Market and Nonmarket Values of Forests in North Carolina:
A Review of the Literature with Preliminary Applications

by

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Abstract

This paper summarizes evidence relevant to quantifying the significance of forest-based sectors in the North Carolina economy and the value of the state's forest products and services. Estimates of the economic impacts of forest based sectors along with market and nonmarket values of forests in North Carolina are summarized based on existing literature, computations using market prices, and by adapting benefit estimates from other studies to represent local conditions. The methods, reliability, and comparability of current estimates have their limitations, but this review provides a starting point for improved assessments of market and nonmarket forest values in North Carolina or elsewhere.

INTRODUCTION

As part of a study of the impacts of wood chip production in North Carolina, many environmental groups requested detailed estimates of nonmarket values of forests in the state. This prompted us to review the literature on market and nonmarket values in the South and consider how they could be applied to North Carolina. North Carolina has about 19 million acres of forests, or about 62% of the state's total area. Forests in the state provide market commodities such as timber, pine straw, wildlife based recreation, and Christmas trees. They provide the basis for an extensive natural resource recreation sector, ranging from wilderness areas, to developed outdoor recreation sites for various activities such as camping, bird watching, hiking, kayaking, and golfing. The forests also provide nonmarket values such as water quality protection, aesthetics, spiritual renewal, biodiversity, and carbon storage.

Selected financial and economic values for forest-based goods and services have been calculated for a variety of areas, using various methods. However, these values have not been summarized for North Carolina or other states, or compared in magnitude or by estimation method. This paper provides preliminary estimates for selected values that could be quantified based on studies from the literature or from educated guesses about relevant values; notes the significant limitations in current estimates and approaches; and discusses areas for improvement in value estimates in the future.

Estimating the economic "value of forests" is a large and complex undertaking that requires definition of the exact geographical area (i.e., currently or potentially forested land), the alternative land use (i.e., agricultural or residential), and the accounting framework (e.g., whose values count), as well as consideration of the compatibility of various forest outputs (i.e., timber and soil retention), market impacts (e.g., equilibrium price changes), and comparability of market and non-market valuation methods. Given space constraints and the preliminary nature of our work, we focus on estimates of the economic impacts and values of different forest outputs, reserving further discussion of comprehensive forest assessment for future work. Table 1 summarizes the updated forest value estimates since the wood chip mill study (Aruna and Cubbage 2000). Again, we note that these estimates are not directly comparable but do provide the basis for further research on forest values.

Forest values can be classified many ways. Kramer et al. (1992) review forest valuation methods. One classification is that of use or non-use values. Use values may include extractive (harvest) or non-extractive values. For example, the extractive values are timber, game, pine straw, or minor plant harvests, and nonextractive values are recreation services, scenic beauty, wildlife watching, or carbon storage. Some use values are traded or potentially traded, while others are nonmarket values. Non-use values are not reflected in the market. For example, existence value is self explanatory, based only on mere existence, not use. Forests may also be the source of option value (willingness to pay for future use)

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and bequest value (value from endowing forests for future generations).

FOREST PRODUCTS

Regional Economic Impacts.--We estimated the impacts of forest-based wood products industry and recreation industry on the economy of North Carolina using the 1996 IMPLAN Model (Aruna and Cubbage 2000). The forest products sector industrial codes for lumber and wood products, wood-based furniture, and paper and allied products were identified directly in the IMPLAN data base. Nature-based tourism economic contributions were estimated as proportions of several identified service sectors, which included hotels and lodging (36%), amusement and recreation (36%), air transportation (28%), local, interurban transit (36%), retail trade-merchandise and food (5%), eating and drinking (15%), auto repair (12%), and auto rental (9%). As shown in the first rows of Table 1, the total forest products sector contributions to the state economy were generally larger than that of the forest-based recreation sector, although the recreation sector grew more rapidly than the forest products sector from 1977 to 1996. These economic impact findings are measures of the sector's share of or contributions to the Gross State Product.

Market Values.--Estimating the value of most forest-based market goods is fairly straightforward, although not precise. We estimated the total inventory (stock) values for forest land and standing timber volumes and the annual sales (flow) values for timber harvests, Christmas trees, and pine straw. Each of these commodities are traded directly in a product market for cash. Total inventory or sales values were estimated by multiplying the best estimate of the relevant market price times the estimated inventory or harvest volume. The stock values should represent the net present value of all future expected flows from the forest. The flow values represent revenues to forest landowners (with harvest costs netted out for stumpage values). For small changes in output of the good in question, these flow values less the cost of production are a good estimate of value. However, large changes in output would affect the equilibrium price, thus changing the amount traded in the market and impacting the welfare of consumers as well as producers. These welfare impacts are not considered here.

