Enhancing the Carbon Benefits of Your Sugarbush

THE UNIVERSITY OF VERMONT EXTENSION

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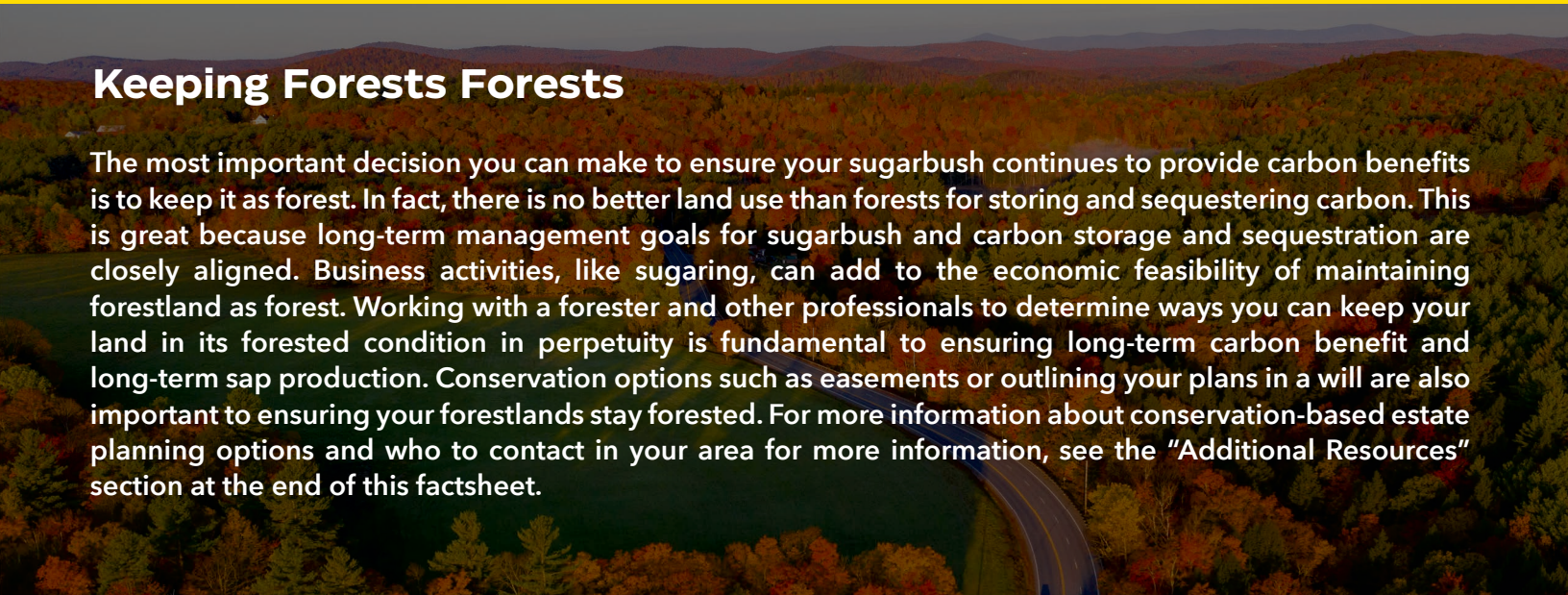
Introduction

The importance of forests in sequestering and storing carbon has gained increased attention over the past decade. Forests' value as a natural climate solution is widely recognized by climate authorities as fundamental to meeting climate goals when paired with reductions in greenhouse gas emissions.[1] The Northern Forest, as the largest contiguous forest east of the Mississippi, plays a key role in climate mitigation both regionally and globally. The heart of the U.S. maple industry is in this forest. Managers of these woodlands have an opportunity to manage for positive economic and environmental benefits. This factsheet describes how you can use forest management techniques to enhance carbon sequestration and storage and sap production.

