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July 18-20, 2005

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Future Forestland Area in the U.S. South

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ABSTRACT

The southeastern United States has been heavily transformed by various forms of resource exploitation. A review of historical data shows that net change in forest area has been minimal while much of the land in the region has experienced some change over time. Recent economic changes have accelerated urbanization in the region. Future forest area depends both on these urbanization factors and on the prospects for timber prices. A forecasting exercise shows that, if timber prices remain low, the South could see strong net declines in forest area for the first time since the early twentieth century.

INTRODUCTION

The southeastern United States is a region heavily transformed by two epochs of resource exploitation. Intensive agriculture peaked in the late nineteenth century with the Boll Weevil. Extensive timbering commenced at about the same time and the two forces together left nearly every acre of the South heavily impacted by human utilization and transformed from its aboriginal condition (Williams 1989). These two epochs were followed by a renewal period within which forests re-colonized abandoned agricultural land and crops and pasture uses settled on a smaller portion of land. Today forests comprise 214 million acres or more than 65 percent of the South's land area and the region's diversity of biota is among the highest in North America.

Since the 1970's the utilization of the South's forests has again evolved in fairly rapid fashion. Restrictions on timber harvesting in the western United States—e.g., harvests on national forests fell by 77 percent between 1987 and 1999--have shifted the focus of the wood products industry to the South. Increased timber prices over this period coupled with declines in agricultural prices have shifted land from crops to tree growing. Since reaching a peak in the late 1990's, timber prices have fallen off, again affecting the utilization of rural lands. Comparative advantage has also fueled general economic growth in much of the South so that population has grown faster than for the nation as a whole between 1980 and 2000 and has driven an expansion of urban and suburban land uses.

In this paper, I examine the history, trends, and possible future of the area of forests in the US South. This is the foundation upon which any analysis of forest sustainability needs

to be constructed. I start by surveying historical land use and forest area changes and then examine forecast scenarios for these variables to the year 2040. Findings indicate a substantial sensitivity to the condition of timber markets in the region. Much of the work presented here is based on findings reported in the Southern Forest Resource Assessment (Wear 2002, Wear and Gries 2002), but also reflects trends that have emerged since that work was completed.

LAND USE HISTORY

Examining land use change in the South generally leads to two seemingly contradictory conclusions: land use has been highly variable and it has been surprisingly stable. A majority of land in the region is rural and a substantial portion of these lands have, at the margin, moved between agricultural and forestry uses over the past century. However, except for a brief period in the 1970's, the net effect of these changes is that the total amount of forest area has remained relatively stable since the 1930's in the South.

Net changes can be evaluated by examining land uses reported by major category for each Census of Agriculture year (roughly every 5 years) between 1945 and 1992 (Economic Research Service 1996). These data show that, between 1945 and 1992, two major changes in land use occurred: (1) the area of urban and rural transportation uses roughly tripled from 2.1 percent to 6.6 percent of land area and (2) agricultural uses declined. This finding is roughly consistent with population growth observed over the same period. Total agricultural uses (cropland plus pasture) declined from about 33 percent in 1945 to about 28 percent in 1992 (Table 1). In contrast, forest area was roughly constant. It was about 56 percent of the South in 1992 and ranged from a low of 55 percent in 1945 to a high of 60 percent in 1964.

Table 1 - Allocation of southern land among major uses, 1945-1992 (values for Texas and Oklahoma are not included)

Year	Cropland	Forest	Pasture	Urban*	Other
			Percent		
1945	25.1	54.6	8.0	2.1	10.1
1949	26.7	55.9	6.0	2.5	8.9
1954	24.2	57.6	8.1	2.6	7.5
1959	21.6	58.1	10.3	3.2	6.7
1964	20.5	60.0	9.6	3.6	6.3
1969	23.1	58.1	8.2	3.8	6.8
1974	23.1	57.9	7.9	4.3	6.9
1978	23.7	57.0	6.2	5.3	7.8
1982	22.9	55.7	7.3	5.8	8.3
1987	21.7	55.4	7.2	6.6	9.1
1992	21.5	56.2	6.7	6.6	9.0

