NCASI Fact Sheet

IMPACT. SCIENCE. SOLUTIONS.

How do Managed Forests Contribute to Reducing Climate Change?

NOVEMBER 2018

Introduction

Forests play a critical role in mitigating greenhouse gas (GHG) emissions through carbon sequestration and other processes. Productive forests that are managed to produce products that store carbon and replace fossil fuels most often have greater long-term carbon benefits than forests left unmanaged. The temporal and spatial scope of forest carbon budget assessments greatly influence conclusions drawn in published studies. Substantial but often overlooked carbon benefits also accrue when active management reduces the potential for wildfire and other disturbances, and when markets for wood create incentives that reduce conversion to urban development or to other land uses with substantial and permanent carbon impacts.

Carbon Implications of Forest Management Depend on Time and Space

Due to funding limitations and other factors, short-term field studies form the basis of many forest carbon assessments, which can result in misleading conclusions about longer-term consequences. The most common example is examining carbon budgets of unmanaged or preserved forests compared to those of actively managed forest stands; the former typically store larger amounts of carbon initially, while the latter generally have greater long-term carbon benefits. A recent global forest carbon model-based analysis found greater carbon benefits from actively harvested stands compared to preservation over 100 years, during which time carbon stored in preserved forests reached its maximum.

Spatial considerations are also important in forest carbon budget assessments. Assessments that focus on individual forest stands can lead to incomplete or biased results by failing to consider dynamics across landscapes or regions. While stand-level biomass and associated carbon may take years or decades to return to previous levels following harvesting, managed forest landscapes typically contain multiple ownerships and/or managers, management objectives and regimes, and forest ages that buffer individual forest stand carbon dynamics. Even actively-managed forest landscapes may include 25 to 35 percent of their area in conservation set asides or incorporate areas managed under lower intensity practices due to regulatory or voluntary best management practices (e.g., streamside management zones or "buffers") because of their environmental sensitivity, or because they are otherwise technically or economically inappropriate for intensive management regimes.

Photo Credit: Adobe Stock Images

Longer Term Implications Beyond the Forest

Active forest management and the use of biomass in place of fossil fuels and alternative products most often have greater long-term carbon benefits than maintaining or increasing forest stocks alone. Evidence from the Lake States, Canada, and Sweden, for example, has demonstrated substantial carbon benefits of actively managed forests with efficient use of harvested biomass for wood products and fossil fuel substitution. Fossil fuel conversion efficiencies and alternatives to which forest-based products are compared also influence results from forest carbon assessments. In addition, while emissions of carbon dioxide and other GHGs resulting from harvesting and management, manufacturing, and transportation should be incorporated into forest carbon budgets, these are small relative to carbon sequestered in biomass and do not significantly affect carbon budgets in most cases.

Short-Term Losses, Long-Term Benefits from Intensive Practices that Increase Productivity

Site factors, tree species, and management regimes all influence productivity and associated carbon sequestration of forest stands. While intensive management and harvesting may initially reduce on-site carbon storage, practices such as fertilization, thinning, competition control, and genetic improvement increase productivity and carbon sequestration by mitigating site-limiting factors related to nutrients, water, or sunlight. Such intensive practices substantially increase productivity of commercial tree species (e.g., loblolly pine) and also increase efficient use of nutrients, water, and other site resources. However, intensive harvesting not accompanied by practices that sustain or increase productivity has the potential to reduce forest carbon storage and sequestration over time.

Mixed Responses of Soil Carbon to Harvesting and Residue Managment

Soils worldwide contain more carbon than vegetation and the atmosphere combined, and even small changes in soil carbon pools can have large impacts. Harvesting and associated practices influence soil carbon pools by removing or reallocating biomass, altering forest productivity and subsequent litter return, and modifying soil organic matter decomposition rates by disturbing the soil and altering soil temperature and moisture regimes. Harvesting and residue removal can reduce soil carbon pools, particularly in the forest floor, but meta-analyses covering hundreds of field studies across many forest types and regions have documented mixed responses that include a range of soil carbon losses to gains, along with no effect. Outcomes are complicated by high variability within and across sites, which can mask effects when they do occur. Biomass harvesting can exacerbate impacts, although substantial residue quantities are typically left on site during actual forest operations due to technical or economic factors.

Management Reduces the Risk of Forest Disturbance and Associated Carbon Loss

In addition to increasing the production of biomass and fossil fuel-replacing products, active forest management improves forest vigor and reduces fuel loads in many cases, reducing susceptibility to wildfire, insects, and disease. In addition to their forest health implications, these disturbances cause substantial forest carbon losses. In North America, fire accounts for forest carbon losses that can exceed those of forest harvesting .

Reference

Vance, E.D. 2018. Conclusions and caveats from studies of managed forest carbon budgets. *Forest Ecology and Management 427 (2018) 350–354*.

For More Information Contact

info@ncasi.org.