# FOREST ECOSYSTEM SERVICES AND DEVELOPMENT PRESSURES

David N. Wear, USDA Forest Service, Southern Research Station, P.O. Box 12254, Research Triangle Park NC 27709 (dwear@fs.fed.us)

## Introduction

Ecosystem services from forests on private lands are often under-produced because landowners bear the costs of restoring, preserving, and managing their lands to produce ecological services that benefit all members of the community or larger society. Over the last two decades, a variety of federal and state programs have applied a combination of regulations, extension, and incentives to encourage private landowners to implement forest management, conservation, and restoration activities.[1] Most of these programs have relied on payments from the government to landowners (usually in the form of cost-shares) to encourage specific types of land management. Although programs that subsidize tree planting for timber production in the U.S. South have a long and successful history, programs specifically designed to enhance the production of ecosystem services such as water and air quality and biodiversity conservation are newer and their impacts uncertain.

Recently accelerated development pressures on forest lands in the U.S. South portend important consequences for the provision of ecosystem services from both the demand and the supply sides. Increasing populations imply an expanding demand for both marketed and non-market benefits of forests—i.e., for both timber and for other ecosystem services. At the same time, a reduction in the amount of forest and a change in the structure of remaining forests implies both constraints on management options and on the ability of forests to provide ecosystem services.

The magnitude of these changes suggests that the ability of federal and state budgets to support programs of sufficient size to significantly influence ecosystem service production is questionable. A direct corollary is that, with nearly 90% of forestlands in the U.S. South under private ownership, production of ecosystem services from southern forests can only be addressed with significant private sector participation. Hence it is crucial from both ecological and economic perspectives, that private sector provision of forest related ecosystem services be as efficient and effective as possible.

This paper explores some general questions regarding scarcity of ecosystem services and recently proposed market based programs for providing ecosystem services from private lands. We start by examining development pressures in the South and outline their likely implications for southern forests, especially regarding emerging scarcities of certain ecosystem services. We then explore the implications for encouraging their provision.

## Development Pressures in the South

With 89% of timberland in private ownership, forest conditions are largely the outcome of decisions to place each parcel of land into a use that matches its highest market value. Shifts in the markets for agricultural and timber products have long held influence over land conditions in the region. In recent years, an accelerating rate and changing pattern of urbanization has played a stronger role in organizing forest conditions in the South. This ownership pattern also implies that only private forest owners can have a significant influence on the provision of ecosystem services in the region.

Studies of the spatial arrangement of land use in the region show that urban pressures dominate rural values in land use choices (Hardie et al. 2000). Among the variables that influence the amount of

[1] Examples include the Forest Legacy Program (FLP), Forest Land Enhancement Program (FLEP), Forestry Incentives Program (FIP), Stewardship Incentives Program (SIP), Sustainable Outreach Initiative (SFOI), and the Conservation Reserve Program (CRP).

developed land within a county, population and income are the most influential. Expanding populations shift the demand for developed land outward and lead to forest clearing. Where these urban pressures are not evident, rural lands are predictably split between forest and agricultural uses based on the relative returns to these two uses. In short, if prices for agricultural trend upward relative to timber, then forests will be converted to agriculture uses.

What's more, the anticipation of population growth and development has an effect on land condition. Wear and Newman (2004) have shown that forecasts of population are strong predictors of current timberland prices and can push prices well beyond the returns to timber production.

To examine the potential effects of ongoing development pressures, we forecast land use changes (Wear 2002) and forest fragmentation changes (Wear, Pye and Riitters 2004) in response to anticipated population growth in the southeastern United States[2]. Projections were made to 2020 and to 2040 for the land uses; only to 2020 for the forest conditions.

In total, roughly 12 million acres of forests were expected to change to a developed use by 2020 in the South. By 2040, forest loss would total about 31 million acres (17% of existing timberland). Urban areas expand from about 20 million acres in 1992 to 55 million acres in 2020 and to 81 million acres in 2040. Land would shift out of agricultural, forest, and all other uses to accommodate development. By 2020, forest declines by about 12 million acres, agriculture declines by about 13 million acres, and other declines by about 7 million acres.

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, Tennessee, and in northern and eastern Virginia.

Forecasts of forest fragmentation (Wear, Pye and Riitters 2004) show similar patterns. We project losses in the area of interior forests to proxy for fragmentation. Among ecological sections, the Southern Appalachian Piedmont would lose the most area of interior forest cover (173,166 ha). The Gulf Prairies and Marshes in Texas has a very small area of interior forest and is the ecological section with the greatest percentage reduction in interior, losing 56.7%. The second and fourth greatest percentage reductions are found in the eastern and western Florida Coastal lowlands respectively.

Roughly 66% of the loss of forest interior is projected to occur in counties attached to Metropolitan Statistical Areas (MSAs). Heavily impacted MSAs are concentrated in Florida. The Tampa-St. Petersburg-Clearwater MSA is forecast to lose 34.5% of its interior forest and seven of the ten MSAs with the highest percentage losses are found in Florida. Columbia, South Carolina; Atlanta, Georgia; and Raleigh-Durham-Chapel Hill, North Carolina round out the top ten.

In the rural portion of the South, forest area could increase, remain stable, or decrease depending on the relative returns of agriculture and forestry. With prices increasing at about ½% per year, we forecast a conversion of roughly 30 million acres of agricultural land to forest by 2040. This would almost completely offset the loss to urbanization, but these gains in forest area would be in the western part of the region, away from urbanizing areas. Stable timber and agricultural prices led to no transitions between agriculture and forests.

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[2] Population and income forecasts are based on county level projections defined by NPA Data Services (1999).

