) or internal rates of return (IRR) to hardwoods was trivial--less than $10 per acre in NPV at a 6% discount rate, or a 0.2 added percentage points to the IRR. The increase in softwoods was more substantial, amounting to over $100 and adding more than 5% to the IRR.

On the other hand, prices are one of the major incentives among NIPF owners to harvest timber; adding a chip component to the harvest would provide more incentive to owners to sell. The actual incremental returns realized from increased pulpwood harvest volumes in the state from 1990 to 1997 were moderate, averaging about $629,094 per year, with 95% of that value increase in hardwood pulpwood. Potential savings in decreased site preparation costs were slightly more than $800,000 per year. Thus the aggregate direct returns actually realized by NIPF landowners and the potential site preparation savings were modest, at $1.4 million in total per year or less than 5% of the total state timber sale value, but would be important for individual landowners who received those benefits.

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