

# **The Southern Forest Futures Project: Using public input to define the issues**

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## ***Introduction***

The US Forest Service, Southern Research Station and Southern Region, in partnership with the Southern Group of State Foresters, are conducting a broad scale assessment of potential futures called the Southern Forest Futures Project. This effort builds on the Southern Forest Resource Assessment (SFRA, Wear and Greis 2002) which identified several forces of change reshaping forests and the potential implications of these changes for economic conditions and ecological services. The Southern Forest Futures Project (herein referred to as the Futures Project) is designed to further examine how these and some new emerging factors could reshape forests over the next half century and beyond. While SFRA provided forecasts of some key variables, it focused primarily on understanding trends and conditions. The Futures Project will focus on forecasting future change and its potential implications for forest ecosystems, their services, and human communities. The overall goal of the Futures Project is to inform forest management choices, policy discussions, and science programs with the best possible understanding of the long term implications of changes in southern forests as well as critical uncertainties regarding forest sustainability.

As with the SFRA, the Futures Project begins with a thorough scoping of the issues that warrant careful analysis. This paper describes the public participation process used to elicit public input and the resulting findings. These findings define how forces of change and implications of these forces are interlinked in a network of social and natural systems in the southeastern United States, and lay out a suite of issues that the public suggested be considered in the conduct of the Futures Project.

In this paper, we present an overview of plans for the Futures Project. We describe the design of the process used to elicit public input and the process used to summarize the input for use in the subsequent stages of the project. We conclude with a description of what we heard from the public and how this input will be used in subsequent phases of the Futures Project.

## **Overview of the Southern Forest Futures Project**

Regional scale resource assessment in the South is especially challenging because of the broad diversity of ecological systems, economic conditions, and social settings involved. Much of the knowledge base relevant to forests is ecosystem-specific and social dynamics and resource problems vary across the South. Furthermore, the various forces of change at work in southern forests are understood in varying degrees and with different levels of certainty. In order to accommodate these challenges, we have designed a three tier analysis approach to address the simultaneous needs for a coherent regional outlook on forest futures and a more detailed analysis of ecological, economic, and social effects.

**Regional Forecasting:** The first tier of analysis will start with a number of alternative scenarios describing potential futures. These scenarios will be drafted by a team of experts using the input from public meetings as a starting point. Each scenario will portray a storyline describing a distinct set of possible, and internally consistent, social, economic, and biophysical forces and how they may play out over the next 50 years. Quantitative models will then be used to forecast the implications of these discrete scenarios.

Quantitative analysis of forest futures will be organized around a technical forecasting system, the US Forest Assessment System or USF<sup>A</sup>S (Wear 2005). This forecasting system simulates future forest conditions and structure in response to land and resource markets as well as climate and other disturbances for all states in the South (see Figure 1). Detailed future scenarios, using the storylines mentioned above, and defined by trajectories of population, products markets, climate and other factors will be evaluated using the USF<sup>A</sup>S. The results will include detailed forecasts of forest inventories, land uses (including forests), timber harvests, and economic and social conditions across the South. These data are provided at relatively fine scales (e.g., counties) and can be aggregated to address regional and sub-regional questions.

**Regional Meta-Issue Analysis:** This second tier of analysis will be used to address certain issues at the broad regional level using a knowledge-synthesis approach similar to that used in the Southern Forest Resource Assessment. That is, for each regional meta-issue defined in the public input process, scientists/analysts will be enlisted to compile the best available information to address those aspects of the issue that are not readily amenable to technical forecasting. They will use a deductive approach to describe the possible effects of scenarios on the evolution of these issues and gauge the uncertainty associated with effects.

**Sub-Regional Analysis:** Every sub-region of the South has unique ecological and social attributes and specific issues of concern regarding forest ecosystem and economic changes. What's more, most ecological and forest resource research is specific to particular ecosystem types. In this third tier of analysis, an interdisciplinary team will be formed for each sub-region to address specific questions regarding forest futures. These teams will evaluate the "downscaled" results of the scenario-based forecasts (tier 1) and the findings of the regional meta-issue analyses (tier 2) to further describe specific implications for each sub-region.

Figure 1. Sub-regional analysis areas for the Southern Forest Futures Project.



For the Futures Project, the South has been divided into five sub-regions (Figure 1). These divisions are roughly based on aggregations of similar ecological sections and each has separate social/cultural/economic identities as well. However, individual sub-regions are not homogenous so the sub-regional teams will strive to address the diversity of conditions and concerns within their sub-region. The five sub-regions are:

- **Coastal Plain**—the southeastern coastal plain from Virginia, down the Atlantic Coast and across the Gulf Coast to the Mississippi Valley.
- **Piedmont**—the Southern Appalachian Piedmont from northern Virginia through Alabama to the Mississippi Valley.
- **Appalachian-Cumberland**—including the Southern Appalachian Mountains and the Cumberland Plateau and ecological sections to the north of these mountains. This includes the entire states of Kentucky and Tennessee as well as portions of Alabama, North Carolina, and Virginia.
- **Mississippi Alluvial Valley**—from Tennessee to the Gulf of Mexico.
- **Mid South**—all land to the west of the Mississippi Valley and extending to the western boundaries of Texas and Oklahoma.<sup>1</sup>

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<sup>1</sup> In addition, Puerto Rico and the U.S. Virgin Islands are initiating a forest resource assessment as a first step toward forecasts of future Islands forests. An Islands Team will eventually be formed and a parallel approach to evaluating the Islands forest future will be linked to the Futures Project.

Each of these teams will identify sub-region specific issues, develop analysis protocols in the form of a study plan, and interpret forecasts in light of these issues. Separate reports will describe the implications of forecasts for each sub-region of the South.

**Defining the Scope of the Project:** A vast number of issues could be addressed by a project such as this, so deciding what to focus on (and what not to focus on) is critical to the conduct and ultimate usefulness of the project. Because the Futures Project is intended to address a broad complement of issues relevant to forest managers, policy makers, science leaders, and the interested public, we sought extensive input from the public on the specific issues that needed to be addressed. Input was necessary to formulate specific plans for all tiers of analysis in the Futures Project. For the forecasting work we sought input on forces of change and their potential implications to help shape the future scenarios. This information and input on southwide issues was solicited to define the set of regional assessment questions. For the sub-regional analysis, we sought input on the potential ecosystem and local economic impacts of future changes and the values at risk within each of the sub-regions.

### ***The Public Input Process***

We sought public input on the focus of the Futures Project because a broad array of citizens and organizations has strong interests in southern forests and important stakes in the issues being addressed by the Futures Project. In addition, the geographic scope and the objectives of the project are broad and needed to be vetted with a wide range of local perspectives and expertise. Accordingly, we used a carefully designed public participation process to elicit input from the interested public. Our primary objective was to survey their insights into the forces of change at play in southern forests and the potential implications of changes in forests in terms of ecological and socio-economic concerns—i.e., to get the questions right. A secondary objective was simply to review and discuss the project with the interested public in order to build interest and trust in the process—i.e., to provide information on project scope and objectives, thereby clarifying expectations with the audience.

