Society of American Foresters
Growing better all the time

Forest Management and Climate Change

A Position Statement of the Society of American Foresters

This position was initially adopted by the Society on December 8, 2008. It will expire on December 8, 2013, unless, after subsequent review, it is decided otherwise by Council

Position

Society at large, the US Congress, state legislators, and policy analysts at international, federal, and state levels must recognize that the sustainable management of forests can, to a substantial degree, mitigate atmospheric pollution and global climate change.

SAF believes that climate change policies and other actions should recognize that forests can: 1) reduce greenhouse gas (GHG) emissions through the use of wood products (in lieu of non-renewable building materials), forest biomass energy (in lieu of fossil fuel-based energy sources), modification of wildfire behavior, and avoided land-use change, and 2) reduce GHG concentrations by sequestering atmospheric carbon in forest biomass and soil and by storing carbon in wood products made from the harvested trees.

Issue

Of the many ways to reduce GHG emissions and atmospheric particulate pollution, the most familiar are increasing energy efficiency and conservation and using cleaner, alternative energy sources. Less familiar yet equally essential is using forests to address climate change. Unique among all possible remedies, forests can reduce GHG emissions and atmospheric GHGs, while simultaneously providing essential environmental and social benefits, including clean water, wildlife habitat, recreation, forest products, and other values and uses.

Society and policymakers have been reluctant to embrace forest management as part of the climate change solution. It is beyond argument that forests play a decisive role in stabilizing the Earth's climate and that prudent management will enhance that role. Forest management can mitigate climate change effects and, in so doing, buy time to resolve the broader question of reducing the nation's dependence on imported fossil fuels.

Background[1]

Forests are shaped by climate. Along with soils, aspect, inclination, and elevation, climate determines what will grow where and how well. Changes in temperature and precipitation regimes therefore have the potential to dramatically affect forests nationwide. There is growing evidence that our climate is changing. The changes in temperature have been associated with increasing concentrations of atmospheric carbon dioxide (CO_2) and other GHGs in the atmosphere.

[1] This position statement is based on a report prepared by the SAF Climate Change and Carbon Sequestration Task Force (see Malmsheimer 2008).

5400 Grosvenor Lane | Bethesda, MD 20814-2198 | (301) 897-8720 | toll-free (866) 897-8720 | fax (301) 897-3690 | www.safnet.org

Reducing GHG Emissions

Forests and forest products can reduce GHG emissions through wood substitution, forest biomass substitution, modification of wildfire behavior, and avoided land-use change.

Wood Substitution

Substituting wood for fossil fuel–intensive products addresses climate change in several ways. The use of wood products avoids the emissions from the substituted products, and the forest carbon remains in storage. Wood products from sustainably managed forests can also be replenished continually, providing a dependable supply of both trees and wood products while supporting other ecological services, such as clean water, clean air, wildlife habitat, and recreation.

Life-cycle inventory analyses reveal that the lumber, wood panels, and other forest products used in construction store more carbon, emit less GHGs, and use less fossil energy than steel, concrete, brick, or vinyl, whose manufacture is energy intensive and produces substantial emissions (Lippke et al. 2004).

Although wood product substitution does not permanently eliminate carbon from the atmosphere, it does sequester carbon for the life of the product. Landfill management can further delay the conversion of wood to GHG emissions, or the discarded wood can be used for power generation (offsetting generation by fossil fuel–fired power plants) or recycled into other potentially long-lived wood products.

Forest Biomass Substitution

The use of wood to produce energy opens two opportunities to reduce GHG emissions. One involves using timber harvest residue for electrical power generation, rather than allowing it to accumulate and decay on site or removing it by open field burning. The other is the substitution of woody biomass as a feedstock for biofuels, which can be substituted for fossil-derived fuels.

The use of forest biomass fuels and bio-based products can reduce oil and gas imports and improve environmental quality. Forest biomass can offset fossil fuels such as coal, natural gas, gasoline, diesel oil, and fuel oil. At the same time, its use can enhance domestic economic development by supporting rural economies and fostering new industries making bio-based products.

The technologies for converting woody biomass to energy include direct burning, hydrolysis and fermentation, pyrolysis, gasification, charcoal, and pellets and briquettes. Energy uses for wood include thermal energy for steam, heating, and cooling; electrical generation and cogeneration; and transportation fuels.

The United States may need to build 1,200 new 300-megawatt power plants during the next 25 years to meet projected demand for electricity, and coal will likely continue to be a major source of energy for electricity production. Although some energy needs can be met by solar and wind, woody biomass presents a viable short- and mid-term solution: it can be mixed with coal or added to oil- and gas-generated electric production processes to reduce GHG emissions.

