



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

**Forests and Climate Change: Cause, Casualty and the Opportunity to Capture
Co-Benefits**

Frances Seymour

*Paper prepared for presentation at the “Agriculture in A Changing Climate: The New
International Research Frontier” conference conducted by the Crawford Fund for
International Agricultural Research, Parliament House, Canberra, Australia,
September 3, 2008*

*Copyright 2008 by Frances Seymour. All rights reserved. Readers may make verbatim
copies of this document for non-commercial purposes by any means, provided that this
copyright notice appears on all such copies.*



Forests and Climate Change: Cause, Casualty and the Opportunity to Capture Co-Benefits

FRANCES SEYMOUR

Center for International Forestry Research
Bogor, Indonesia

The relationships between forests and climate change are complex and multidimensional. Deforestation and forest degradation are now recognised to be a globally significant source of greenhouse gas emissions, and it is asserted that reduction of forest-based emissions may be among the least expensive mitigation options. However, decades of unsuccessful efforts to reverse high rates of deforestation and degradation in the tropics have revealed the fundamental failures of markets, governance and policy that drive forest loss. New initiatives toward 'Reducing Emissions from Deforestation and Forest Degradation' (REDD) will face similar challenges, but could bring to bear new sources of finance and political will.

Forests are also vulnerable to the direct impacts of climate change. Warming temperatures, increased variability of rainfall patterns and increased frequency and severity of extreme weather events will all affect the ability of forests to continue providing goods and services to local

communities and to society at large. Because healthy forests are more resilient to climate change, sustainable forest management must be given more emphasis in national adaptation strategies. Forest-related mitigation and adaptation strategies are also inter-linked: the permanence of carbon currently stored in forests is at risk from climate change, with some models predicting significant loss of forests due to climate change impacts.

Improved forest management in the interest of climate change mitigation and adaptation offers significant potential for co-benefits. The wealth of biodiversity harboured by tropical forests currently being eroded by deforestation and forest degradation can be conserved through management strategies that include biodiversity as well as carbon storage and adaptation objectives. While there will certainly be trade-offs between efficiency and equity, REDD initiatives provide a potential new source of income for rural communities. Finally, the newly-felt urgency of harnessing forests for climate change mitigation and adaptation could accelerate long-overdue reforms in the institutions and governance mechanisms necessary for sustainable forest management.

FRANCES SEYMOUR is the Director General of the Center for International Forestry Research (CIFOR) with headquarters in Bogor, Indonesia. Prior to CIFOR, Ms Seymour founded and directed the Institutions and Governance Program at the World Resources Institute in Washington, DC. At WRI, she guided the launch of The Access Initiative, a global civil society coalition promoting citizen involvement in environment-related decisions. She previously served as Director of Development Assistance Policy at the World Wildlife Fund, and spent five years in Indonesia with the Ford Foundation. She has served on numerous boards and advisory committees, including those of World Neighbors, the International NGO Forum on Indonesian Development, and the African Centre for Technology Studies. She is a member of the Council on Foreign Relations. She holds a masters degree from the Woodrow Wilson School at Princeton University, and a BS in Zoology from the University of North Carolina.

An introduction to CIFOR

CIFOR is one of fifteen centres in the CGIAR system with a specific forestry research mandate. CIFOR is the only global-scale organisation with its international headquarters in Indonesia with staff and partners scattered all over the world conducting research programs. CIFOR is particularly pleased with our partnerships with Australia, a country that played an important role in the founding of CIFOR through inputs by ACIAR and CSIRO. We now have significant funding from ACIAR and AusAid, particularly for our climate change work, and lots of cooperation with the Australian scientific community.

Our global research agenda is focused on six areas, all of which are inter-related with issues of climate change. The two of primary focus in this presentation are the role of forests in climate change mitigation and their role in adaptation. The other four areas of CIFOR research are small scale and community forestry, conservation and development at landscape scale, impacts of globalised trade and investment on forest and forest communities, and sustainable management of production forests.

The role of forests in carbon emissions

Over the last two years, the global public has become increasingly aware of the threat of climate change in general, and the role of deforestation in exacerbating that threat in particular. Nevertheless, the linkages between forests and climate change — and the magnitude of the challenges in addressing them — remain underappreciated.

One key cause of climate change is the emissions from deforestation and forest degradation. An assessment of the *net* change in global forest area during 2000–2005 revealed that deforestation occurred at a rate of around 13 million ha per year, with the leading contributors being South America and Africa (FAO 2005). Interestingly, South-East Asia has the highest rate of deforestation but the net figures for that region are positive because of significant reforestation efforts in China.