There are many ways that you can maintain and enhance the carbon benefits of your sugarbush. As summarized in *FBFS 070: Forest Carbon in Your Sugarbush* the amount of carbon stored and sequestered by your sugarbush is influenced by several factors, including stand age and land-use history. The way you manage your sugarbush, including the trees you retain for tapping or the stand densities you encourage, affects levels of carbon storage and sequestration. Managing your sugarbush for carbon can improve its ecological values (increasing biodiversity and improving habitat for wildlife species) and its economic value (increasing tree size and ensuring sustainable operations). Managing the sugarbush for carbon also provides value to your business. Whether applied to internal operations for offsetting your business's carbon emissions and providing value to consumers looking for climate friendly products or providing additional sources of revenue through various carbon market opportunities, focusing on managing the flow of carbon in your business operations provides multiple values to businesses. Learning how your management activities can enhance the carbon in your sugarbush is important to ensuring your forests contribute to reducing the impacts of climate change, while also meeting other objectives you have for your land.

[1] United Nations Environmental Programme (UNEP), "Why Do Forests Matter?" https://www.unep.org/topics/forests/why-do-forests-matter

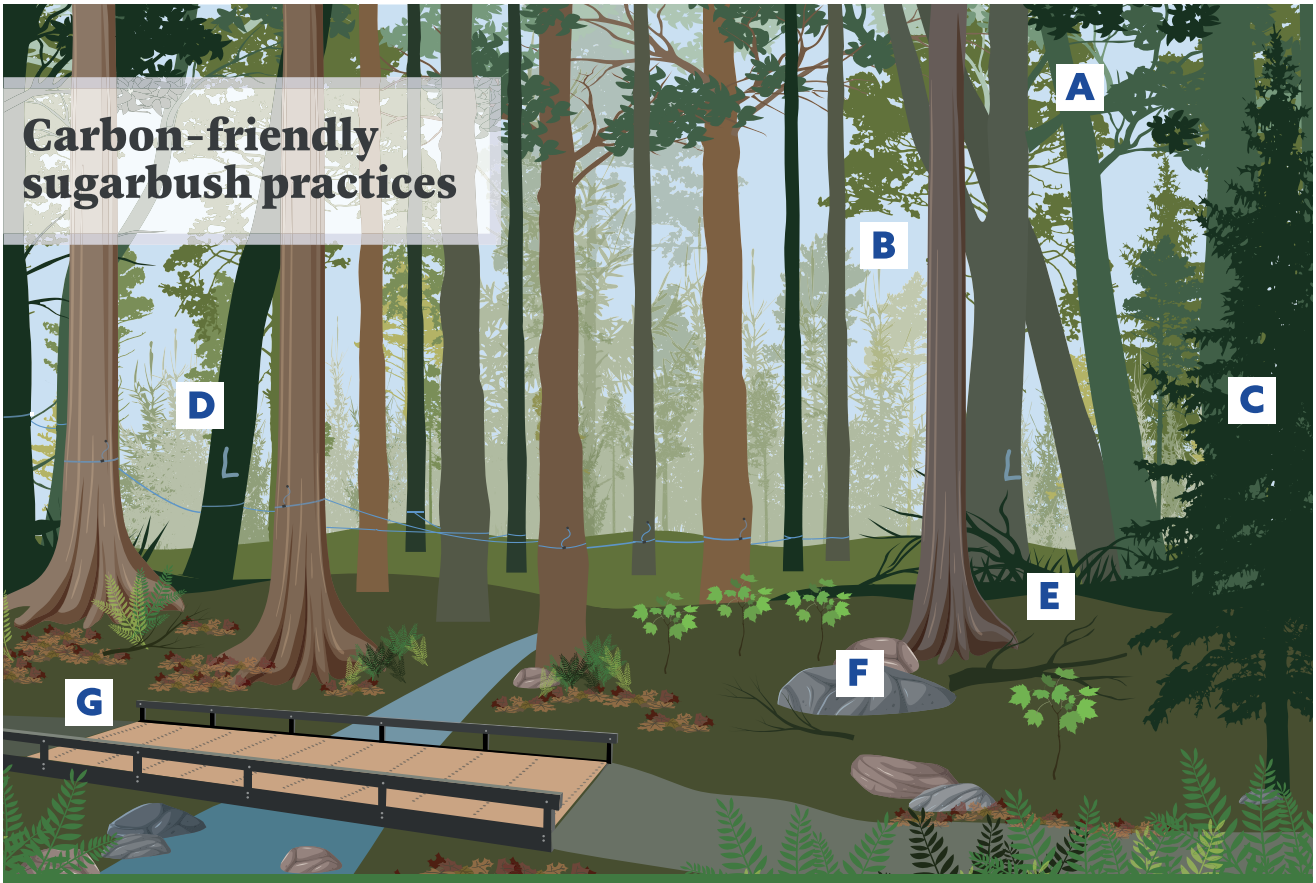
Carbon Informed Management of Your Sugarbush