This initial invitation for input represents only one part of an ongoing discourse with the public in the conduct and evaluation of the Futures Project. Following principles described by Bleiker and Bleiker (1995), we intend to make the Project fully transparent to the public, and to provide the public with opportunities to have meaningful input at several junctures throughout its duration, including elicitation of input on the scope and focus of the project, evaluation of study plans, review of final reports, and broad discussions of findings. Input is only meaningful to the extent that the Project is responsive to it -- we posted records of the inputs we received and this document will describe how they are interpreted and used.

The largest part of our input elicitation process was focused on public meetings held in fourteen different locations around the South (see Figure 2). This set of meeting sites

provided at least two public meetings in each of the five sub-regions and at least one public meeting in each State. The latter criterion was important because State agencies had a strong interest in participation in these meetings, but would have had difficulty traveling to out-of-state meetings. We also reproduced the face-to-face meetings through three “webinars” using internet and phone access, which allowed people to participate without traveling to meetings. Two of these were held in the evening to provide opportunities to participate after work hours. The public was also invited to provide input through the project web site.

Figure 2. Locations, sub-regions represented, and schedule of public meetings held for the Southern Forest Futures Project in 2008.

<b>Meeting Location</b>	<b>Sub-Region Represented</b>	<b>Date</b>
Baton Rouge, LA	Coastal Plain/ Mississippi AV	Jan 29
Stoneville, MS	Coastal Plain/ Mississippi AV	Jan 30
Gainesville, FL	Coastal Plain	Feb 7
Charleston, SC	Coastal Plain	Feb 8
College Station, TX	Mid-South	Feb 11
Stillwater, OK	Mid-South	Feb 12
Little Rock, AR	Mid-South/Mississippi AV	Feb 13
Lexington, KY	Appalachian Cumberland	Feb 19
Nashville, TN	Appalachian Cumberland	Feb 21
Raleigh/Durham, NC	Piedmont/Coastal Plain	Feb 25
Blacksburg, VA	Appalachian Cumberland	Feb 26
Asheville, NC	Appalachian Cumberland	Feb 27
Athens, GA	Piedmont/Coastal Plain	Mar 6
Auburn, AL	Piedmont/Coastal Plain	Mar 7

Webinar #1	All sub-regions	Apr 8 evening
Webinar #2	All sub-regions	Apr 16 afternoon
Webinar #3	All sub-regions	Apr 16 evening

We designed the meeting format to encourage input on the full set of issues relevant to forest futures within a formal structure that helped organize discussion. To set appropriate context, we started each meeting with a one-hour general session where the co-leaders of the project introduced the objectives and the general management plan and timeline for the Futures Project. This addressed the need to inform the public of our intent and offered an opportunity for dialogue about the legitimacy, objectives, and structure of the project.

After the overview and discussion of the project, we provided a picture of changes likely to affect forests in the South, based largely on the findings of the Southern Forest Resource Assessment (Wear and Greis 2002a; 2002b). This framework included three primary drivers of change:

1. **Economic factors**—changes in the demands for goods and services derived from land and natural resources, and changes in the scale and distribution of economic activity.
2. **Social factors**—changes in the social context of resources management, including general societal changes related to the size and demographic make up of the general population and changes in the demographic makeup of forest landowners.
3. **Institutional factors**—changes in the institutional framework within which land is managed, including current and new systems of taxation, regulations, and public policies and programs.

Changes in these three primary drivers help drive changes in forested landscapes through four broad forces of change:

1. **Land use**—changes in economic, social, and institutional factors can all have direct and indirect effects on land use choices. Notably, population and income growth give rise to development and urbanization which consumes forest and other rural land. In addition, changes in agricultural and forest product markets can shift land use within the rural landscape.

2. **Forest Management**—much of the forested landscape of the South is actively managed for timber and other forest products and nearly every acre of forest has been harvested at least once in the past one hundred years. Changes in timber markets as well as in forest-growing technologies can alter the way forests are managed.
3. **Physical**—changes to the environmental context of forests can have important implications for forest structures and uses. Climate change portends changes in forest extent and species composition in parts of the South. Wildfire and changing fire regimes, hurricanes, ice storms, and other large scale events alter the health, productivity, and trajectory of forests in the region.
4. **Biological**—biological agents can have important impacts on forests. Both floral and faunal invasive species have restructured forests, and newly introduced invasive species hold uncertain implications for future forest ecosystem structure and health.

For each of the three primary factors and four forces of change, we presented definitions and then several examples of relevant changes (based on SFRA) during the opening general session. This provided the starting point for the second part of the meeting: 2 ½ to 3 hours of facilitated small group discussions organized by these seven factors/forces of change. At each public meeting we divided the participants into seven or fewer groups of 10-12 people, each focused on one or more different factors/forces of change. Small group facilitators were recruited ahead of the meeting and they received a briefing on process and expectations immediately prior to each session. Facilitators were coached to elicit and record the input without debate or judgment as to its value or validity and to focus discussion on clarification of content, not on approving or rejecting the comments.

Within each discussion group, facilitators asked participants to provide input on: (1) details regarding how the factor or forces of change could play out both at the regional and sub-regional scales and (2) potential implications of the change for forest conditions, services, and other values in the region. Input was gathered on flip charts and in some cases keyed into a computer on site. At regular intervals (every 20 minutes or so), participants were signaled to move to a different factor/force of change small group area, while the facilitators remained. Each time the participants shifted, the facilitators provided a briefing on the input offered by the people previously discussing that topic and then asked for additional input. This encouraged the discussions to be additive rather than repetitive. Time was allowed for participants to contribute to all of the factors/forces of change.

Following each meeting, all input was transcribed from flip charts and entered into a spreadsheet. Each comment was keyed to the location of the meeting and the factor/force of change for which it was provided. In addition, comments addressing local concerns were keyed to the specific sub-region. The co-leaders then examined each comment and added several labels. These included, where appropriate: 1) the specific factor/force of change the comment addressed, 2) an implication category for those comments that

provided input on implications of change, and 3) a secondary factor/force of change where more than one was offered up. This spreadsheet then provided the raw data for further synthesis of the public input.

