Global Environment

In this Section

- Program Overview
- Restoring Scientific Integrity
- Forests
- Invasive Species
- Global Warming
- Archive

Contents

forests and climate change

Recognizing Forests' Role in Climate Change

The world's forests provide many important benefits: Home to more than half of all species living on land, forests also help slow global warming by storing and sequestering carbon. Forests are sources of wood products. They help regulate local and regional rainfall. And forests are crucial sources of food, medicine, clean drinking water, and immense recreational, aesthetic, and spiritual benefits for millions of people.

As globally important storehouses of carbon, forests play a critical role in influencing the Earth's climate. Forest plants and soils drive the global carbon cycle by sequestering carbon dioxide through photosynthesis and releasing it through respiration. Although carbon uptake by photosynthesis eventually declines as trees age, many mature forests continue to sequester carbon in their soils.[1,2,3]

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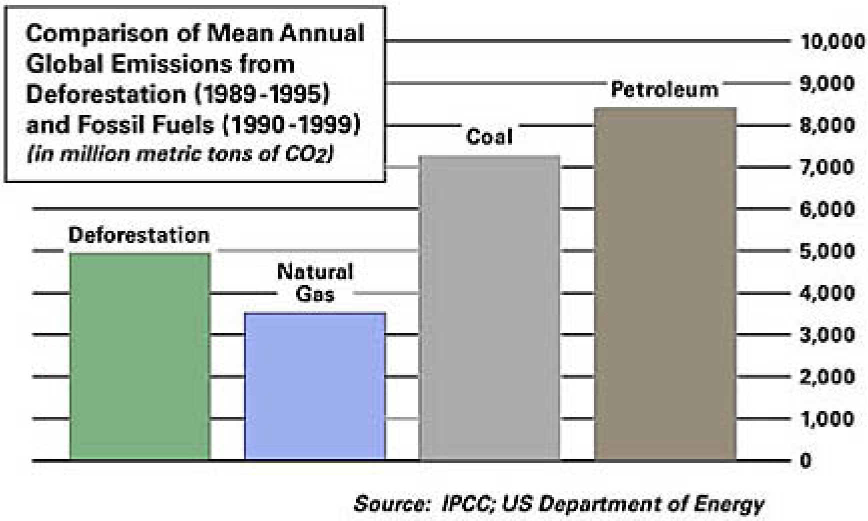
Yet, in many parts of the world, forests are being rapidly cleared for agriculture or pasture, destructively logged and mined, and degraded by human-set fires. When forests are degraded or cleared, their stored carbon is released back to the atmosphere during harvest and through respiration, thus these forests are net contributors of carbon to the atmosphere. Tropical deforestation is responsible for approximately 20% of total human-caused carbon dioxide emissions each year, and is a primary driver of extinction of forest species (see graph below).[4]



In the U.S., forests are currently net carbon "sinks," sequestering more carbon than they emit. A key reason for this is that forests in the Northeast and elsewhere, cleared previously for agriculture, are now re-establishing on abandoned lands. Other reasons include suppression of wildfires, changes in timber harvesting practices, and increased growth of trees through fertilization from elevated atmospheric concentrations of CO2. Although highly uncertain, the net terrestrial sink of North America appears to have increased on average from the 1980s to the 1990s. However, sinks of today's magnitude cannot be counted on in the future, as many of the key processes are likely to diminish or otherwise change.[5]

In the tropics, a survey of recent science finds a net carbon flux of approximately zero, that is, tropical land areas are in balance with respect to carbon exchange. This suggests that the carbon sink there is large enough to offset carbon emissions associated with deforestation. Due to sparse atmospheric and ecological data for the tropics, however, the uncertainty around this result is significant.[6]

Forest and land-use measures have the potential to reduce net carbon emissions by the equivalent of 10-20% of projected fossil fuel emissions through 2050. Efforts to increase carbon storage in U.S. forests could to sequester an additional 40 to 80 million metric tons of carbon annually,[7] equivalent to about 3-5% of current annual U.S. fossil fuel emissions.[8] Worldwide, the greatest potential for carbon sequestration by forests exists in tropical and subtropical regions.[9]

Carbon Sequestration in Forests

Measures to protect, restore, and sustainably manage forests offer significant climate change mitigation potential. Furthermore, forest-based measures can be an effective complement to abatement options focused on fossil fuel emissions. Forest-based mitigation of global warming can occur by three strategies:

- Conservation of existing forests - to avoid emissions associated with forest degradation or clearing.
- Sequestration by increasing forest carbon absorption capacity - occurring primarily by planting trees or facilitating the natural regeneration of forests, especially on marginal land and by making changes in forest management to increase biomass.[10]
- Substitution of sustainably produced biological products - substituting wood products for materials requiring energy-intensive production, such as aluminum or concrete, and substituting woody biomass for fossil fuels as an energy source.[11]

Properly designed and implemented, forest and land-use measures to mitigate climate change can result in other social and environmental benefits (e.g., protecting biodiversity and watersheds, promoting rural employment). However, poorly designed measures may result in significant negative social and environmental impacts.[12] For example, by allowing credit for reforestation without first establishing a reasonable baseline, measures that fail to provide for carbon sequestration that is truly additional to what would have taken place otherwise (i.e., under a "business-as-usual" scenario) may actually encourage forest clearing.