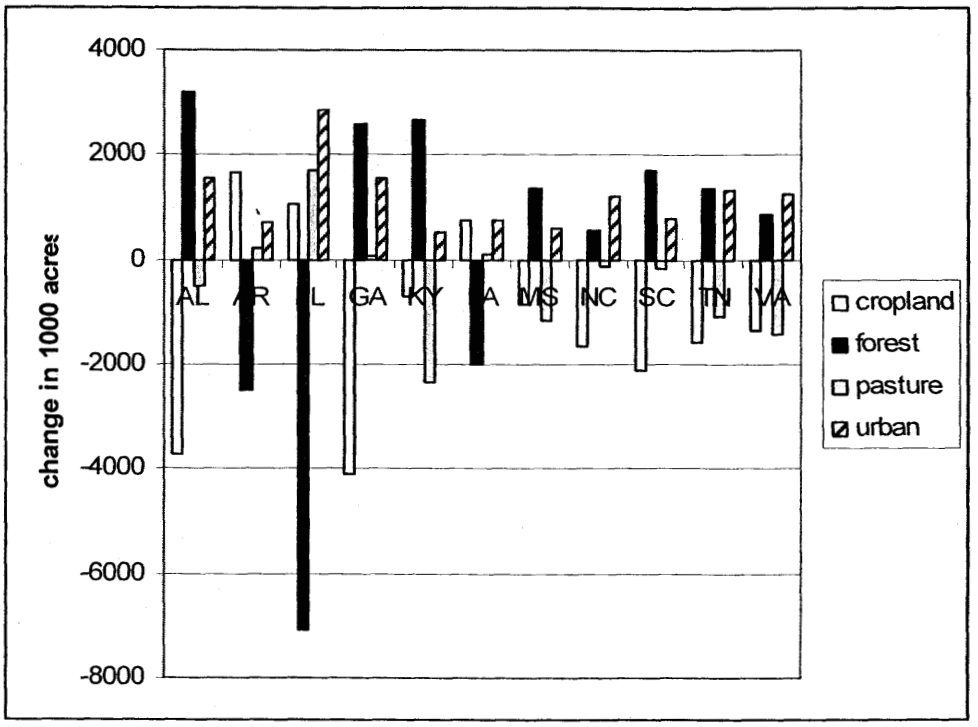

Figure 1 - Land use changes by State (1945-1992)

The pattern of change for forestland differs among States. With the exceptions of Arkansas, Florida, Louisiana, Oklahoma and Texas, all States had more forestland in 1992 than they did in 1945 (Fig. 1). In the eight States with gains, land use shifted strongly from agriculture to forest between 1945 and 1969. Georgia, North Carolina, and Virginia have experienced declines in forest area since the early seventies. Over the same period, area in forest has been essentially stable in Alabama, Kentucky, Mississippi, South Carolina, and Tennessee.

To examine more recent changes in land use, we examined data from the National Resource Inventories for the period 1982 to 1997. These data indicate that the predominant pattern of change between 1982 and 1997 has been a reduction in the total area of cropland and an increase in the area of developed uses. The total area of pasture and forest declined only slightly between 1982 and 1997 (Fig. 2). Most of the urban land uses and the observed increase in urban land uses were concentrated in the five states along the Atlantic Coast from Virginia to Florida (Fig. 3). In these states, 3 to 6 percent of nonfederal land became developed over this period.

The preceding data describes net change in land use. There can be considerable offsetting changes between land uses that are not revealed by measures of net change. While we could not derive gross changes at the state level from the available NRI data, the 1997 NRI report indicates that 9.6 percent of all rural nonfederal land in the United States experienced a land use change between 1982 and 1997. That number is likely to be higher in the East where the share of private lands is much higher than in other regions. Land use data from forest inventories described in the FIA period surveys reveal

that over the past 20 years 2-3 million acres per year experience a change either from forest to nonforest or vice versa.