After reading all the comments, the co-leaders next identified several “meta-issues” contained in the public comments and coded comments to respective issues. A meta-issue was defined as a broad area of concern that contained a complement of interrelated drivers and/or implications. We then evaluated comments and generated a report for each force of change, implication category and meta-issues. Sorting algorithms grouped comments according to the various categories with extensive cross-referencing and we then summarized the major points raised within each group. For example, we examined all of the comments addressing “land use” and summarized the comments using the primary factors (social, economic, and institutional changes) to organize these points.<sup>2</sup>

## **Results**

The fourteen public meetings described above were preceded by a meeting with invited leaders of public and private natural resource organizations in Asheville, North Carolina in January 2008. This initial meeting was used to refine and finalize our meeting structure and design.<sup>3</sup> Public meetings were conducted between January and March of 2008 with an average participation rate of 37 people (Figure 3). Attendance ranged from lows of 24-26 in Stoneville, Mississippi, Nashville, Tennessee, and Charleston, South Carolina to highs of 76 at the initial meeting in Asheville, North Carolina and 54 at the final meeting in Auburn, Alabama. Webinars were offered at three different times in April of 2008, but attendance was quite limited ranging from one to 12. Participants provided more than 2200 recorded comments. These were entered into tables and a record of comments from each meeting was posted on the Futures Project website for inspection by participants and others.

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<sup>2</sup> The spreadsheet containing all public comments along with their labels can be found at the Southern Forest Futures Project web site.

<sup>3</sup> Most notably, in response to feedback from this meeting, we (1) separated out the primary factors from the discussion of forces of change and (2) changed the structure of break out sessions so that participants could attend sessions for all the topic areas—i.e., participants were not forced to choose among topics of interest.

Figure 3. Attendance at public meetings by location.

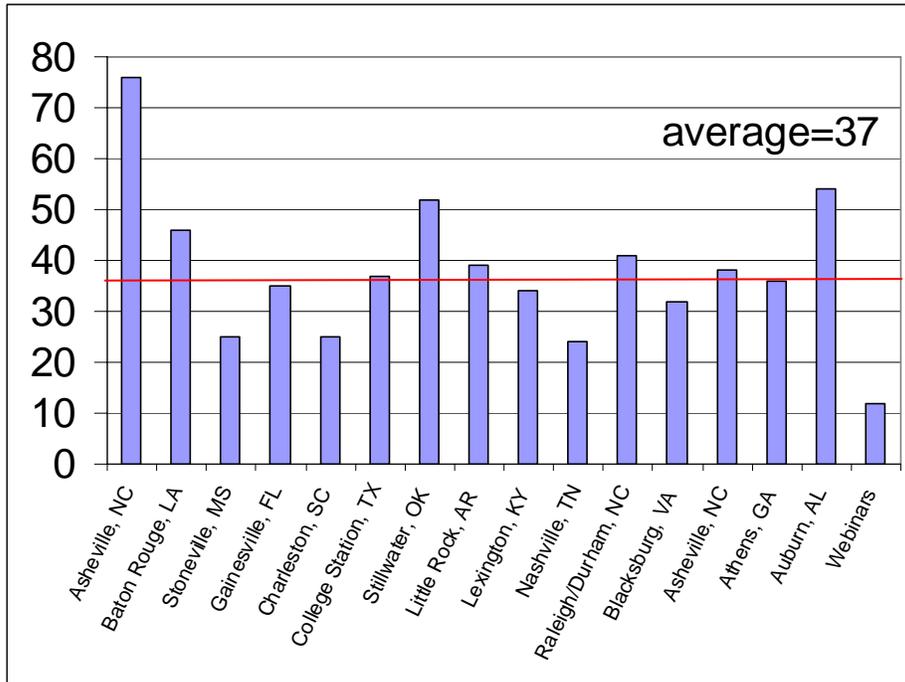
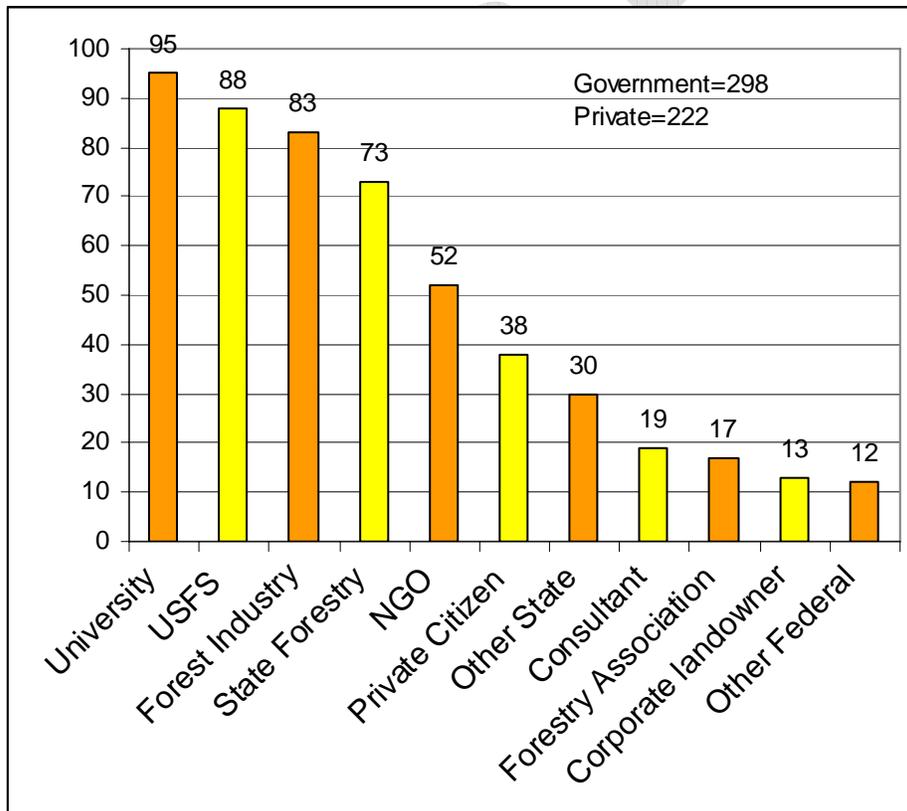


Figure 4. Participation at public meetings by category of participant.



We next present a synthesis of the public input organized in three different ways to support the three tiers of analysis. First we summarize the input on the **four forces of change** and how they might be expressed in the South. This input provides information for Tier 1 of the analysis—i.e., for beginning the discussion of scenarios and for organizing the analytical framework for doing forecasts. Second we summarize the input with respect to the **potential implications of change**—i.e., values at risk—that the public thought should be assessed within the Futures Project. This input provides information for organizing the evaluation of the effects of the scenarios in Tier 2 of the analysis. Finally we present the set of meta-issues that emerged from an analysis of these inputs. These are defined as complexes of interrelated implications associated with a common development or suite of changes in the South and define the complement of regional meta-issues that will be addressed in Tier 3 of the analysis.

## **Forces of Change**

### **Land Use**

Participants raised a number of factors that could influence the path of land use changes in the future (see Box 1). Economic factors addressed both the drivers of urbanization and factors behind allocation of rural land to forest and agriculture. With respect to urbanization, population growth and income were raised as key issues. With respect to rural lands, discussion focused on the potential future of agricultural and timber markets, with special emphasis placed on the uncertain effects of the emergence of various markets for biofuels and their feedstocks. Concerns were raised regarding the potential shift of forest land toward crop production if demands for grain feedstocks increased but also the potential for shifts toward more intensive forest management if cellulosic feedstocks become more desirable.

