Estimating Regional Timber Supply and Forest Carbon Sequestration under Shared Socioeconomic Pathways: A Case Study of Maine, USA

Jianheng Zhao1†*, Adam Daigneault1†*, Aaron Weiskittel1

1 University of Maine School of Forest Resources, Orono, Maine, United States of America

* Corresponding author:

E-mail: jzhao35@buffalo.edu (JZ)

adam.daigneault@maine.edu (AD)

†These authors contributed equally to this work.
Supporting information

S1. Shared Socioeconomic Pathway (SSP) Narratives

SSP1 - Sustainability

Population is expected to rise partially due to migration into Maine. Technology development and economic growth is high and more environmentally friendly. Maine strictly implements natural climate solutions and acquires technological and policy innovation to reduce GHG emissions. Land use is heavily regulated, and forest owners receive incentives to enhance carbon sequestration. The area of voluntary set-aside for conservation and biodiversity is significantly increased, and most forestland participates in third-party certification programs (e.g., Sustainable Forestry Initiative, Forest Stewardship Council). Land connectivity increases with conservation and the collective action of family forest owners. Sustainable and efficient logging techniques reduce harvest and transportation costs. Active management and careful harvest planning increase. With the development of the renewable bioenergy initiatives (e.g., cellulosic energy and wood energy) and increasing markets for ecosystem services, the value of wood products and forestland increases and drives additional investments in forest management. As the market for biomass, payments for carbon sequestration, watershed protections, or other ecosystem services become more common, corporate landowners seek diverse investments and land management practices for environmental and social considerations.

SSP2 – Middle of the road

Technology development and economic growth in Maine’s forest sector proceeds at a historical rate. Social, economic sector, and technological developments continue to follow historical patterns. There are no fundamental shifts in patterns of land use, and forest management. Widespread forest owner participation in certification programs continues. With
raising concerns about sustainability and GHG mitigation, bioenergy consumption increases moderately. Carbon prices are imposed on the forest sector, but heavily discounted relative to prices on energy- and industrial-based GHGs. The moderate technological development reduces harvest and transportation cost relative to today, which also encourages moderate increases in wood production efficiency.

SSP3 – Regional rivalry

Maine’s population shrinks overall and trends toward to a high aging population. Economic growth and technological change is slow, leading to the low productivity of land and low investment in human capital. Maine and the U.S. become increasingly compartmentalized due to concerns about competitiveness and security. It moves toward to a regionalized economic system with reduced trade flows and low institution cooperation. There are few regulations on forest use, and most of the policies around clearcutting, riparian management, and sediment control in place today have been rolled back. The participation in carbon sequestration policies and markets are delayed. Forest landowners emphasize near term profit over long run sustainability, and there is low investment in the sector. The limited technological improvement has a minimal effect on management and transportation cost. Consumers largely traditional forest products (e.g., lumber, fuelwood) and thus there is limited development of new biomaterials.

SSP4 – Inequality

Large disparities in political power and economic opportunity resulted in inequality development between the less affluent northern and more developed southern areas of Maine as show in S1 Fig, in which north and south are categorized by population density. Attracted by large number of working opportunities and investments, more people migrate to the southern part
of the state, with the slow growth and an aging population in northern Maine. Forest and land use regulations are strictly followed in the south, but loosely regulated in the north. Southern Maine landowners are eager to participate in climate change mitigation and pay more attention to sustainable management and environmental consideration. Traditional wood products are still the dominant drivers in forest-based economy in northern Maine. In southern Maine, landowners focus more on other ecosystem services and carbon sequestration during the management of natural resources, encouraging more land connection, conservation land, and efficient wood production.

SSP5 – Fossil-fueled development

Population is expected to rise markedly and create suburban and urban sprawl. Maine has a rapid growth in energy- and resource-intensive development, characterized with competitive markets, advanced technologies, and fossil fuel-based development. Rapid technological change and rising investment increases forest yields and wood production. Maine’s forest use and land use are moderately regulated, but landowners receive limited incentives to enhance carbon sequestration. Increased access to global markets increases the demand for and export of Maine’s wood products. Wood-based fuels increase slightly, but fossil fuels are still the dominant energy source.