

3. Developing Scenarios to Use in Model Simulations

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Scenarios are predictions that describe various combinations of possible events and likely outcomes. These simplified representations of the future will allow PINEMAP researchers to evaluate the best options for increasing carbon sequestration and decreasing nitrogen use in an organized and efficient manner.

PINEMAP will use region-wide models to understand how management, climate, and other factors collectively affect planted pine productivity in the future. To focus this effort, we are developing a series of scenarios of the most likely future conditions. We envision there will be four essential components to the PINEMAP scenarios: land use, productivity, environment, and disturbance. Land use describes the amount of land in loblolly pine plantations. Productivity is the amount of carbon sequestered by loblolly pine plantations. Environment describes the future climate and atmospheric carbon dioxide (CO₂) concentrations that could affect plantation productivity. Disturbance includes both biotic and abiotic disturbances that reduce plantation productivity.

Land use is affected by many economic and policy factors. The amount of land in loblolly pine plantations in the future could increase, decrease, or stay the same in response to timber and wood fiber prices, regional population growth, investments by forest industry, farm commodity prices, added economic value of sequestered carbon from new plantations (carbon markets), government economic incentives to plant loblolly pine on marginal farmland, or changes in forestry activities in other countries.

Because of improvements in silviculture and genetics over the last 50 years, productivity has increased in successive rotations of loblolly pine plantations and is likely to continue to increase in the future. In this case, an increase in productivity means an increase in the rate of biomass accumulation over time or an increase in carbon stored in wood products. There are many management options for increasing plantation productivity and carbon sequestration in forests. Wood products can also increase carbon sequestration; for example, if more wood is used in buildings, the carbon is sequestered in the structures longer, or new products can be developed that can use additional wood. An increase in the use of woody biomass for energy production, substituting wood for fossil fuels, is also a consideration.

With regard to climate, we expect temperatures to increase throughout this century. Changes in precipitation are less certain. In the near term, i.e., the 2014 to 2030 period that is the focus of the PINEMAP project, we can assume the climate will not be significantly different than the present condition. However, when we consider the remainder of the century, we can expect significant changes in temperature, precipitation, and atmospheric CO₂ concentration.

Major disturbances affecting loblolly pine plantations include hurricanes, tornadoes, insects, diseases, and fires. All of these disturbances reduce productivity and therefore have the potential to reduce carbon sequestration. Disturbance is the most uncertain scenario condition to predict. Because of this, both biotic and abiotic disturbances are being considered together as a category of change to regional plantation productivity.



Photo by Steve McKeand.

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Twelve scenarios were developed for the near term time period up to 2030. These scenarios focus on changes in land use and productivity and assume that the effects of environment and disturbance will be similar to present conditions. In its simplest form (shown in Table 3.1), these scenario combinations can be visualized as combinations of a small increase (1) or decrease (-1), no change from the present (0), or a large increase (2). These factor levels represent various management options, policy decisions, and economic considerations that are feasible between now and 2030. These scenarios will allow collaborators in PINEMAP to have a standard basis through which they can evaluate the best ways to increase carbon sequestration and reduce nitrogen use. Because the number of scenarios is large and region-wide model runs consume large amounts of computer resources, large-scale simulations will probably focus on a subset of these scenarios.

What happens during the rest of the century, from 2030 to 2100, is also very important, so we are in the process of developing additional scenarios to address the likely conditions of the time period beyond the initial PINEMAP focus. This will allow us to predict productivity of loblolly pine plantations across the region and help managers and policy experts make informed decisions about growth rates, fertilizer use, and carbon sequestration.



Photo by John Seiler.

Land use	-1	-1	-1	0	0	0	1	1	1	2	2	2
Productivity	0	1	2	0	1	2	0	1	2	0	1	2

Table 3.1. Twelve scenarios, visualized as combinations of increasing (1 or 2), unchanging (0), or decreasing (-1 or -2) factor levels, represent likely combinations of changes in land use and productivity that could occur in the near term (2014 to 2030) PINEMAP focus period. Some combinations have a higher probability of happening than others. Because of the large number of scenario combinations, PINEMAP region-wide simulation assessments will likely focus on a subset of these scenarios.