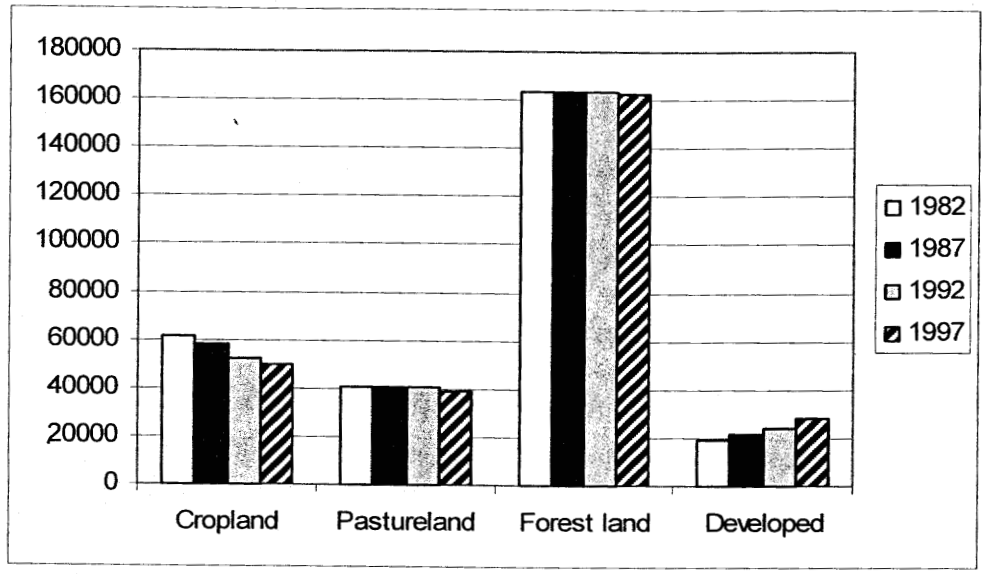

Figure 2 - Percent of (a) forest, (b) urban, and (c) agricultural land uses by county for Southern States 1982-1997, various years (note that Texas and Oklahoma are not included). Source: National Resource Inventories, USDA Natural Resource Conservation Service

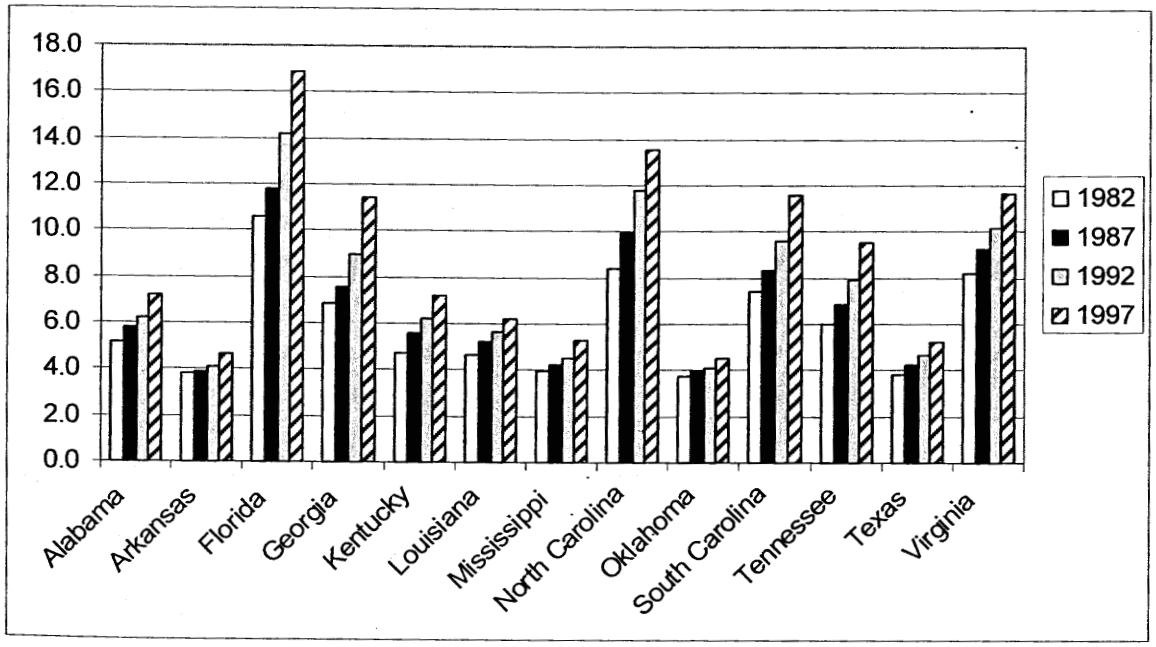

Figure 3 - Percent of nonfederal land in developed uses for Southern States 1982-1997, various years. Source: National Resource Inventories, USDA Natural Resource Conservation Service