Social factors focused largely on the changing ownership profile of the South's forests and the potential to accelerate development. Participants at all locations raised specific concerns regarding the divestiture of forest industry lands in the South over the past ten years (see Clutter et al.) and the rise of the corporate investment ownership group, including Timber Investment Management Organizations and Real Estate Investment Trusts (TIMO's and REIT's). Additional concerns focused on smaller landowners, in particular an anticipated generational turnover of owners. In addition, several comments addressed how changes in demographics might increase the demand for land for recreational and retirement uses in more remote locations. Among institutional factors affecting land use, participants focused on the current and future effects of tax policy. Comments also addressed how potential new policies related to biofuels and ecosystem service payments (including carbon) and increased numbers of local regulations in high-growth areas might affect land uses.

**Box 1. Summary of comments regarding Land Use changes in the South.**

**1. Economic Factors**

- a. How will change in agricultural markets—i.e., food prices--affect land use?
- b. How will change in timber markets affect land use?
- c. How will bioenergy markets—including markets for both wood and other fuel stocks--affect land use?
- d. How will changes in populations and income affect land use?
- e. How will energy prices influence peoples choice of where to live—will this alter development of land?
- f. What are the options for agroforestry and how might they influence land use patterns?

**2. Social Factors**

- a. How will changing ownership patterns (for large and small owners) affect land use?
- b. How will changing demographics influence associated demands for aesthetic settings, recreation, and second homes?

**3. Institutional Factors**

- a. How will increasing urban populations affect options for land use through various regulations?
- b. What effects do regulations have on land use in the South?
- c. How will policies regarding bioenergy affect land uses?
- d. How could ecosystem service payments, especially for carbon sequestration, influence land use and forest loss in the future?
- e. How does tax policy influence ownership and uses of land and forestland?
- f. How do conservation easements and “unbundling” of landowner rights affect land uses?

**Forest management**

Most economic factors raised with respect to forest management in the South addressed either the future demand for current forest products or the emergence of biofuels markets

in the region (see Box 2). Participants highlighted the need to understand regional demands for wood products in the context of global markets and how wood might substitute for other natural resource materials. With respect to biofuels, participants asked how these new demands might directly affect the management of forests and compete with traditional forest products for the region's timber.

Participants asked how social change might influence forest management in the South. In particular they raised questions about the propensity of new large corporate (TIMO/REIT) landowners to continue levels of forest investment observed on industry land in the past. The trend toward smaller tract sizes caused by urbanization and recreation development and the constraints this places on management was seen as another big issue. Institutional issues focused especially on the potentially distortionary impacts of future biofuels policies. Technology was seen to drive change in forest product demands and to possibly change the demand for plantation forests in the future.

Box 2. Summary of comments regarding **Forest management** in the South.

**1. Economic drivers**

- a. Evaluate changes in the demands for all forest products and the implications for forest management in the South.
- b. Consider the effects of global demands in domestic wood products markets (important case is demand for wood pellets from Europe).
- c. Consider how the development of bioenergy markets could affect the demand for other forest products.
- d. Consider how the development of bioenergy markets could affect management regimes in southern forests.
- e. Evaluate how the markets for other non-wood materials could influence demand for timber products.
- f. Evaluate the potential emergence of other wood and non-wood forest products markets and their influence on management.

**2. Social drivers**

- a. Consider the effects of ownership changes on forest management approaches (harvesting and investment).
- b. Evaluate the effects of fragmentation and parcelization on viability for forest management (minimum viable stand size).
- c. Consider the effects of a shrinking work force and human capital in the logging sector.

### 3. Institutional drivers

- a. Consider the potential for distortionary and negative effects on wood products markets from policies to encourage bioenergy production.
- b. Consider the potential (negative and positive) impacts of the farm bill on forest management in the South.
- c. Consider how conservation easement and land withdrawal programs could affect timber availability.

### 4. Technology

- a. Consider how technological changes will influence demands for various forest products.
- b. Consider changes in plantation technology and productivity and implications for forest management.

## Biological Forces

Public input focused on three categories of Biological forces of change in the South: Invasive species, genetics, and forest succession (Box 3). Invasive species issues were raised at every meeting and addressed 26 individual species (Figure 5). Many comments focused on the potential influence of invasive plant species (most commonly, Cogon grass) and of various insects (e.g., Hemlock Woolly Adelgid) and diseases (e.g., Sudden Oak Death) on forest composition and productivity. Comments also addressed the vectors of spread for these invasives and identified land use, forest management, and climate change as being especially important factors affecting the establishment and spread of invasive species.

Figure 5. List of invasive species raised as issues in public meetings for the Southern Forest Futures Project.

Anosus root rot  
Asian Jumping Carp  
Beavers  
Callery pear  
Chinese Privet  
Chinese tallow tree

Cogon grass  
Elm disease  
Emerald ash borer  
Feral hogs  
Gypsy Moth  
Hypoxylon canker  
Japanese climbing fern  
Kudzu  
Laurel Wilt  
Mimosa  
Nutria  
Popcorn tree  
Red Oak Borer  
Salt Bush  
Sawtooth Oak  
Sirex notilio  
Southern Pine Beetle  
Sudden Oak Death  
Tallow  
Whitetail Deer

Comments addressed the potential use of genetically modified trees for timber production. Questions were raised regarding the effect of high-productivity genetically modified organisms (GMO's) on the economics and distribution of timber production but also on the ecological implications of potential "escapes" of genetically modified stock. In addition, participants focused several comments on how changes to disturbance regimes (e.g., fire and storms) might affect the availability of early successional habitat and restructure the successional pathways of forests in the South.

Box 3. Summary of comments regarding **Biological** forces of change in the South.

### **1. Invasive Species**

- a. Evaluate the spread of existing and the emergence of new invasive plant species in the South.
- b. Evaluate the spread of existing and the emergence of new invasive insect and disease species in the South.
- c. Consider how land use patterns affect the distribution and spread of invasive species.
- d. Consider how forest management could affect the success of invasive species.
- e. Consider how climate change may affect the success and spread of invasive species.

## **2. Genetics**

- a. Evaluate the potential deployment and effects of genetically modified trees in the South.
- b. Consider the institutional structures that govern the licensing of genetically modified plants.
- c. Consider the potential for the escape of genetically modified plants and potential interactions with native species in forested ecosystems.

## **3. Forest succession**

- a. Evaluate the implications of changes in disturbance regimes for natural succession in forests (e.g., reductions in early successional habitats).
- b. Consider how fire suppression alters species composition and successional pathways.