The Role of Markets in Forest-based Climate Mitigation

A major obstacle to slowing forest loss is that markets generally fail to capture the values of biodiversity, carbon storage, water purification, and other "ecosystem services" that forests provide. Effective approaches to addressing the "market failure" for forest goods and services should address the fact that financial incentives to clear or destructively log forests are generally stronger than those to conserve, restore, and use them sustainably. UCS generally supports the use of market-based approaches to promote forest-based climate mitigation options, provided that they achieve the following:

1. Ensure real, verifiable, and lasting greenhouse gas reductions by designing policies that account for the potential reversibility of forest-based emissions reductions. For example, a change in land management or a natural disturbance can re-release

carbon stored under a forest-based program to the atmosphere.[13]

2. Create incentives for activities that are environmentally and socially beneficial. Natural forests must not be cleared in preference for plantations, for example, nor should historical fire regimes be altered to promote biomass accumulation. Policies to conserve or enhance forests for carbon storage must also consider other benefits that forests provide. In general, managing forests for carbon conservation by increasing forest area, forest age, and tree size can have beneficial effects on biodiversity and forest ecosystem function.

3. Complement rather than replace activities that reduce fossil-fuel emissions, as both are essential for long-term climate protection. The timing, magnitude, and scope of actions implemented to address climate change through forestry projects should take into consideration a suite of factors - relative cost-effectiveness, quantity and permanence of carbon offset, and environmental, social, and economic co-benefits all should figure importantly into decision-making on best policies for greenhouse gas reductions.

Bearing in mind the advantages and limitations of market-based approaches, UCS endorses the following set of specific actions and measures for achieving forest-based mitigation of climate change.

- Slow deforestation internationally through the Clean Development Mechanism (CDM) and other international investments in forest conservation.
- Create a carbon market that recognizes domestic forest carbon values and creates strong incentives for reducing emissions in the U.S. by protecting and restoring natural forests.
- Manage timber production forests for carbon and other environmental values.
- Preserve the integrity of mature forests when managing for timber or biomass.
- Maintain historical fire regimes.
- Maintain environmental safeguards on U.S. public forest lands.

Slow deforestation internationally through the Clean Development Mechanism (CDM) and other international

investments in forest conservation.

The CDM, which is part of the Kyoto Protocol agreement, allows industrialized countries to invest in emission reduction projects taking place in developing countries, where emissions abatement is often the most economically efficient option. Under the CDM, developed countries will be able to apply the certified emission reductions achieved by such projects (including forestry projects) to meet their emissions reductions target.

At the June 2001 climate policy negotiations in Bonn, Germany, governments decided to grant CDM credits to projects that grow trees in developing countries but not those that protect existing forests from being cleared or degraded. This decision applies only to the Kyoto Protocol's "first commitment period" of 2008-2012. As such, the current agreement leaves open whether other forest and land-use projects, including those designed to slow deforestation, will be eligible for CDM credits beyond 2012.

The decision to limit CDM credits to afforestation and reforestation (A&R) perversely eliminates CDM financing for the most important measure that forest-rich developing countries can take to slow emissions and protect biodiversity - protecting threatened natural forests (i.e., forest conservation). CDM credits for forest conservation would provide significant new funding for climate mitigation and conservation activities in these countries. UCS is committed to working with scientists, NGOs, and policymakers to ensure that sound measures to protect threatened forests are eligible for CDM carbon offset financing in future commitment periods.

The U.S. Congress is also considering legislation to provide U.S. firms with tax credits to invest in international forest-based projects which mitigate climate change and protect biodiversity.[14] The passage of such legislation could generate useful projects that build experience and confidence in forest-based climate mitigation in developing countries. Return to list.

Create a carbon market that recognizes domestic forest carbon values and creates strong incentives for reducing emissions in the U.S. by protecting and restoring natural forests.

Regardless of whether the U.S. Government ratifies the Kyoto Protocol, it should implement mandatory limits (or caps) on carbon emissions and create an economy-wide domestic carbon market equivalent to that stipulated by the Protocol. Such a "cap-and-trade" approach allows the marketplace great flexibility in finding the most economically efficient and innovative ways of meeting mandatory emission limits.