LAND USE FORECASTS

The history of land use change in the South provides evidence of how economic and biophysical factors interact to change the highest valued uses of land over time. To examine the potential for future changes in land use change, we employed a county-level land use model developed by Hardie and others (2000). This econometric model assumes that:

1. The allocation of land between urban and rural uses is driven by population density, personal income and housing values.
2. The allocation of rural land to agricultural and forest uses is driven by returns to local crops, returns to grazing, agriculture costs, land quality, and timber prices. All of these variables except timer prices are defined at the county level of resolution. Timber prices are defined for two or three subregions per state defined by the Timber Mart South price reporting service.

The model was estimated based on land-use patterns recorded in 1982, 1987, and 1992 by the National Resource Inventories. See Hardie and others (2000) for modeling details. Detailed land-use categories were lumped into four classes: urban/residential, cropland/pasture, forest, and other. The urban/residential class includes areas in transportation, and other corridors. The "other" class can be considered a transitional zone where land use is unclear due to changing conditions.

Two core projections were developed to (1) isolate the influence of general economic and population growth on the region and (2) develop a complete assessment of land use changes that account for market responses to increased scarcity of timber as rural land is developed. The two core projections were defined for the following scenarios:

1. Base scenario. An initial scenario was developed assuming that the population, income, and housing value forecasts are correct and that the relative position of timber and agricultural markets does not change in the future. This provides an estimate of how population growth and economic growth will drive urban land uses
2. Market scenario. A scenario was also constructed to evaluate how rural land uses might be influenced by a relative shift in returns to agricultural and timber management. This scenario assumes that the population and economic change forecasts in the base scenario hold and that the real price of softwood timber will increase by 35 percent by 2020Agricultural returns are held at their 1992 levels. This scenario was built by imbedding the land use model described here within the Southern Regional Timber Supply model (SRTS). This allowed land use, timber management, timber harvesting, and timber prices to be jointly and consistently determined. (See Murray and others (2001) for a description of how these models are linked together.)

The results of the two simulations are shown in Fig. 4. The base scenario indicates a growth in urban area from about 20 million acres in 1992 to 55 million acres in 2020 and to 81 million acres in 2040 (Fig. 4). Without price adjustments in rural land markets (addressed below), land would shift out of agricultural, forest and other uses. Forest

declines by about 12 million acres, agriculture declines by about 13 million acres, and other declines by about 7 million acres.