## **Physical Forces**

Input focused on three categories of physical changes affecting forests in the South: fire regimes, climate change, and storms (Box 4). Comments indicated the need to examine the effects of future fire regimes (including prescribed fire and fire suppression) on forests and human populations. Participants anticipated that fire regimes would be complicated by land use patterns and regulations, especially in the wildland urban interface. Participants asked how climate change, fuel treatments, and fire suppression activities might interact to influence broad scale fire regimes.

Participants asked how future climates could alter forest extent and composition in the region. In particular, they asked how temperature, precipitation, and CO<sub>2</sub> fertilization

would influence forest productivity, how rising sea-levels might affect the area of forest by way of inundation and salt water intrusions, and the potential interaction of climate change with water availability and drought. In addition to climate change effects, participants suggested that climate change mitigation activities, through carbon cap and trade programs, might have an important influence on forest land use and management.

Box 4. Summary of comments regarding **Physical** forces of change in the South.

**1. Fire Regimes**

- a. Evaluate current and anticipated fire regimes and how these disturbances affect forests.
- b. Consider how fire regimes might be altered by changes in climate.
- c. Consider how fire regimes might be altered by changes in land use patterns, especially in the wildland urban interface.
- d. Consider how regulations affect fire regimes (e.g., clean air regulations).
- e. Consider the effects of both fuel treatments and fire suppression on long run fire dynamics.

**2. Climate Change**

- a. Examine how climate influences forest area and conditions via temperature, precipitation, and CO<sub>2</sub> fertilization.
- b. Examine how sea level rise would influence forests.
- c. Consider the effects of various climate-change mitigation activities on forests.
- d. Examine how climate could influence drought, water availability, and salt water intrusions.

**3. Storms**

- a. Examine disturbance regimes from hurricanes and other storms and how they may change in the future.
- b. Consider the effects of climate change on storm frequency, strength and variability.
- c. Examine disturbance regimes from ice storms and how they might change in the future.

## Implications of Change

Participants identified a very broad range of potential implications associated with current and anticipated forces of change in southern forests. We aggregated these implications into four categories (Figure 6): ecosystem structure, forest conditions, ecosystem services, and social/economic implications. These, of course are interrelated, with forest conditions being a subset of ecosystem structure and ecosystem services being closely linked with social economic implications of forest changes. Under “forest conditions” we focus mainly on tree species and changes in the tree composition and condition of forests. “Ecosystem structure” implications focus on the broader complement of plant species as well as effects on wildlife habitats and species. Social/economic implications focus on the direct economic and social effects of changes in forest uses, while ecosystem service implications focus on “public good” types of forest benefits including water and biodiversity.

Figure 6. Linkages between categories of Primary Factors, Forces of Change and Implications used to organize public input.

Primary Factors	Forces of Change	Implications
		<i>Ecosystem structure</i>
	<i>Land use</i>	
<i>Economic</i>		<i>Forest conditions</i>
	<i>Forest management</i>	
<i>Social</i>		
	<i>Biological</i>	
<i>Institutional</i>		<i>Social/Economic</i>
	<i>Physical</i>	
		<i>Ecosystem services</i>

## Ecosystem Structure

Public input on ecosystem structure implications focused on aquatic and terrestrial ecosystems, riparian forests, and ecotones (Box 5). Appalachian riparian forests were

seen as especially vulnerable to changes caused by the mortality of expected widespread mortality of hemlocks.

Participants raised a number of concerns regarding the effects of management activities on long term soil productivity, chemistry, and biota. Concerns also addressed the impacts on soil productivity of land use change and in potential intensification of cropping for future biofuel production.

Concerns also linked multiple forces of change including invasive species and disturbance regimes related to fire and storms to the vegetative structure of terrestrial ecosystems. Participants asked about the impact of fire exclusion on the persistence of fire-adapted forest communities. Resulting habitat changes were linked to concerns regarding species persistence in the South.

**Box 5. Summary of comments regarding the effects of change on **Ecosystem Structure**.**

**1. Aquatic Ecosystems**

- a. Evaluate the effects of land use change, management, and invasive species on the quantity and function of riparian forests.
- b. Evaluate the potential cascade of effects of Hemlock Woolly Adelgid on southern Appalachian riparian forests, stream quality, aquatic species, and trout fishing.

**2. Soils**

- a. Evaluate the effects of land use changes on soil chemistry and biota and sedimentation.
- b. Evaluate the effects of forest management extent and intensity on soil chemistry and biota and sedimentation.
- c. Evaluate the potential effects of increased utilization rates on soil nutrients and the need for fertilization.

**3. Terrestrial Ecosystems**

- a. Examine how changing disturbance regimes, including fire and storms, will affect forest species and conditions.
- b. Assess the potential loss and modification of fire-adapted forest communities resulting from fire exclusion.
- c. Assess the impact of invasives on forest structures.
- d. Consider the effects of fragmentation on habitat structure and wildlife and on the spread of invasive species.

- e. Evaluate the cumulative impacts of forces of change on rare forest types.
- f. Evaluate the effects of habitat changes, driven by multiple forces of change, on wildlife of all types in the South.

### **Forest Conditions**

Participants raised a number of issues regarding how changes will affect the standard measures of a forest inventory, including forest area, biomass, and tree species composition (Box 6). Specific concerns addressed the effects of intensified management for biofuel feedstocks and invasives on forest conditions.

Comments also focused on how various forces of change might affect the production of a variety of timber products—including the use of clonal materials and genetically modified organisms, intensified management, ownership changes, and climate. Constraints on management actions were also linked to forest productivity in the wildland urban interface.

#### **Box 6. Summary of comments regarding the effects of change on Forest Conditions.**

##### **1. Forest area**

- a. Evaluate the effects of all forces of change on the future area of forest land in the South.
- b. Examine the impact of demand for population-driven new infrastructure developments (e.g., highways and reservoirs) on the area of forest land in the South.

##### **2. Forest conditions**

- a. Evaluate the effects of all forces of change on the condition of forest inventories in the region, including biomass, species composition, and products.
- b. Evaluate the potential implications of cloning/genetically modified tree species for diversity of pines and associated risks
- c. Examine the impact of invasive species on forest composition and health.

##### **3. Productivity**

- a. Evaluate the implications of intensified harvest activities with increased demand for biofuel feedstocks or other products on the long run productivity and sustainability of timber production.
- b. Evaluate the implications of increased productivity from cloning/GMO's on the location of forest management and the condition of forests.
- c. Examine how management shifts related to ownership changes affect the overall productivity of forest land in the South.
- d. Consider the effects of climate on forest productivity including the effects of changed growing seasons, precipitation, and CO<sub>2</sub> fertilization.
- e. Consider how constraints to management, e.g., loss of fire and herbicide use in the wildland urban interface and increasing costs for fertilizer and transportation, may affect productivity in the future.