Keeping Forests Forests

The most important decision you can make to ensure your sugarbush continues to provide carbon benefits is to keep it as forest. In fact, there is no better land use than forests for storing and sequestering carbon. This is great because long-term management goals for sugarbush and carbon storage and sequestration are closely aligned. Business activities, like sugaring, can add to the economic feasibility of maintaining forestland as forest. Working with a forester and other professionals to determine ways you can keep your land in its forested condition in perpetuity is fundamental to ensuring long-term carbon benefit and long-term sap production. Conservation options such as easements or outlining your plans in a will are also important to ensuring your forestlands stay forested. For more information about conservation-based estate planning options and who to contact in your area for more information, see the "Additional Resources" section at the end of this factsheet.

Practicing carbon informed management in your sugarbush requires consideration of how the different pools of carbon might be impacted by your management decisions. The following sections consider the soil as well as live and dead aboveground carbon pools in your sugarbush. Given that those are the biggest pools, focusing strategies on them will have the greatest impact. A key consideration across all these strategies is not just protection and enhancement of carbon pools over time, but also ensuring they are resilient to future stressors and disturbances. To promote resilience, use management to diversify tree species composition to reduce possible carbon losses from insect pests, and promote a range of tree ages to ensure trees toppled by a windstorm are rapidly replaced by younger trees.



CARBON-FRIENDLY PRACTICES TO ENHANCE AND SUSTAIN THE CARBON BENEFITS SUGARBUSHES PROVIDE

A. Retain Large Trees
Large trees disproportionately contribute to carbon storage, so keep these in your sugarbush.

B. Encourage Development of Understory and Multiple Canopy Layers
Having many layers of vegetation increases the packing of carbon in your forest and sustains different wildlife species.

C. Maintain Non-Maple Species
Enhance the resilience of your sugarbush to future disturbances, pests, and climate change by having a diversity of tree species.

D. Designate Legacy Trees
Allow trees to live out their natural lifespans to become large trees and ultimately contribute to deadwood carbon.

E. Increase Amounts of Deadwood
Downed logs and standing dead trees are critical habitats and great for carbon. Deliberately felling and leaving trees and designating legacy trees can restore this feature.

F. Establish Areas of Young Trees
Young trees sequester carbon at a faster rate than older trees, so having a mix of young and old trees can balance carbon storage and sequestration goals in your sugarbush.

G. Minimize Impacts of Forest Roads
Consider closing out unused legacy roads which can become conduits for water flow and minimize roads and trails. Follow best management practices to protect soil carbon. Remember "slow, spread, and sink" when thinking about water management.