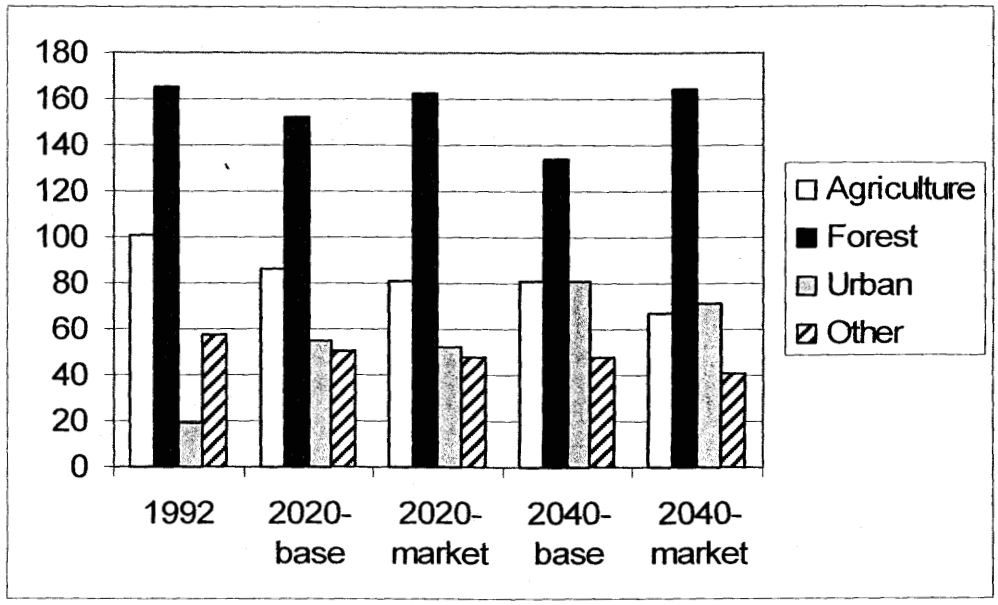

Figure 4 - Areas of land in (a) forest, (b) urban, (c) agricultural and (d) other land uses in 1992 and for two forecast scenarios and two time frames. Source: Land use forecasting model described in Hardie and others (2000)

In the forecast for 2020, substantial population and income growth are projected for about one third of the region's counties. Urbanization is concentrated in the Southern Appalachian Piedmont stretching from Raleigh/Durham North Carolina through Atlanta Georgia, the Atlantic Coast from the Carolinas through Florida and a portion of the Gulf Coast centered on Mobile Bay. Other centers of expanding urbanization are around Nashville and Knoxville, TN, and in northern and eastern Virginia.

Losses of forestland are concentrated in areas of expected urbanization (Figure 5). The Southern Appalachian Piedmont of the Carolinas and Georgia, central Tennessee, and Florida all are expected to experience substantial losses of forestland in response to population and income change.

Mapping changes in land use by ecological section shows that forest loss will generally be concentrated in the eastern half of the South. The ecological section with the greatest loss will be the Southern Appalachian Piedmont. Fig. 6 again shows forest losses would be high along the entire Atlantic Coast and the Gulf Coast of Florida. The largest contiguous block of forest loss will include the Southern Appalachian Piedmont, the Blue Ridge Mountains, the Ridge and Valley, and the Southern Cumberland Plateau.

The market scenario shows how the base scenario would be altered if timber rents continued to increase relative to agricultural rents consistent with timber market projections. A 35-percent increase in real forest rent relative to real agricultural rent is forecast for 2020; a 75 percent increase for 2040.