Voluntary actions rewarded by tax credits or other government incentives may serve as an interim measure towards developing tradable credits for forest-based emissions reductions. Similar to other federal programs that provide payment for private conservation projects (such as the Conservation Reserve Program[15]), several legislative proposals under consideration provide incentives for voluntary CO_2 sequestration or emission reduction projects on private lands.[16] Potential measures include reforestation and changes in agricultural practices that lead to increased soil carbon storage. Incentives include tax credits, subsidies, and funding for carbon registries and demonstration projects to establish standards for key carbon performance metrics such as carbon accounting, verification, additionality, and permanence. Unfortunately, the eligibility of projects that reduce carbon emissions by protecting U.S. forests from destructive logging practices remains uncertain.

Measures to promote voluntary carbon sequestration on private forest and agricultural lands could be an effective means to increase participation and learning by farmers and forest land-owners in mitigating climate change. In addition, voluntary measures will serve to galvanize greater recognition of the role of land-use in climate change. Building confidence in this approach requires that rules be sufficiently rigorous to ensure that voluntary actions result in both measurable net reductions in atmospheric carbon as well as other environmental benefits. Without a true economy-wide cap on carbon emissions, however, such interim voluntary measures are not likely to ameliorate the failure of the market for forest products and services - i.e., the untapped potential of forests in mitigating climate change. Return to list.

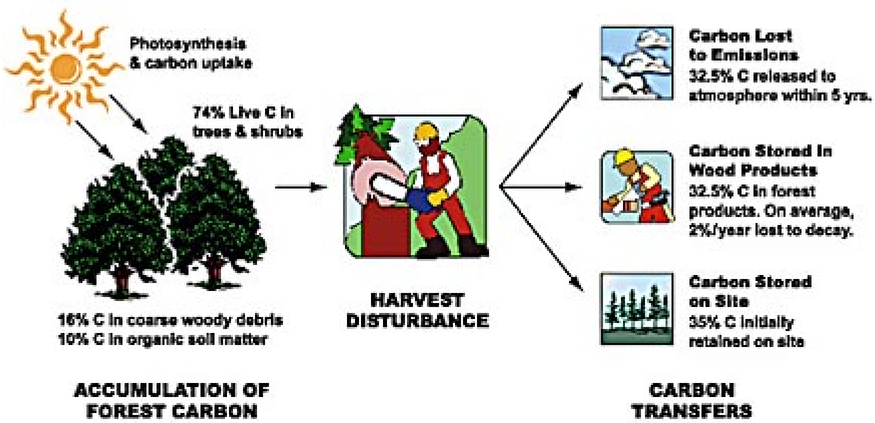
Manage timber production forests for carbon and other environmental values.

Forests that have been managed primarily for timber production should also be managed for climate mitigation and other environmental values. Expanding forest area by promoting regeneration of native trees, allowing trees to grow larger, employing harvesting methods that reduce damage and waste, and establishing conservation set-asides within production forests can all increase the average long-term quantity of stored carbon. These management options also tend to have beneficial effects on biodiversity, and on other key ecosystem services such as maintaining watersheds.

Restoring forests also tends to improve habitat quality, especially for wide-ranging forest birds and mammals. Allowing trees to grow larger before harvesting generally increases a forest's structural diversity and provides habitat for a broader range of forest species. Healthy forests that retain their natural complexity and diversity in age and habitat structure generally have greater stability and resilience to withstand disturbances associated with climate change.[17]

Trees grow quickly when they are young, but growth slows as they mature. To increase average carbon storage over time, harvests should occur after the annual growth rate falls below the average growth rate. Because timber companies have a strong economic incentive to harvest when prices are most favorable, however, many forests are harvested well before this optimal age. Lengthening the time between harvests or retaining older trees through successive harvests could significantly increase the carbon stores in the Pacific Northwest and Southeast.[17] Establishing a carbon market and a sound regulatory framework could provide financial incentive to lengthen harvest cycles. Reducing damage to non-harvested trees and disturbance of forest soils during logging operations can also substantially reduce CO2 emissions.[18]. Advantages of reduced-impact forestry include immediate carbon benefits at modest cost as well as a decrease in the risk of fire.[19] Return to list.

Carbon in Forests: Growth, Harvest, Decay



Source: Wayburn *et al*. (2000), based on (1) Harmon, M.E., J.M. Harmon, W.K. Ferrell, and D. Brooks. 1996. Modeling carbon stores in Oregon and Washington forest products: 1900-1992. Climatic Change 33: 521-550.; (2) Turner, D.P. et al. 1995. A carbon budget for forests of the coterminous United States. *Ecological Applications* 5(2): 421.; and (3) Turner, D.P. et al. 1995. Carbon sequestration by forests of the United States: current status and projections to the year 2040. Tellus 47B: 232.