Federal funds and venture capital are beginning to support the production of cellulosic ethanol. Substituting cellulosic biomass for fossil fuels greatly reduces GHG emissions: for every BTU of gasoline that is replaced by cellulosic ethanol, total life-cycle GHG emissions (CO_2, methane, and nitrous oxide) are reduced by 90.9 percent (US EPA 2007).

The woody biomass is available from several sources: logging and other residues, treatments to reduce fuel buildup in fire-prone forests, fuelwood, forest products industry wastes, and urban wood residues. Plantations of short-rotation, rapidly-growing species, such as alder, cottonwood, hybrid poplar, sweetgum, sycamore, willow, and pine, are another source.

The impact of forest biomass substitution needs to be considered carefully since biomass products compete with other forest products for fiber. Government policies should be crafted to consider impacts to existing regional fiber markets.

Wildfire Behavior Modification

Reducing wildland fires, a major source of GHG emissions, prevents the release of carbon stored in forests. One modest wildfire—the July 2007 Angora wildfire in South Lake Tahoe, on 3,100 acres of forestland— released an estimated 141,000 tonnes of carbon dioxide and other GHGs into the atmosphere, and the decay of the trees killed by the fire could bring total emissions to 518,000 tonnes. This is equivalent to the GHG emissions generated annually by 105,500 cars (Bonnicksen 2008).

In 2006, wildfires burned nearly 10 million acres in the United States, and virtually all climate change models forecast an increase in wildfire activity. Under extreme fire behavior scenarios, which could be exacerbated by climate change, increased accumulations of hazardous forest fuels will cause ever-larger wildfires. Wildfires are also burning with more intensity, which can then lead to unintended consequences of changes in vegetative makeup and subsequent reduction in carbon sequestration. The proximity of population centers to wildlands significantly increases the risk and consequences of wildfire, including the release of GHGs. Wildfires in the United States and in many other parts of the world have been increasing in size and severity, and thus future wildfire emissions are likely to exceed current levels. Three strategies to reduce wildfires and their GHG emissions can address that trend:

- Pretreatment of fuel reduction areas— that is, removing some biomass before using prescribed fire;
- Smoke management—that is, adjusting the seasonal and daily timing of burns and using relative low-severity prescribed fires to reduce fuel consumption; and
- Harvesting small woody biomass for energy, or removing some larger woody material (over 10 centimeters, or 4 inches, in diameter) for traditional forest products and burning residuals.

Active forest and wildland fire management strategies can dramatically reduce CO_2 emissions while also conserving wildlife habitat, preserving recreational, scenic, and wood product values, and reducing the threat of wildfires to communities and critical infrastructure.

Avoided Land-Use Change

More carbon is stored in forests than in agricultural or developed land. Preventing land-use change from forests to non-forest uses is thus another way to reduce GHGs. Globally, forestland conversions released an estimated 136 billion tonnes of carbon, or 33 percent of the total emissions, between 1850 and 1998— more emissions than any other anthropogenic activity besides energy production (Watson et al. 2000). Forest conversion and land development release carbon from soil stocks. For example, soil cultivation releases 20 to 30 percent of the carbon stored in soils. Additional emissions occur from the loss of the forest biomass, both above-ground vegetation and tree roots.

In the United States, a major threat to forestland is the rise in land values for low density development. Forestland in the US Southeast, for example, has been appraised for forest use at $415 per acre and for urban use at $36,216 per acre. Landowners generally convert forestland to residential and commercial uses to capture increasing land values, but when forests are damaged by wildfire, insects, or other disturbances, selling the land for development rather than investing for long-term reforestation can be attractive. Since climate change may increase the prevalence of such disturbances, forestland conversion may increase in the future.

Moreover, conversion of forests to agricultural lands is likely if energy policies favor corn-based ethanol over cellulose-based ethanol. Tax policies that increase the cost of maintaining forestland also promote conversion, as do the short-term financial objectives of some new forest landowners.

Because it is unlikely that publicly owned forestland will increase, efforts to prevent GHG releases from forestland conversion must focus on privately owned forests. New products, such as cellulosic ethanol and newly-engineered wood products, may add value to working forests. Sustainable utilization of working forests for a combination of wood products, including bioenergy, can improve forest landowners' returns on their land, bolster interest in forest management, and prevent conversion to other uses. Credits for forest carbon offset projects, if trading markets develop, may provide the additional income to encourage private landowners to retain forests.