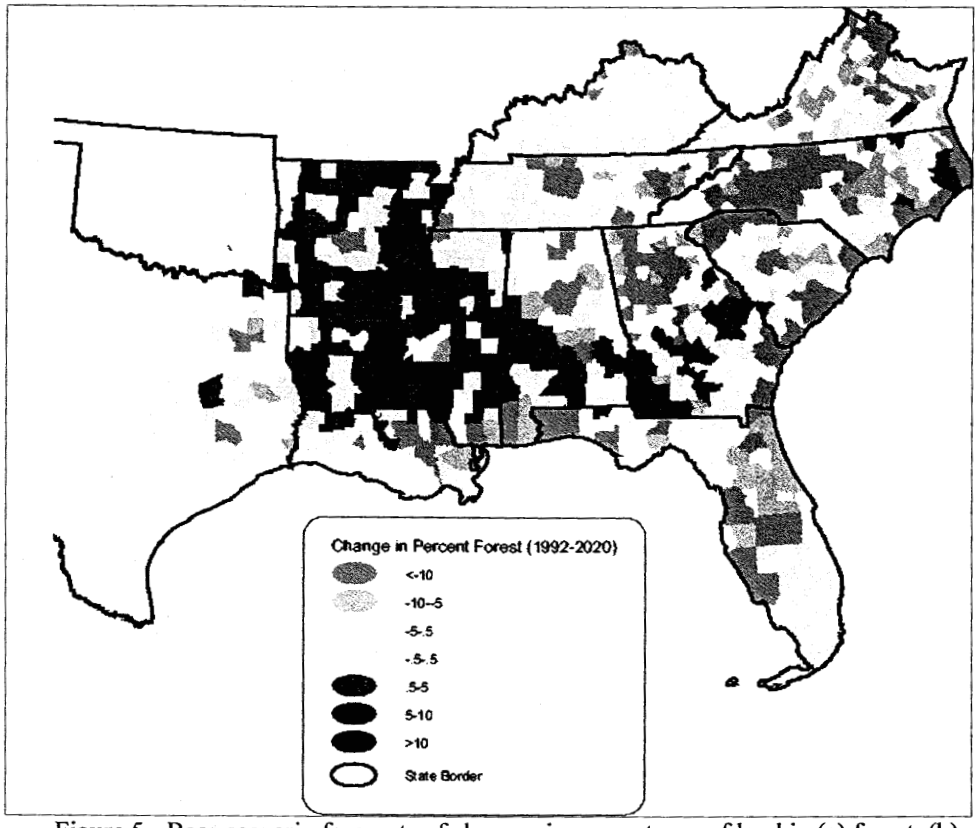

Figure 5 - Base scenario forecasts of changes in percentages of land in (a) forest, (b) urban, and (c) agricultural land uses by county for 1992-2020. Source: Land use forecasting model described in Hardie and others (2000)

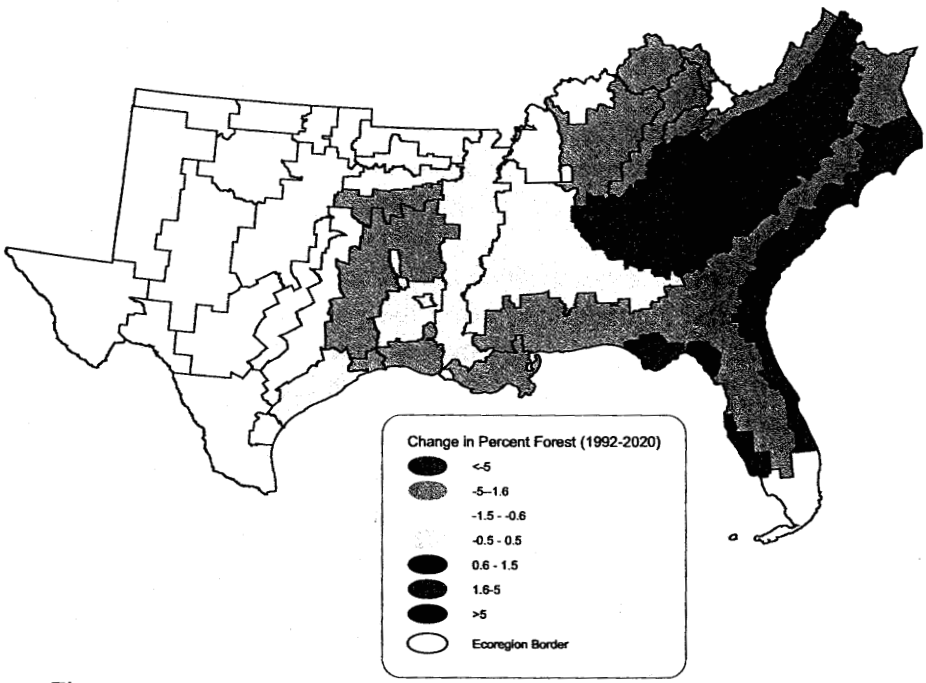

Figure 6 - Forecast changes in percent of forest by ecological section for 1992-2020 under the Base Scenario. Source: Land use forecasting model described in Hardie and others (2000). County aggregation according to Rudis (2000)