A hedonic pricing approach would suggest that land values in the state should fully incorporate all the market-based values of forests, for production (timber, Christmas trees, pine straw, etc.) and for amenity or recreation values that accrue directly to the landowners (second homes, tourism, wildlife watching, etc.). Based on USDA Economic Research Service data, we estimated an approximate range for land values throughout the state. These price estimates were $1000 to $2900 per acre for rural land (about 2/3 of the state) and $5000 to $20,000 per acre for urban land. Applying these estimates to the urban and rural forested areas, we estimate that the total forested land values alone are $45 billion to $165 billion.

The total value of standing timber was calculated as the amount of growing stock from the FIA reports multiplied by the weighted average stumpage price estimates. Depending on the assumptions used, the standing timber values of $17 billion would be equal to as much as one-third of total forest land values, or as little as 10%. Note that the discounted present value of future timber incomes would increase the direct inventory estimates shown in Table 1. Nontimber forest products also make market-based contributions between willing sellers and buyers in North Carolina. Foremost among these is Christmas trees production, which is estimated to generate a retail value of $70 to $100 million annually for growers in the state. The stumpage value of Christmas trees would be perhaps half as much. Pine straw production also generates modest incomes for forest landowners, at lease rates of about 50 cents per bale, or $50 to $150 per acre per year for good land. At a guess of 50,000 to 100,000 acres of pine lands being used to rake straw, this would translate into annual returns to landowners of $5 million to $10 million. Many other forest products such as mushrooms, berries, honey, medicinals, kudzu baskets, walking sticks, and other crafts come from forests, but we cannot estimate their sales or stumpage value based on current literature or our knowledge.

WILDLIFE AND RECREATION

Wildlife Expenditures.--North Carolina has a very active market for fish and wildlife recreation, which is reflected in direct market exchanges between forest landowners and persons who lease hunting rights for forest land. The 1996 Fish and Wildlife Service National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Census Bureau 1999) reported data for North Carolina. The survey reported recreation by all state and non-state residents 16 years or older. This tally included 1,557,000 anglers, for 22 million angler days of fishing, with total expenditures of $1,571,727,000. Hunting data tallied 370,000 hunters, spending 7,834,000 days at the sport, with total expenditures of $463,096,000. Wildlife watching data reported 2,404,000 participants, with expenditures of $509,725,000.

Thus the total reported wildlife-related expenditures for the state were a substantial $2.5 billion. This includes fresh and salt water fishing, in and out of state recreationists, and expenditures on equipment and on travel. These cash payments accrue to commercial businesses, not to public lands, lakes, streams, or ocean "owners". These expenditure figures could be used to estimate economic impacts on the state economy, as reported above for nature-based tourism. As with forest product market values, these figures do not include the substantial benefits to hunters, anglers, and sightseers (the consumers in this case). These benefits must be estimated through non-market valuation methods. While forest landowners probably only receive a fraction of the wildlife recreation expenditures, they do receive revenues from hunting leases. Franklin and Allen (1985) found that approximately 2.26 million acres (12%) of North Carolina forest land was leased in 1984 for about $3 million. Discussion with landowners now indicate that forest lease rates range from as little as $2 per acre up to $15 per acre for excellent sites. These lease rates would result in revenues of about $5 million to $25 million annually for the 2.2 million acres reported in 1984.

Nonmarket Values.--A number of techniques have been developed to estimate the value of forest-based nonmarket goods. Two that have been applied to North Carolina forests are the travel cost and contingent valuation methods. The travel cost method (TCM) recognizes that visitors to a recreation area pay an implicit price in terms of the cost of traveling to the designated area (including the opportunity cost of their time). By measuring the travel costs for individuals, which serve as surrogate prices, the value people place on forest recreation sites can be inferred. A demand schedule can be constructed by observing the frequency of visits by people with different travel costs. The contingent valuation method (CVM) estimates a willingness to pay schedule--either the willingness to pay for an improvement in the quality or quantity of some environmental good, or the willingness to accept for a deterioration in environmental provision. Surveys are used to elicit (hypothetical) monetary bids to estimate a value for some environmental gain or loss (Perman et al. 1996).