Reducing Atmospheric GHGs

Forests can also reduce GHG concentrations by sequestering atmospheric carbon in biomass and soil, and the carbon can remain stored in any wood products made from the harvested trees. Because the area of US forests is so vast—33 percent of the land base—even small increases in carbon sequestration and storage per acre add up to substantial quantities.

Carbon Sequestration in Forests

The capacity of stands to sequester carbon is a function of the productivity of the site and the potential size of the various pools—soil, litter, down woody material, standing dead wood, live stems, branches, and foliage. Net rates of CO_2 uptake by broad-leaf trees are commonly greater than those of conifers, but because hardwoods are generally deciduous while conifers are commonly evergreen, the overall capacity for carbon sequestration can be similar. Forests of all ages and type have a remarkable capacity to sequester and store carbon. There may be potential to sequester or store additional carbon in complex stand structures with mixed species compositions or several age classes (Kelty, 2006).

Enhancement of sequestration capacity depends on ensuring full stocking, maintaining health, minimizing soil disturbance, and reducing losses due to tree mortality, wildfires, insect, and disease. Management that controls stand density by prudent tree removal can provide society with renewable products, including lumber, engineered composites, paper, and energy, even as the stand continues to sequester carbon. Above all, enhancing the role of forests in reducing GHGs requires keeping forests as forests, increasing the forestland base through afforestation, and restoring degraded lands.

Two active forest management approaches to addressing climate change are 1) mitigation, in which forests and forest products are used to sequester carbon, provide renewable energy through biomass, and avoid carbon losses; and 2) adaptation, which involves positioning forests to become healthier. Adaptive strategies include increasing resistance to insects, diseases, and wildfires; increasing resilience for recovering after a disturbance; and assisting migration—facilitating the transition to new conditions by introducing better-adapted species, expanding genetic diversity, encouraging species mixtures, and providing refugia. This last kind of intervention is highly controversial, however, because action would be based on projections for which outcomes are highly uncertain.

Traditional silvicultural treatments focused on wood, water, wildlife, and aesthetic values are fully amenable to enhancing carbon sequestration and reducing emissions from forest management. Choices regarding even-aged and uneven-aged regimes, species composition, slash disposal, site preparation, thinning, fertilization, and rotation length can all be modified to increase carbon storage and prevent emissions. Because forests are the most efficient land use for carbon uptake and storage, landowners with plantable acres and degraded areas that can be restored to a productive condition have a significant opportunity to sequester carbon.

Storage in Wood Products

Harvesting temporarily reduces carbon storage in the forest by removing organic matter and disturbing the soil, but much of the carbon is stored in forest products. The carbon in lumber and furniture, for example, may not be released for decades; paper products have a shorter life. Storage of carbon in harvested wood products is gaining recognition in domestic climate mitigation programs, though accounting for the carbon through a product’s life cycle is problematic.

The climate change benefits of wood products lie in the combination of long term carbon storage with substitution for other materials with higher emissions. Because wood can substitute for fossil fuel-intensive products, the reductions in carbon emissions to the atmosphere are comparatively larger than even the benefit of the carbon stored in wood products. This effect—the displacement of fossil fuel sources— could make wood products the most important carbon pool of all.

References

Bonnicksen, T.M. 2008. Greenhouse gas emissions from four California wildfires: Opportunities to prevent and reverse environmental and climate impacts. FCEM Report 2. The Forest Foundation, Auburn, CA.

Kelty, M.J. 2006. The role of species mixtures in plantation forestry. Forest Ecology and Management 233:195-204

Lippke, B., J. Wilson, J. Perez-Garcia, J. Bowyer, and J. Meil. 2004. CORRIM: Life-cycle environmental performance of renewable building materials. *Forest Products Journal* 54(6):8 –19.

Malmsheimer, R.W., P. Heffernan, S. Brink, D. Crandall, F. Deneke, C. Galik, E. Gee, J.A. Helms, N. McClure, M. Mortimer, S. Ruddell, M. Smith, and J. Stewart. 2008. Forest

Management Solutions for Mitigating Climate Change in the United States. *Journal of Forestry* 106(3):115-173.

US Environmental Protection Agency (EPA). 2007a. *Greenhouse gas impacts of expanded renewable and alternative fuels use.* EPA 420-F-07-035. Office of Transportation and Air Quality, Washington, DC.

Watson, R.T., I.R. Noble, B. Bolin, N.H. Ravindranath, D.J. Verardo, and D.J. Dokken. 2000. Land use, land use change and forestry. Intergovernmental Panel on Climate Change special report. Available online atwww.grida.no/climate/ipcc/land_use; November 17, 2007.