Preserve the integrity of mature forests when managing for timber or biomass.

There is a widespread and misguided belief that logging or clearing mature forests and replacing them with fast-growing younger trees will benefit the climate by sequestering atmospheric CO2. While younger trees grow and sequester carbon quickly, the fate of stored carbon when mature forests are logged must also be considered. When a forest is logged, some of its carbon may be stored for years or decades in wood products. But large quantities of CO2 are also released to the atmosphere - immediately through the disturbance of forest soils, and over time through the decomposition of leaves, branches, and other detritus of timber production. One study found that even when storage of carbon in timber products is considered, the conversion of 5 million hectares of mature forest to plantations in the Pacific Northwest over the last 100 years resulted in a net increase of over 1.5 billion tons of carbon to the atmosphere.[20]

Using forest products as a source of biomass energy can present a conflict between climate mitigation and other environmental objectives. This is because a trade-off exists between leaving carbon in standing forest and producing a sustainable flow of renewable woody biomass that can be used to produce energy (instead of fossil fuels) or building materials (instead of energy-intensive steel or aluminum). While increased forest carbon storage yields climate benefits, greater mitigation may be possible over time by managing forests for the long-term production and use of biofuels. Managing for biomass should only be an option if deleterious effects on biodiversity can be avoided (i.e., is fully compatible with the Forest Stewardship Council's guidelines for biomass management).

Mature forests and other forest areas with recognized high conservation value should be fully protected. Even careful commercial forestry operations in high conservation value forests impose substantial costs to other forest ecosystem services such as biodiversity conservation, watershed maintenance, recreation and other forest amenities. These forests should not be managed for timber or biomass. Return to list.

Maintain historical fire regimes.

Historical forest fire regimes should not be altered to increase carbon storage. Forest fires release large quantities of CO_2 to the atmosphere and are estimated to contribute 10-20% of annual global emissions of methane and nitrogen oxide, both potent greenhouse gases. Fire, however, is a natural disturbance factor upon which many forest processes depend. Suppressing fires to protect either carbon, timber resources, or private property thus leads to fuel accumulation, exacerbating the risk of future catastrophic wildfire and associated "boom-bust" cycles of unpredictable carbon storage and release.

Most forests and their biological features developed in balance with a natural fire regime. These natural patterns are thus a critical ecosystem process. Fire is often a primary determinant of a forest's species composition. In fire-prone regions, for example, fire-tolerant species dominate. For these species, infrequent hot fires are important for seed germination and suppression of faster-growing but fire-susceptible species. By suppressing natural fires, fire-tolerant species become competitively disadvantaged.

Western forests are especially vulnerable to catastrophic fire, due to suppression of wildfires and destructive logging practices, both of which have allowed these areas to grow unnaturally dense with young trees. The U.S. Forest Service recently reported that about 17 million hectares of National Forest in the western United States are at "...high risk of catastrophic wildfire, a fragility brought on by years of efforts to quell natural fires."[21]. Not only can a catastrophic 'crown' fire kill an entire stand but soil damage, nutrient depletion, and watershed damage may also occur. Moreover, these catastrophic fires can so degrade a site that forest recovery may be delayed or a very different ecosystem (such as grassland) may replace the forest.[22] Return to list.

Maintain environmental safeguards on U.S. public forest lands.

Forty-two percent of all U.S. forests and the vast majority of old-growth forests are located on public lands.[23] Numerous federal and state policies affect the conservation and use of these forests. These policies, and proposed changes to them, must consider the full range of possible environmental and social impacts, including forests' influence on climate through carbon emissions.

Much public debate surrounds the Roadless Area Conservation Rule, finalized by the U.S. Forest Service in January 2001. This rule calls for ending nearly all logging, road building, and new coal, gas, oil and other mineral leasing in 58.5 million acres of the wildest remaining national forest lands.[24] Bush Administration efforts to weaken the Rule would threaten land that serves as habitat for threatened and endangered species, provides quality recreational opportunities, protects against invasion of non-native species, protects watersheds, and stores significant quantities of carbon.

There is a substantial disconnect between Congressional proposals to provide incentives for private landowners to sequester carbon (e.g., tax credits) and other, countervailing measures that may increase carbon emissions from public lands (such as weakening of the Roadless Area Conservation Rule).[24] Meaningful benefits to the climate require consistent measures to protect, restore, and sustainably manage forests for the carbon and other environmental values on both public and private lands.Return to list.

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15. http://www.fsa.usda.gov/dafp/cepd/crp.htm

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