Recreation Benefits.--Walsh et al. (1990) compiled and summarized the benefit estimates from recreation activities in the U.S. from 20 years of empirical research using CVM and TCM, and adjusted them for inflation, and other variations such as availability of substitutes, value of travel time, restriction of samples to instate residents, etc. so that these values can be compared. Mean value of the 287 estimates is a consumer surplus (CS) of $34 per day with a 95% confidence interval of $31 to $37 and a range of $4 to $220. The median is $27. The average benefit of activities ranges from $12 to $72 per day with the highest values reported for non-motorized boating ($48.70), hunting ($41.70), fishing ($39.30), hiking ($29.10), and winter sports ($28.50).

Casey et al. (1995) used two different travel cost models to measure the net benefits of recreational services from the Grandfather Mountain Wilderness Preserve in Linville, North Carolina. The mean of the estimated CS for the wage rate model was $1,206 per person per year (standard deviation of $1,532). The average CS for the revealed value of time model was $42,892 per person per year (standard deviation of $5,129). The two models provided significantly different estimates. Casey et al. (1995) also estimated the aggregate CS derived by all hikers on the Grandfather Mountain in one hiking season. Their estimates of aggregate CS derived by all participating hikers within one season amounted to $5,332,730 for the wage travel cost model and $12,786,176 for the revealed value of time travel cost model.

Niemi and Whitelaw (1997) estimated the annual CS for all types of recreational activities in 1995 for the southern Appalachian region as $1.6 to $11.2 billion for the entire region. Total fishing related CS in 1995 was in the range of $237 to $637 million, developed water related CS was in the range of $199 to $302 million, dispersed recreation was in the range of $242 to $5,274 million and developed sites recreation was in the range of $951 to $5,006 million. If we assumed that North Carolina comprised about one-fifth of the Southern Appalachians, then the state's share of the nonmarket recreation CS estimates would range from about $300 million to $2 billion in total.

These CS estimates do not include the expenditures of recreationists (such as the wildlife-related expenditures detailed above), but rather represent the benefits to visitors over and above the costs that they incur. These benefits cannot be fully captured by the owners of forest and other recreation sites, due to the difficulty of determining and charging the exact CS of each visitor. Thus, these CS estimates are substantially higher than any revenues that could be expected through market transactions.

FOREST SERVICES

Various nonextractive goods and services are provided by forests. These include the indirect market-based values of forests as recreation sites and viewsheds, the imputed value of water quality protection, and goods traded in nascent markets such as wetland restoration sites, endangered species or biodiversity protection, or carbon storage. They also include nonmarket values for preservation of forests for option, existence, or bequest values.

Soil Protection, Water Quality, and Wetlands.–One would expect forests to have high values for protecting streams, rivers, lakes, wetlands, and estuaries from soil and nutrient pollution. Ribaudo and Young (1989) estimated the cost of soil erosion to be about $1 per on in 1986, which would approximate about $2 per ton currently. Forest land average erosion rates are 0.16 tons per acre; agriculture crop land is 4.6 tons per acre; pasture land 1.7 tons per acre. Thus for 18 million acres of private forest land, the net benefit of retained forests rather than agriculture could be estimated as the opportunity cost of $55 to $160 million per year.

Private entrepreneurs and the state of North Carolina are building wetland banks that can replace or mitigate other wetland losses that have occurred during development. These areas are small but the values per acre are substantial. Wetland credits currently are worth $10,000 to $20,000 per credit (acre). Total values will amount to millions of dollars annually.

Carbon Sequestration.--Many studies have been performed on carbon sequestration by forests. The values of opportunity cost range from $13 to $600/ton of carbon produced. If we valued the total amount of the 17 million acres of natural forest in the state at $3 to $100 per ton, the annual value for carbon sequestration of protecting all those forests from harvest would be $40 million to $1.4 billion per year, and the current standing value would be $1.75 billion to $52 billion. For the existing 2 million acres of pine plantations, carbon values would range from $20 million to $650 million per year, or $200 million to $7 billion standing in the woods. The 2.1 million acres of planted pines in the state could generate a carbon sink (offset) value of $20 to $660 million per year, or a standing value of $200 million to $6.6 billion. Improving growth on existing natural stands by about 25% (about 1 ton per acre per year on 15 million acres) could generate perhaps another $20 million to $660 million per year.

Forest Health.--Haefele et al. (1991) studied the nonmarket benefits of protecting forest quality of over 34,000 ha of Spruce-Fir forests in the Southern Appalachian Mountains using CVM with two question formats. Residents were asked their willingness to pay (WTP) (in the form of increased taxes) for the 1/3 of the high-quality forests in the region along roads and trails, and for all of the high-quality forests in the region. They found substantial WTP to protect forest quality, with most of benefits due to nonuse values. Depending on the question format, respondents were willing to pay about $18 to $59 per year to protect forests along roads and trails, and about $20 to $99 per year to protect all of the remaining high quality forests. The existence values made up about half of the total bid for both formats (58.5% and 55.9%), followed by bequest value (29.6% and 29.8%). Use value makes up only about 9% to 13% of the total WTP for forest protection.