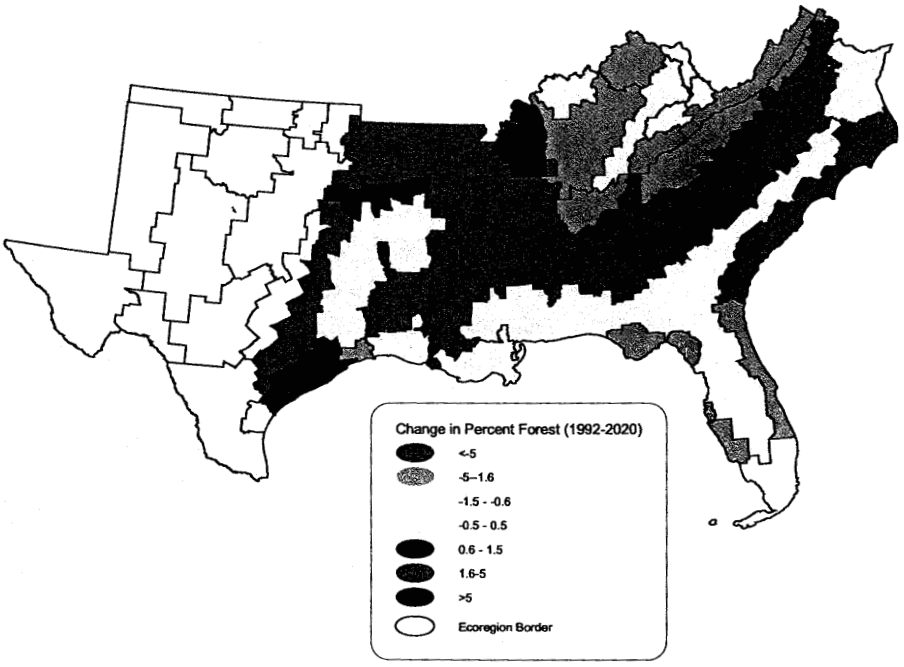

Figure 7 - Forecast changes in percent of forest by ecological section for 1992-2020 under the Timber Price Scenario. Source: Land use forecasting model described in Hardie and others (2000). County aggregation according to Rudis (2000)

The expected increase in timber prices has two effects. One is to dampen slightly the demand for land in urban uses. As a result, urban land is forecast to be at about 52 million acres rather than 55 million acres in 2020 and at 72 million acres rather than 81 million acres in 2040. The other effect is that some agricultural land would be planted to forest cover. Roughly 8 million acres would be planted by 2020 and 23 million acres by 2040 (Figure 4). The net effects are: (1) urban area expands, (2) forest change is nil, and (3) agricultural and other land declines. Consistent with history, gross change among land use types would continue to be substantial.

The increase in timber prices leads to shifts from agriculture to forest within the South in 2020. Certain areas of the South may be especially sensitive to these changes (Figure 7). In the eastern half of the region, two areas show an increase in forest area. One is a small area in the Upper Coastal Plain centered on the border between of North Carolina and Virginia. The other is the entire Upper Coastal Plain of Georgia and parts of the Coastal Plain of South Carolina.

However, the largest block of potential gain in forestland would lie in the western one third of the South. This area includes the southwestern quadrant of Alabama and nearly the entire States of Mississippi, Louisiana, and Arkansas. In this area, rural land use appears to be very sensitive to changes in relative returns to agricultural and forest uses (Figure 7).

As significant as the areas showing gains in forest area is a large contiguous portion of the region showing little response to increasing forest rent. This area reaches from the northern parts of South Carolina, Georgia, and Alabama to the northern boundary of the South.

CONCLUSIONS

These projections perhaps provide a bracketing of possible futures for forest land in the South. The base scenario defines a world where timber prices remain relatively constant relative to agricultural returns over the foreseeable future. This seems somewhat consistent with market conditions observed so far in the twenty first century. Under this scenario, approximately 31 million acres of forest (about 15 percent) would be converted to an urban use.

With the base scenario, where timber prices increase relative to agricultural returns, the outcome is much different. Here, we expect a similar large amount of forests to be converted to urban uses, but we also simulate shifts from marginal agricultural uses to forest uses. These latter changes nearly completely compensate for the forest land losses to urbanization: a total of 3 million (1.5 percent) would be lost.

This variation is substantial. The base case defines a scenario where an unprecedented and substantial net loss of forests occurs. This would define a dramatic change from historical patterns of change observed since the 1930's. In contrast, a stronger timber market would result in a continuation of very small net change in forests in the South.

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