### **Social/Economic**

Public comments addressed several concerns regarding the economic and social implications of changes in the forests of the South (Box 7). How might changes in forest uses affect direct employment in rural areas of the South? Employment issues also extended to how immigration policy might affect the availability of labor for woods work. Other policy issues asked how economic activity—primarily in the form of wood production—might be affected by policies designed to either encourage carbon storage in forests or encourage the production of biofuels from cellulosic feedstocks.

Comments also addressed forest-based recreation--both its supply and demand--and the potential for increased congestion and conflicts among types of recreation uses. Another set of comments asked about the future of wood products production across product classes and sub-regions in response to various forces of change. Participants also suggested that analysts track the total value of forest benefits to the quality of life in the region.

Box 7. Summary of comments regarding the effects of change on **Social/Economic** implications.

#### **1. Employment**

- a. Evaluate changes in labor supply including the role of immigrant labor and the potential implications of immigration policy for labor supply.
- b. Evaluate the demographics of logging and other woods workers and the potential for increased scarcity of labor for these services.
- c. Consider how changing wood production will affect employment and income in the rural areas of the South.

## **2. Policy**

- a. Consider how bioenergy policies might affect timber supply and activities in other wood products sectors.
- b. Consider how carbon policies might affect timber supply and activities in other wood products sectors.

## **3. Recreation**

- a. Evaluate how population growth and changing demographics will affect changes in demands for different types of recreation activities and implications for forest land uses.
- b. Evaluate how changing ownership and land uses will affect the supply of recreation opportunities.
- c. Examine the potential for increased congestion and conflict among recreational uses of forests as a result of changing supply and demand factors.
- d. Examine the changing economics of hunting leases and implications for forest land uses.

## **4. Wood products sector**

- a. Evaluate the effects of changes in ownership and land uses on timber supply and potential changes in the structure of wood products sectors.
- b. Evaluate the implications of changing industry structure on the distribution of economic activity and employment throughout the South.
- c. Consider how energy markets may differentially affect wood products sectors due, for example, to high transportation costs.
- d. Evaluate shift in markets away from some wood products toward ecosystem services of different types.
- e. Consider the effects of fragmentation on the economics of timber harvesting/logging and associated costs of timber.
- f. Consider the futures of various wood products sectors in detail, for example, hardwood lumber, treated southern pine, oriented strand board, etc...
- g. Examine how new biofuel markets may interact with other wood products markets in the South and affect overall economic activity, returns, and employment.

## **5. Other**

- a. Evaluate the total economic value of forest benefits including in situ as well as extractive benefits.
- b. Examine the effect of forest conditions on overall quality of life in the South.

### **Ecosystem Services**

Concerns regarding ecosystem services focused largely on biodiversity, carbon, and water (Box 8). Participants raised concerns regarding the effects of multiple forces of change on the persistence of various imperiled plant and animal species and on the genetic diversity of forests. Specific concerns concentrated on the effects of land use change and fragmentation and climate change on wildlife habitats. Issues related to carbon services provided by forests asked how a new cap and trade program might affect the quantity and quality of forests in the region (especially given other policy initiatives in play). Water issues focused on the role of forests in producing high quality water and the effects of forest management practices and land use changes on those benefits. Finally, participants raised general questions about the implications of proposed markets for ecosystem services on forest persistence and uses in the South.

#### **Box 8. Summary of comments regarding the effects of change on Ecosystem Services.**

##### **1. Biodiversity**

- a. Assess how loss and alteration of habitats will affect the biodiversity of the South.
- b. Evaluate the influence of climate change on the persistence of plant and animal species.
- c. Examine the implications of multiple forces of change on imperiled (or threatened and endangered) species in the South.
- d. Assess the potential effects of management strategies (including restoration activities) on genetic diversity of forests.

##### **2. Carbon**

- a. Evaluate the implications of the development of carbon credit markets for forest area and conditions in the South.
- b. Examine the potential interactions of a new carbon credit market with current timber markets and potential markets for cellulose-based biofuels.

##### **3. Water**

- a. Evaluate the effects of forces of change on the ability of forested wetland

to assimilate wastewater and dampen the effects of nutrient flows into water courses (including effects on hypoxia in the Gulf of Mexico).

- b. Evaluate the role of forests in protecting municipal watersheds and how land use and other changes might affect this role.
- c. Examine how a program of watershed protection credits could affect forest area and conditions in the South.

**4. Other**

- a. Examine the potential for and the effects of ecosystem service credit markets for forest landowners in the South.
- b. Examine the potential use of tax credits and other tax incentives to encourage the provision of ecosystem services.

**Meta-Issues**

As we summarized the public’s comments on forces and implications of change, we identified issues that had several interrelated concerns. A distillation of these themes led to the seven meta-issues listed in Figure 7. Each meta-issue is defined by a set of interrelated drivers and implications associated with a common topic. A meta-issue defines a set of questions that have broad regional implications and might therefore warrant careful analysis at the broad regional scale. We describe each of the seven meta-issues in turn below.

Figure 7. Issues regarding southern forest futures derived from public input.

Meta-Issue
Bioenergy
Climate change
Forest ownership change
Invasive species
Fire
Taxes and regulations
Water and forests

**Bioenergy** and the potential development of bioenergy markets in the South received numerous concerns and questions from participants. Comments were raised at every meeting regarding the emergence of new markets for grain-based and/or cellulose-based bioenergy products, the potential impact on forests and forestry, and the secondary impacts on forest ecosystems and productivity (see Box 9). Economic issues were focused either on the potential for new returns to landowners or the effects of potential competition for raw material between new bioenergy firms and other wood products sectors—in particular, the potential for the displacement of some sectors if biofuel production consumes large amounts of timber. As an extension of this latter point, participants asked how subsidies and other policies might distort markets and provide competitive advantage in biofuels over other sectors that currently consume wood fiber.

Comments also focused on how the emergence of new biofuel feedstock markets could influence the management of forests of the South. In particular, participants asked whether afforestation or deforestation would result and to what degree feedstocks would be derived from existing forest inventories or from more intensively managed plantations. Comments also addressed the impacts of management changes on site productivity and ecosystem integrity.

Box 9. Summary of comments regarding the **Bioenergy** meta issue.

**1. Social/Economic**

- a. Evaluate likely effects of emerging biofuel feedstock markets on markets for all other forest markets.
- b. Will potential new markets lead to substantial increases in timber scarcity?
- c. How will economic returns to forest landowners be affected by potential markets for biofuel feedstocks?
- d. Evaluate expected rural labor supply and demand needed for a bioenergy market.

**2. Forest Conditions**

- a. How will afforestation (gain of forest land) and deforestation (loss of forest land) be driven by a bioenergy market?
- b. What will be the likely effects of intensive management for biofuels on soil fertility and productivity?
- c. Consider how the development of bioenergy markets could affect management regimes in southern forests.

