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Forest carbon benefits, costs and leakage effects of carbon reserve scenarios in the United States

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ABSTRACT

This study evaluated the potential effectiveness of future carbon reserve scenarios, where U.S. forest landowners would hypothetically be paid to sequester carbon on their timberland and forego timber harvests for 100 years. Scenarios featured direct payments to landowners of $0 (baseline), $5, $10, or $15 per metric ton of additional forest carbon sequestered on the set aside lands, with maximum annual expenditures of $3 billion. Results indicated that from 1513 to 6837 Tg (Teragrams) of additional carbon (as carbon dioxide equivalent, CO_2e) would be sequestered on U.S. timberlands relative to the baseline case over the next 50 years (30–137 Tg CO_2e annually). These projected amounts of sequestered carbon on timberlands take into account projected increases in timber removal and forest carbon losses on other timberlands (carbon leakage effects). Net effectiveness of carbon reserve scenarios in terms of overall net gain in timberland carbon stocks from 2010 to 2060 ranged from 0.29 tCO_2e net carbon increase for a payment of $5/$tCO_2e$ to the landowner (71% leakage), to 0.15 tCO_2e net carbon increase for a payment of $15/$tCO_2e$ to the landowner (85% leakage). A policy or program to buy carbon credits from landowners would need to discount additions to the carbon reserve by the estimated amount of leakage. In the scenarios evaluated, the timber

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set-asides reduced timberland area available for harvest up to 35% and available timber inventory up to 55%, relative to the baseline scenario over the next 50 years, resulting in projected changes in timber prices, harvest levels, and forest product revenues for the forest products sector.

Introduction

Forests draw carbon from the atmosphere in the process of photosynthesis, and the carbon may remain stored for long periods in trees and other forest vegetation (in above- and belowground biomass and in forest soils) and in forest products in use or in landfills. Because of such capacity to store carbon, interest in using forests for climate change mitigation has been growing, and several strategies to use forests for achieving mitigation goals have been suggested. For example, avoiding deforestation or protecting existing forests, planting new forest area, decreasing harvest intensity, increasing forest growth, forest thinning to reduce fire threat, increasing carbon storage in harvested wood products (HWP), using wood biomass for energy to replace fossil fuels, and substituting wood for fossil-fuel-intensive products are important forest-related strategies that can contribute to climate change mitigation (Malmsheimer et al., 2011; McKinley et al., 2011; Ryan et al., 2010).

The U.S. forest sector is considered to have a substantial potential to contribute to climate change mitigation (U.S. EPA, 2011; Heath et al., 2010; Perlack et al., 2005), primarily through improved forest management and afforestation. The capacity of the U.S. forest sector to mitigate climate change by carbon sequestration that offset atmospheric greenhouse gas (GHG) emissions could be augmented by the implementation of appropriate government incentives and/or policy and programs, and such policies may affect the forest management choices of forest landowners. For example, a rational landowner may accept or reject carbon offset contracts involving timber set-asides depending on the perceived opportunity costs (Van Deusen, 2010; Sohngen and Brown, 2008) of timber harvest versus carbon offset payments. Once the landowner decides to enter into carbon contracts involving timber set-asides, the qualified tracts of lands entering into the contract are likely to be withdrawn from harvests,[1] which can also impact forest product markets in several ways.

For example, according to economic theory, restricting timber harvest on some lands via voluntary set aside contracts would decrease the nationwide shares of timberland area and timber inventory available for harvest; shift timber harvest to other lands without set aside contracts; increase timber prices and forest product prices; decrease forest product production, consumption, and net exports; and decrease forest sector employment and profitability (Latta et al., 2011; Wong and Alavalapati, 2002). This is because the expected market effects of reduced availability of timberland area and timber inventory for timber harvest are to generally reduce timber supply and increase timber prices, which can be conceptualized as a leftward shift of the available timber supply curve within a given region (Fig. 1). This study aims to assess the broad U.S. timber market impacts and forest product market impacts of timber set-asides by estimating changes in timber supply and prices, and resulting impacts on forest product revenues, due to hypothetical government programs that would pay forest landowners to voluntarily forego timber harvest and accumulate forest carbon. In addition, the study aims to assess the carbon leakage effects of such voluntary timber set-aside programs, by assessing the changes in timber harvest and timber removals that would occur on remaining timberlands without set-aside contracts.

More specifically, this study seeks to answer two questions: what are long-term net impacts on (a) carbon sequestration and (b) forest product markets of a hypothetical program that would pay some U.S. forest landowners for carbon accumulation on their lands by voluntarily setting aside timberland

[1] It may be possible that future carbon policy would allow some forms of harvests in the contracted timberland (e.g., to maintain productivity). However, here we focus on the possibility of long-term harvest withdrawal (avoiding harvest for at least 100 years).