Holmes and Kramer (1996) continued the analysis of the Haefele et al. (1991) data. Respondents were divided into users and nonusers and median annual household WTP to protect all remaining healthy areas of spruce-fir in the southern Appalachians was estimated to be $36.22 for users and $10.81 for nonusers. MacNair (1996) used the same data and found that the median WTP to protect remaining spruce-fir forest along road and trail corridors were $48.49, $48.54, and $24.36 for the maximum score, smoothed maximum score, and probit models, respectively. Thus estimates of WTP for healthy forests vary with the question format, type of respondent, and method of analysis. In all cases, however, North Carolina residents placed positive values on the existence and recreational use of spruce-fir forests.

CONCLUSIONS

We could derive moderately reasonable estimates of revenues from many extractive and some non-extractive forest products, but only rough or perhaps even inaccurate estimates for nonmarket values. These estimates do at least provide some benchmarks regarding overall forest values in North Carolina. The literature review indicates that nonmarket values appear to be at least as large, and sometimes larger, than the market values, although it is not possible for any particular individual or firm to fully capture or profit from them. To a large extent, these market and nonmarket values are joint products that are stackable, although they surely influence each other. For example, forestry practices such as timber harvesting might decrease the aesthetic enjoyment and recreation performed on forest lands. On the other hand, active forest harvesting and management might increase some of these nonmarket forest values. Carbon storage in

particular has potential to generate huge nonmarket benefits from tree plantations or increased stocking levels in natural forests. Preventing of the loss of forests to natural disasters through more active management and maintaining healthier stands might yield significant positive nonmarket forest benefits as well.

We summarized some nonmarket valuation research in the Southern Appalachian forests. Estimates from other regions could be used to estimate the value of changes in the extent and condition of North Carolina's forests through a benefits transfer approach. The most basic method of transferring values is through applying unit values, such as consumer surplus per day of recreational use (c.f., Walsh et al. 1990). The relevance of such values from other regions must be adjusted for differences in population and the resource conditions in North Carolina. Better estimates of market values could also be made with more specific research.

The large economic values indicate some limits of nonmarket valuation. These values are difficult for forest owners to capture. If society does value these benefits for goods and services, it may choose to intervene in the market outcomes in order to enhance their protection. Specifically, society may choose to (1) provide incentives or subsidies for production of nonmarket values; (2) regulate private forest landowners to require them to produce such goods and services, at those owners expense; or (3) provide education or technical assistance in hopes of changing landowners' production of goods and services. Many nonmarket values are not likely to be internalized, either through actual financial markets, state policy or fiscal incentives, or private owner's management actions. The difficulty in quantifying those values, costs of distributing payments, and government funds required would be substantial. The degree and costs of public intervention required obviously are crucial questions regarding the protection of forests and enhancement of nonmarket values.

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Table 1. Summary of Selected Values of Forests and Forest Products in North Carolina

Characteristic	Year	Annual/Per Acre Value	Total Value
Value Added	1996	$205 billion NC GSP	na
Forest Products Mfg	1996	$4.917 billion	na
Nature Tourism	1996	$2.206 billion	na
Forested Land Value	1996	$1000 - $20,000/ac	$45 - $165 billion
Rural	1996	$1000-$2900/ac	$12.8 - $37.2 billion
Urban	1996	$5000-$20,000/ac	$32 - $128 billion
Timber Stumpage	1997/90	$650 million (1997)	$17.5 billion (1990)
Wood Chips	1997	$10 million	na
Pulpwood	1997/90	$60 million (1997)	$1.5 billion (1990)
Sawtimber	1997/90	$580 million (1997)	$16 billion (1990)
Wildlife Expenditure	1996	$2.544 billion	na
Hunting	1996	$463 million	na
Fishing	1996	$1.571 billion	na
Non-Consumptive	1996	$510 million	na
Hunting Leases	1985	$3 million	na
Nontimber Products			
Christmas Trees	1998	$75-100 million	na
Pine Straw	1998	$5-$10 million	na
Water Protection	2000	$55-$160 million	na
Carbon Sequestration			
Pine Plantations	2000	$20 - $650 million	$200 million - $7 billion
Preserved Forests	2000	$40 million - $1.4 billion	$1.75 - $52 billion
Recreation Consumer Surplus	1995	$300 million - $2 billion	na