**3. Ecosystem Structure**

- a. Evaluate how wildlife habitat and other ecosystem functions could be

affected by the growth in biofuel markets.

- b. What will be the likely ecological characteristics of energy plantations and their management?
- c. How will emergence of forest bioenergy affect forest ecosystem integrity?
- d. What will be the ecological effects of utilizing increasingly small material?

#### **4. Other**

- a. Consider various ways the markets for different biofuels could develop in the future.
- b. Consider the potential for distortionary and negative effects on wood products markets from policies to encourage bioenergy production.
- c. Describe the pros and cons of potential financial incentives and other policies for encouraging production of bioenergy from wood (including new Farm Bill policies).
- d. Describe the current and potential technology needed to realize large scale production of biofuels from cellulosic feedstocks.

**Climate change** defined another meta-issue regarding southern forests (Box 10). Participants were concerned about the impact of climate on various economic and ecological values. Economic concerns related to the potential for changes in the location of industry and potential losses due to declines in productivity and increases in damaging storm events.

With regard to forest productivity, participants asked how future climate change could affect timber production rates as growing season, temperature, precipitation and CO<sub>2</sub> change. Input also indicated a need to analyze the potential for adaptation strategies that would move tree species to more favorable locations. Participants asked about the potential for climate change to exacerbate the spread of invasive species. They asked for additional insights into the effects of climate on drought cycles and the frequency of severe weather events. A broad complement of questions asked how climate might restructure forest ecosystems and change the provision of the full gamut of ecosystem services.

Box 10. Summary of comments regarding the **Climate Change** meta issue.

**1. Social/Economic**

- a. Evaluate the implications of climate change for the location of forest industry.
- b. Evaluate the total costs of increased extreme weather events.

**2. Forest Conditions**

- a. Consider the implications of changes in growing season length, temperature, precipitation, and CO<sub>2</sub> fertilization for forest productivity.
- b. Evaluate alternative strategies for adapting forest management to climate change—e.g., species to plant and treatments to favor as well as assisted migration of tree species.
- c. Consider how climate will change the range of invasive species and otherwise interact with invasives and native pests.
- d. How will climate change affect the drought cycle and therefore the persistence of forest types?
- e. How might changes in extreme weather events (hurricanes, tornadoes, and ice storms) affect forest structure?

**3. Ecosystem Structure**

- a. How might climate change alter the range of forest types in the South?
- b. How might climate change affect the distribution of rare forest types—e.g., spruce fir types in the Southern Appalachians?
- c. How might climate change alter the structure of and change the effectiveness of conservation areas, including wildlife refuges?
- d. How would climate change alter fire regimes in southern forests?
- e. How resilient are various forest communities to climate change?
- f. Consider the effects of sea-level rise and increased salinization on coastal forests.

**4. Ecosystem Services**

- a. Examine how potential increases in drought might affect the comparative value of forests in protecting watersheds.
- b. How will climate change affect species composition of forests?

- c. How will threatened/endangered/imperiled species be affected?

**5. Other**

- a. Explore detailed forecasts of climate change variables and define where climate change might be greatest (or most uncertain) in the South.

**Ownership changes** experienced since completion of the SFRA were of concern to many (Box 11). Most comments focused on forest industry’s divestiture of timberland and concomitant increases in ownership by Timber Investment Management Organizations and Real Estate Investment Trusts. But other comments focused on changes in the nonindustrial forest landowner class. Here the questions focused on the implications of a generational turnover in owners. In both cases the implications focused on the changing physical and management structure of forests. What happens to management as lands become more fragmented? What are the long run implications for timber supply and economic activity? Participants looked beyond the recent history of ownership changes to ask how this new ownership structure might lead to increased turnover in ownership in the future.

Box 11. Summary of comments regarding the **Ownership Change** meta-issue.

**1. Social/Economic**

- a. Examine how the divestiture of forest industry land could affect long-term timber supplies and the structure of the wood products industry.
- b. How might ownership changes alter recreation opportunities on private lands?

**2. Forest Conditions**

- a. Will increasingly fragmented and parcelized ownerships limit management options and timber productivity from these lands—what is the minimum manageable tract size?
- b. Consider opportunities to “rescale” forestry to new owners with smaller tracts—defining new silvicultural practices.
- c. What will be the likely extent of conversion and loss resulting from ongoing transactions by TIMOs, REITs and other large ownerships?
- d. How might economic conditions work to stabilize (or destabilize) forest

ownership and keep (or reduce) forests in forest cover?

- e. Describe how the expected new owners will change management activities that could affect forest health.

### 3. **Ecosystem Structure**

- a. What will be the major conservation challenges posed by expected ownership changes?
- b. Evaluate the full suite of expected ownership trends relative to management activities, forest conditions and health, and the implications of these for wildlife habitat and species.
- c. Consider the effects of fragmentation on wildlife persistence.

### 4. **Other**

- a. Define how much land has changed hands in the South and where changes might be focused in the future.
- b. Estimate the likely rate and direction of ownership turnover in the future.
- c. Estimate the likely impacts of ownership changes on fragmentation and parcelization.
- d. Consider all economic determinants of ownership change (e.g., resource markets, land markets and alternative investment returns) and how these might change in the future.
- e. Evaluate changes in ownership across all categories of owners.
- f. How will change in industry/TIMO/REIT management influence opportunities for other landowners?

**Invasive species** received expressions of concern from participants, including invasive plants and animals as well as new insects and diseases and their effects on forests (Box 12). Because of their potential to restructure forest vegetation, comments regarding invasives largely focused on how ecosystem structure might be altered. Economic concerns focused on the costs of management and control (where controls exist). Participants asked about the effect of invasives on forest productivity. In addition to questions regarding the effects on terrestrial ecosystems, participants asked about the effects on riparian forests and aquatic ecosystems (especially with regard to Hemlock Woolly Adelgid).

Box 12. Summary of comments regarding the **Invasive Species** meta-issue.

**1. Social/Economic**

- a. How will invasive species affect management costs and the returns to forest management?

**2. Forest Conditions**

- a. What effects will non-native animals, e.g. nutria, have on the regeneration and reestablishment of forests?
- b. How will expected changes in forest species composition due to invasives affect the overall productivity of forests?
- c. What are the likely effects of the interaction of forest insect or disease pests and changes in forest species composition due to climate change, population expansion and fragmentation?
- d. How do (will) policies, laws and regulations affect the control, spread and introduction of forest pests?
- e. What is the likely future capability to control invasives, given future land uses, fragmentation, ownership patterns and other forces of change?
- f. What will southern forests look like if catastrophic loss of dominant species, e.g. oaks, occurs?

**3. Ecosystem Structure**

- a. Evaluate the impacts of invasive plant species, e.g. salt cedar, Russian olive, privet, Chinese tallow, on the composition and function of riparian forests.
- b. Evaluate the likely impacts of the hemlock woolly adelgid on aquatic ecosystems.