Soil represents the largest carbon pool in your sugarbush. It is a very stable pool that continues to slowly accumulate carbon. Maintaining these soil-based carbon stocks should be a primary objective of woods operations. Damage by storm events, woods operations, and management activities, such as rutting by equipment and erosion and displacement by moving water, work roads, and trails leads to carbon losses (emissions). To minimize these impacts, always follow forestry best management practices (BMPs) across your sugarbush to protect soils and water quality, avoid soil damage, and control the overland flow of water. See the "Additional Resources" section for more information about your state's forestry BMPs. Several general considerations to protect and enhance the soil carbon pool are:

- Lay out forest roads to minimize their number and grade. Ensure they are located on stable ground and stabilize ground where needed.
- Limit equipment use to roads, preferably under frozen or dry soil conditions.
- Monitor the ground conditions to ensure it is stable enough to operate and minimize soil damage when using equipment in your sugarbush.
- Work with a forester to develop a strong contract that specifies soil and water performance standards for the timber harvest if you are conducting a harvest as part of your sugarbush management activities. For example, specify the maximum allowable rutting depth and the timing of harvest. Conduct a final inspection before the timber harvesters leave the site to make sure that the site has been stabilized and the contract has been satisfied. These activities often occur in the summer when ground conditions are dry.
- Leave tops, limbs, and deadwood in the forest to increase carbon pools over time.

Managing Live Aboveground and Belowground Carbon Pools in Your Sugarbush

The live aboveground and belowground carbon pools in your sugarbush are affected by species composition and stand structure, which includes the size, density, and arrangement of trees. To achieve the desired benefits, carbon-informed sugarbush management strategies must consider both composition and structure. Also consider management for both carbon sequestration and storage to optimize your sugarbush's role in mitigating climate change. This may include actively managing your sugarbush to have a balance of small, young fast-growing trees that sequester carbon at a fast rate along with large, old slower growing trees that store a lot of carbon. Managing for mixed-age classes also supports your sap gathering operation over the long term by ensuring new trees are coming online regularly.

Distribution of Tree Ages in Your Sugarbush

Identify the appropriate combination of young and old trees to meet your goals and develop sugarbush resilience through diversity.

- As described in *FBFS 070: Forest Carbon in Your Sugarbush,* carbon sequestration rates peak when forests are young and then decline with age, but carbon storage is greatest in old forests. This means that maintaining a sugarbush with stands composed of multiple age classes of trees provides a balance of larger/older trees for storage and younger/faster growing trees for sequestration. In addition, multi-aged sugarbushes increase the forest's resilience to natural disturbances.
- Trees of different ages often vary in height, which increases the vertical structure within the forest. Although potentially presenting obstacles for running tubing, a sugarbush with multiple canopy layers will store more carbon and provide other benefits, such as nesting sites for breeding birds. Minimizing the amount of understory clearing you do will allow for the development of a multi-aged, stratified forest that provides the opportunity to increase the levels of "carbon packing" in your sugarbush.

Sugarbush Stand Structure

Tree size has always been an area of emphasis in sugarbush management given its influence on the number of potential taps. Thankfully, what makes a good, tappable tree also corresponds to a tree that stores a lot of carbon as larger diameter trees make up a disproportionate amount of the live aboveground and belowground carbon stored in a forest. Follow these recommended management techniques:

- Maximize a tree's ability to store carbon by letting trees grow larger which stores more carbon. This is largely consistent with your plans for tappable species, but make sure to also retain larger diameter trees from other species in your sugarbush for resilience in this pool. Consider enhancing the health and vigor of those trees using practices like crop-tree release.
- Use methods that maintain large trees across the forests when it is time to regenerate a portion of your sugarbush. Given your emphasis is likely on sugar maple regeneration, multi-age regeneration methods including irregular shelterwoods and single and group selection methods will retain mature trees while also creating growing conditions conducive to recruiting regeneration that includes sugar maple.
- Designate large "legacy trees" that you permanently retain in your forest. As these trees die, they will become part of the dead wood pool. In addition to the carbon storage benefits these large diameter legacy trees provide, they provide cavities and food for wildlife, including birds and bats that consume forest insects; may be an important seed source for future trees; and have high aesthetic value, while still being tapped. For increased biodiversity and careful management in sensitive areas, groups of legacy trees can be designated around areas of high ecological value, such as vernal pools.