**Implications for Ecosystem Services**

Ecosystem services are classic economic production externalities. That is, because they are not traded, the levels of these services are side effects of production decisions made regarding priced goods and services. As a result, we don't expect the market to "find" the production level that is right for society. A key first question is whether or not we expect the production level to be higher or lower than the "correct" level.

It seems clear from the projections of development pressures, that ecosystem services will be altered by land use changes and fragmentation over the near future. These changes are likely to be concentrated in the eastern seaboard states of the South: Virginia, the Carolinas, Georgia, and Florida. The next question is which services are most likely to be affected.

*Habitat*: Changes in land use and fragmentation lead directly to alterations of forest habitats for various species. Based on findings from the Southern Forest Resource Assessment (Wear and Greis 2002), we might be concerned about two types of changes. In the Southern Appalachian Piedmont, the area with the highest amount of recent and projected development concerns focus on habitats for neotropical migrant birds. Smaller forest patches that are increasingly isolated limit the contribution of forest cover to species persistence. In the coastal flatwoods, a combination of development and intensive management may alter habitats for endemic imperiled amphibians.

*Water*: Forests provide cleaner water than any other land use. As forests are cleared for expansion of urban areas, two compounding forces apply. First, the demand for clean water increases as the number of consumers and businesses increase. Second, water retention and water quality decline as land shifts from native cover to a higher concentration of impervious surface. Water supply debates have begun to emerge throughout the developing portion of the South. In addition, water quality regulations are coming to represent binding constraints on development in parts of the South.

*Recreation*: Development also portends an increase in the demand for and a decrease in the supply of recreation in the proximity of urban areas. Public forests will become increasingly congested and the demands for recreation on private forests will likely increase. This will translate into expanded opportunities and prices for recreational leases but may also lead to outright purchase of more remote forest areas for recreational uses.

**Provision of Ecosystem Services**

Development pressures will lead to increased scarcity of water, biodiversity, and recreation ecosystem services. Increasing the provision of land and ecosystem services from this private land base would require either direct regulation of land use and management or providing a set of incentives that motivate landowners to produce more of these ecosystem services. The latter approach would involve emulating markets for the production of ecosystem services. In this section, we speculate on the issues that challenge the development of these approaches.

Economics of land use define two very different zones where land use changes are likely to occur: the urban-rural interface, which is difficult to shift, and the agriculture-forestry interface where small changes could have larger effects. It is important to distinguish between these two zones when discussing future programs.

The focus of conservation in the urban-rural interface is likely to be on delivery of specific services to urban centers and is heavily influenced by the legacy of historic land use changes (many options are already foreclosed). In the urban-rural interface, development values dominate and land prices are 10 to 100 times prices in adjacent rural areas. In these areas, it is difficult to change land use outcomes without a massive infusion of capital. Because options are limited, efforts are likely to focus on providing essential consumptive services such as recreation or water quality. In the cases where

producers and consumers of the ecosystem service are well-defined, direct contracting for the service can result. A key issue for the forestry sector is to communicate options to municipalities, for example to mitigate water treatment costs through forest retention and careful management.

Protecting habitat and biodiversity in the urban-rural interface will continue to be extremely difficult. High land prices preclude managing habitat at a large scale, suggesting that conservationists focus on "conservation triage" to identify and protect key remnant habitat areas ahead of the bulldozer.

Owners of forests located between development poles may not be under direct pressure to develop, but may find it increasingly difficult to hold timberland as property taxes increase. Incentives based on tax relief for conservation may be the most effective means to compensate landowners for providing essential ecosystem services in the proximity of urbanizing areas.

At the agriculture-forestry interface, marginal incentives may have a much greater impact on land use and forest management. As a result, ecosystem services that depend on a broader landscape level configuration of conditions are influenced by this margin. These services include

- habitats for neotropical migrants,
- amphibians,
- carbon storage,
- forest health, and
- protection and restoration of rare forest types.

The effective provision of ecosystem services, with the exception of carbon, requires spatial targeting—location of forest is as important as the amount of forests. One focus for targeting habitat protection is to focus on rare forest types, where ecological and conservation values may be especially high.

**Conclusions/Implications**

The protection and enhancement of ecosystem services from forests is emerging as an area of interest to many in the forest sector. In the South, ecosystem services can only be maintained or enhanced through engagement of private landowners. Policy makers and researchers are beginning to contemplate the design of market based programs to encourage these activities. We close by offering several general observations regarding the development of these types of approaches in the South.

- Scarcity of ecosystem services will continue to be concentrated in specific subregions of the South, therefore requiring some mechanism for targeting programs and weighting the contributions of management activities.

- Policy discussion needs to start by defining scarce ecosystem services and anticipated changes in their provision. The next step is to develop specific measures of service outcomes and goals. The Southern Forest Resource Assessment provides a first step toward identifying these emerging scarcities.

- Market-based solutions depend on providing incentives, therefore raising the question of who pays. The answer depends on the service and who benefits and this may differ between the urban-rural and the agriculture-forestry interfaces. Purchasers could include government—either through exchange of payment programs or tax relief—NGO's who broker funds from members and foundations to achieve environmental goals, or corporations in the case of carbon credits.

- Keeping trees on the land is a starting point for policy rhetoric but is not the end of the story. Most ecosystem services of interest depend on the spatial configuration of forest cover—requiring mechanisms to target the application of incentives.

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**For more information about this research, contact:**

Dr. George Ice
Principal Scientist
NCASI West Coast Regional Center
P.O. Box 458
Corvallis, OR 97339-0458
(541) 752-8801
gice@ncasi.org

Dr. Alan Lucier
Senior Vice President
NCASI
P.O. Box 13318
Research Triangle Park, NC 27709-3318
(919) 941-6403
alucier@ncasi.org

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publications@ncasi.org

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