**4. Ecosystem Services**

- a. What will be the effects of the introduction and spread of invasives by urbanization, recreational use and other human activities?

**5. Other**

- a. Examine historical spread rates for invasive species and forecast future spread of important invasives.

**Fire** remains a central issue of concern for forests in the South (Box 13). Participants asked about the potential for damages associated with changing fire regimes. They were concerned about the potential for increased fire frequency and intensity related to climate changes. In addition to damages, participants raised questions regarding the effects of changed fire regimes on ecosystem structure as well as a number of ecosystem services including clean air, clean water, and biodiversity.

Box 13. Summary of comments regarding the **Fire** meta issue.

**1. Social/Economic**

- a. Evaluate the likely economic consequences of reduced prescribed burning, including property and structural damage and loss, air pollution effects, timber quality and others.
- b. Define and forecast the potential for economic losses of all types from wildfire in the South (values at risk).
- c. How will concerns regarding liability affect fire use in the future and what will be the consequences for forest conditions?

**2. Forest Conditions**

- a. Describe the relationship and likelihood that catastrophic events play in forest conversion?
- b. How will changed fire regimes affect the overall health of southern forests?

**3. Ecosystem Structure**

- a. How will changing fire regimes affect the structure of forest vegetation in the future?
- b. What will be the likely effects of fire restriction or exclusion on fire-adapted or dependent communities, including critical or rare forest types or rare, imperiled or endangered species?
- c. How will likely changes in fire regimes in the future affect biodiversity of affected forests?

**4. Ecosystem Services**

- a. Describe the options to the use of prescribed fire and their implications for stand composition, air and water pollution, and biodiversity.

**5. Other**

- a. Forecast future fire regimes and their implications for forest structure as well as costs and benefits.

**Taxes** were the most common institutional issue raised in the public meetings (Box 14). The full suite of tax types—income, property, inheritance, and severance—were discussed. The accumulation and interaction of these various types of taxes on forest uses defined a meta-issue. Concerns focused on (1) the implications of tax treatment for the use of easements and other potential conservation instruments, (2) the effects of inheritance taxes on fragmentation and parcelization, and (3) the links between property tax treatments on land uses and the retention of forest cover. Comments were also raised about the potential to structure tax incentives that would encourage retention and management of forest lands.

Box 14. Summary of comments regarding the **Taxes** meta issue.

**1. Social/Economic**

- a. Consider the effects of tax code on easements and other mechanisms for private sector conservation.
- b. Would taxes on recreation values affect landowners' willingness to lease land for this purpose?

**2. Forest Conditions**

- a. Evaluate the effects of inheritance taxes on losses of forest land.
- b. Consider how property taxes (including differential tax rates) influence land use and ownership of forest land.
- c. Consider the effects of differential income tax rates for “C” corporations and other entities for land use and ownership of forest land.
- d. Consider the cumulative effects of all taxes--including property, income, estate, and severance taxes--on land use and ownership of forest land.
- e. How do taxes affect management practices and productivity of forests?

**3. Ecosystem Services**

- a. Consider the potential use of tax incentives to encourage forest retention and management for ecosystem services.
- b. Consider potential “proactive” tax policy that would encourage forest stewardship—including ad valorem taxes or other alternative tax instruments.

**Water and Forests** were another topic over which participants expressed concern, viewing water production and quality as a key issue relevant to forests and forest management in the South (Box 15). Concerns focused on the ability of forested landscapes to protect water quality in the future and on the ability of forested wetlands to

assimilate polluted runoff. Comments also addressed the various effects of forest management on water quality and the potential for adverse impacts with the intensification of management associated with increased production of wood-based biofuels. Land use change and the loss of forests were also seen as critical factors in determining the quality of water.

Box 15. Summary of comments regarding the **Water and Forests** meta issue.

### **1. Ecosystem Services**

- a. Consider the growing demand for water of high quality in urbanizing areas of the South and the role of forests in providing clean water.
- b. Quantify and evaluate potential change in the ability of the region's wetlands to assimilate wastewater.

### **2. Forest Management**

- a. Evaluate how forest management practices affect water quality in sub regions of the South.
- b. Examine how the use of herbicides and fertilizers in forest management may affect water quality especially with potential increases in management intensity related to biofuels.
- c. Evaluate the role of forest management regulations in protecting water quality in the South.

### **3. Land Use**

- a. Consider the impact of water impoundments and related infrastructure on forest area and conditions, especially in the Mid South.
- b. Consider how land use change and loss of forests to other uses could affect the quality of water in the South.
- c. Evaluate anticipated changes in the amount and structure of forested wetlands.

## **Conclusions**

Taken together, the more than 2,200 comments processed from public meetings define a comprehensive view of natural resource dynamics in the South. They address the social dynamics that reshape forested ecosystems and the myriad benefits that flow from forests. They also focus attention on a number of key uncertainties related to anticipated structural changes in this interrelated human-ecological system. We've summarized

these as seven “meta-issues:” bioenergy, climate change, forest ownership change, invasive species, water and forests, taxes, and fire.

Our synthesis of the comments defines a set of 178 key concerns regarding the seven meta-issues, four categories of forces of change, and four categories of implications of change. They could define a broad research program for a community of researchers for years to come. Our objective, however, was to distill comments in a way that helps shape the plan for the Southern Forest Futures Project. The content analysis described here provides the critical first step, by summarizing the key elements of what the public sees as important with respect to changing forested ecosystems in the South. Our next steps will be to choose which of these concerns we will address and how we will address them via the three analysis tiers of the Futures Project.

For the Regional Forecasting tier we will use quantitative models to forecast the effects of the different forces of change on land area, forest inventories, and other measures of interest. Our approach will be to use the input on forces of change as the starting point for the development of a set future scenarios to use in the forecasts.

The Regional Issue Analysis tier will apply a knowledge-synthesis approach to evaluate the spectrum of concerns identified for each of the seven meta-issues. The public comments summarized here will help us define the research question and important elements for evaluating each meta-issue using the public comments summarized here. Each meta-issue will be assigned to an expert scientist to manage the analysis.

The Sub-Regional Analysis tier will address the implications of forces of change for the five sub-regions of the South using the scenarios evaluated in the Regional Forecasting tier. In each sub-region a team of analysts will examine specific concerns and issues regarding forest futures. The starting point for developing the specific questions to be addressed will be the public comment summaries for the four “implications of change” categories.

Meetings in thirteen states and interactions with about 600 people from a variety of backgrounds have made it clear that the public anticipates important changes will occur in the forested landscape of the South. These changes will be driven by multiple forces of change and their effects will span ecological, economic, and social dimensions. As described above, the public sessions provided validation for undertaking the Futures Project at this time and they provided the foundation upon which the project will be conducted from this point on.

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