Sugarbush Tree Regeneration

Although we often emphasize what currently can be tapped for sap collection, maintaining and encouraging new age classes of trees is important for meeting long-term carbon and business goals.

- Depending on the conditions of your sugarbush, you may need to address barriers to successful seedling survival including competition by invasive plants, hay-scented fern, or beech sprouts, and excessive deer and moose browsing. Timely regeneration of species well-suited to the site and future conditions will ensure that there are trees in place to sequester and store carbon into the future, while also sustaining future opportunities for sugaring.

Sugarbush Species Composition

Manage your sugarbush for a variety of species which will increase carbon potential and resilience.

Although maple species, primarily sugar maple, are a logical area of emphasis when considering the species composition goals for your sugarbush, having a mix of species is important to foster forest resilience. A good target is to aim for 20 to 25 percent non-sugar maple species.

- Maintaining and promoting non-maple species within your sugarbush that are locally adapted to soil conditions and that are predicted to be competitive in future climatic conditions will help achieve a vigorous flourishing sugarbush over time. Depending on the site, this may include species like basswood, red oak, bitternut hickory, yellow birch, or white pine. Consider including red (soft) maple in your sugarbush, especially where site conditions favor it, to diversify sap producing species.
- Promoting a diversity of species will increase your sugarbush's resilience to natural disturbances by ensuring that a disease or insect that kills one species will not kill your entire sugarbush. Plus, a greater diversity of species can slow the spread and intensity of damage from pests while also providing habitat for a range of birds and bats that feed on these pests, helping to control their populations.
- Tree species have different wood densities. Given sugar maple has high density wood, sugarbushes often have a high level of carbon storage. Favoring other species, particularly other hardwoods that also have high wood densities, like red oak, can add important redundancy to this benefit.

Managing Sugarbush Dead Aboveground Carbon Pools

The amount of carbon in the form of standing dead trees (often called "snags") and downed logs is far more variable from site to site than live aboveground carbon pools. Most often, sugarbushes and other forests have much less deadwood than would have naturally occurred in forests because historically many landowners cleaned up or burned deadwood. As a result, there is a lot of potential for increasing the amount of carbon contained in dead aboveground pools, while also promoting habitat for species which depend on decaying logs and dead trees. Ways of promoting increases in the deadwood pool include:

- Designating legacy trees will ensure a future source of deadwood as the trees are left on site until they die. (Previously noted in the live biomass section.)
- Felling or girdling poor quality trees (where safe to do so) will add to the deadwood pool while also providing habitat and freeing up space and resources to increase the growth rates on adjacent trees being grown for sap production and other benefits. In addition, leave dead trees and downed logs where they occur naturally in your sugarbush unless they interfere with infrastructure. This both reduces emissions associated with operations and provides food for the forest and carbon into the soil pool.
- If you plan to harvest timber from your sugarbush, work with a forester to establish utilization standards that maximize the amount of slash left on site and include these into your contract.

Cost-Share Programs For Carbon-Friendly Management

For sugarbush owners who are seeking to be paid for carbon friendly management practices, practice-based programs offer a financial option separate from selling carbon offsets (see factsheet *FBFS 072: Valuing the Carbon Benefits of Your Sugarbush).* These programs are typically funded by state or federal governments. For example, the Environmental Quality Incentives Program (EQIP) and Conservation Stewardship Program (CSP) administered by the Natural Resources Conservation Service (NRCS) provide technical and financial assistance to sugarbush owners for a variety of actions such as writing management plans, constructing roads, managing water, controlling invasive plants, and more.

Under the new NRCS practice to enhance forest carbon benefits, sugarbush owners will need to follow specified active management techniques over a 10-year period. Currently, the annual per-acre payment for this practice is similar to selling offsets in a carbon market. One important consideration is that if a landowner enrolls a sugarbush in a practice-based program specifically for carbon, it is likely not eligible to also sell offsets because it would be difficult to demonstrate additionality.

For landowners interested in practice-based programs, the next step is to reach out to a professional forester or to your state forestry office. You can inquire about the availability of state-funded initiatives or get in touch with your local Natural Resources Conservation Service (NRCS) office.

Conclusions

By nature of their structure (i.e., large, mature trees) and composition (sugar maple-dominated), sugarbushes can contain conditions consistent with those providing carbon benefits. A sugarbush is a special kind of forest and committing to sugarbush management ensures your forest stays as forest. There are many ways to further enhance these benefits by favoring structurally and compositionally diverse conditions through the management actions you take. The critical decisions you make about managing your sugarbush for carbon should be made with an understanding of the tradeoffs between maximizing carbon sequestration and storage and maximizing sap production and meeting other goals you may have for your sugarbush.

Work with a professional forester and/or Extension staff knowledgeable about managing carbon, sugarbushes, and maple operations to evaluate how to best meet your goals for enhancing the carbon benefits in your sugarbush. Interested in sap business? Sign up to discuss the potential of your forest as a sap business and receive guidance on next steps for establishing a carbon friendly sugarbush. Establishing a sugarbush and enhancing sustainable sap production by focusing on carbon management is a powerful way to contribute positively to local rural economies and global carbon management. In our next publication we will learn about "valuing" carbon and enrollment in carbon market programs. These opportunities are an important consideration for all sugarbush owners and are discussed further in *FBFS 072: Valuing the Carbon Benefits of Your Sugarbush.*

References and Resources

Catanzaro, P.F., and A.W. D'Amato. 2019. "Forest carbon: an essential natural solution for climate change. University of Massachusetts, Cooperative Extension Landowner Outreach Pamphlet," 28 pp.

Kosiba AM. "Managing Forest Carbon." *Northern Woodlands Magazine,* Fall 2023, pp. 34-41.

For additional information and resources, visit www.maplemanager.org

Conservation-based Estate Planning

Connecticut:	**ctwoodlands.org/our-work/conserve/**
Maine:	**www.forest.umaine.edu/legacy/**
Massachusetts:	**www.masswoods.org/legacy**
New Hampshire:	**www.extension.unh.edu/resource/estate-planning-nh-woodlot-owners**
New York:	**www.nyfoa.org/resources/plans-contracts**
Rhode Island:	**web.uri.edu/rhodeislandwoods/legacy/estate-planning/**
Vermont:	**www.vhcb.org/forestland**

Find your state's Natural Resources Conservation Service (NRCS) office:

www.nrcs.usda.gov/conservation-basics/conservation-by-state

Find a Forester

Connecticut:	**www.depdata.ct.gov/forestry/ForestPractitioner/directry.pdf**
Maine:	**www.maine.gov/dacf/mfs/policy_management/selecting_a_consulting_forester.html**
Massachusetts:	**masswoods.org/professionals**
New Hampshire:	**www.extension.unh.edu/resource/directory-licensed-foresters**
New York:	**woodproducts.ny.gov/find-forester**
Rhode Island:	**web.uri.edu/rhodeislandwoods/local-businesses/foresters/**
Vermont:	**fpr.vermont.gov/forest/list-vermont-county-foresters**

Forestry Best Management Practices (BMPs)

Connecticut:	**portal.ct.gov/DEEP/Forestry/Forest-Practitioner-Certification/Best-Management-Practices**
Maine:	**www.maine.gov/dacf/mfs/publications/handbooks_guides/bmp_manual.html**
Massachusetts:	**masswoods.org/caring-your-land/water**
New Hampshire:	**extension.unh.edu/goodforestry/**
New York:	**www.nysbmpguidelines.com/**
Rhode Island:	**www.rifco.org/publications.htm**
Vermont:	**fpr.vermont.gov/forest/managing-your-woodlands/acceptable-management-practices**

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