One result is that deforestation and forest degradation are globally significant sources of total CO₂ emissions, forming about one-fifth of the total global emissions. According to the IPCC 2007, forestry is actually more important than the transport sector as a source of global emissions, with 1.7 billion tonnes of carbon released annually due to land use change (primarily tropical deforestation). Two forested nations — Indonesia and Brazil — currently account for some two-thirds of total annual emissions from land use change. As a result of those emissions, estimates now place those countries as the third and fourth largest overall GHG emitters, after the United States and China (PEACE 2007). Brazil's emissions are driven by high rates of deforestation in the Amazon. The draining, clearing and burning of peatland forests — much of which are concentrated in Indonesia — is particularly emissions-intensive.

The importance of peatlands

Peatland degradation creates around 11% of global greenhouse gas emissions and is disproportionately responsible (on a per-hectare basis) for emissions once those ecosystems are disturbed. As most peatlands are concentrated in South-East Asia that region is particularly responsible for those emissions (Fig. 1). Carbon stocks in peat are particularly large: peat may extend to depths of 6 m below the surface (Hooijer *et al.* 2006) in addition to above-ground vegetation, so emissions deriving from the burning and draining of peatlands for land conversion are disproportionately significant. Disturbed peatlands are the 'gift that keeps on giving' from the perspective of carbon emissions.

Causes of deforestation and degradation

Lots of research over the last decade has been directed toward understanding the causes of deforestation and forest degradation. Direct drivers of deforestation vary by country but include:

- conversion of forest for agricultural expansion, either commercial plantations or small-holder developments
- unsustainable wood extraction due to poor logging practices that leave behind wood waste that in turn leads to fires or conversion to small-holder agriculture
- infrastructure development, principally roads and mining, which may not themselves have a heavy footprint on the forest, but provide an entry and catalyst for other conversion or degradation processes.

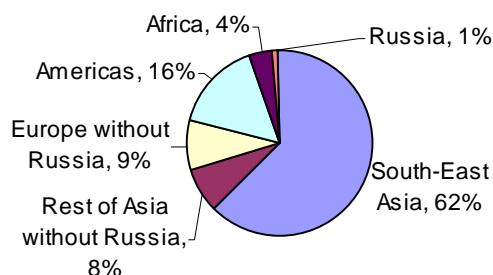


Figure 1. Decomposition of drained peatland to 800 million t of CO₂ per year. Source: Wetlands International and Delft Hydraulics

Oil palm plantations

An example of a direct cause of deforestation is oil palm plantation development. This is often an example of planned deforestation; part of national development plans, in the interest of economic growth and employment, to convert forested areas into productive agriculture. In Indonesia right now, the market for palm oil is driven by its use as a domestic cooking oil in developing countries as well its use as a 'climate friendly' transport fuel in industrialised countries (Naylor *et al.* 2007). However, the 'climate friendly' label is not deserved. Ironically, to the extent that agrofuels development comes at the expense of natural forests — as is occurring — the net impact on GHG emissions is a significant net *increase* (Searchinger *et al.* 2008). Research suggests that it would take more than 840 years to repay the 'carbon debt' from converting Indonesia's carbon-rich peatland forests to oil palm plantations and using the palm oil to substitute for fossil fuels (Fargione *et al.* 2008, p. 2).

Underlying causes

Underlying causes of deforestation and degradation revolve around:

- market failures that give biodiversity in forests no value by the market
- governments' failures that do not enforce laws and regulations
- misguided policies which provide perverse subsidies that are positive incentives to convert forest to low-value uses.

The pulp and paper industry

A second example in South-East Asia arises from the structural over-capacity in the pulp and paper sector. There is a mismatch between the amount of wood needed to keep the mills running to produce pulp and paper, and the sustainable and legal supply of wood coming from the plantations. As a result, lots of the wood necessary to feed current and planned expansion of capacity will have to come from the natural forest.

The pulp and paper sector illustrates all three underlying causes of deforestation:

- a market failure when investors fail to do their due diligence on the availability of legal and sustainable feedstock
- a governance failure stemming from the lack of law enforcement that allows mills to run on timber from illegal sources. However, the

Indonesian government must be given due credit for recent efforts to step up enforcement

- finally, a policy failure, through a variety of subsidies to the industry providing perverse incentives to convert forest to low-value uses; not least the bail-out companies were given in the aftermath of the 1998 financial crises.

The good news is that maintaining forest carbon has a low opportunity cost in many instances. A group of CGIAR centres and partners conducted research in advance of the Conference of the Parties to the UNFCCC in Bali last December to get a sense of what the opportunity cost incurred by forest users in keeping the trees in the ground would be. In many cases, forests are being converted for low-value uses such as cattle ranching, and the cost of compensating those users to leave the forest as it is would be less than \$5 per ton for emissions averted. As global prices for emissions are on the order of \$20 per ton, that seems like a good deal, with room left over to cover transaction costs. It is consistent with the Stern Review's assessment two years ago that mitigating forest-based emissions could be among the most cost-effective mitigation strategies in the global carbon emissions budget (Stern 2006). The Review asserted that controlling deforestation could provide one of the least expensive strategies for reducing emissions, and that such efforts must be a key element of any future climate protection regime. As a result, 'Reducing Emissions from Deforestation and Forest Degradation' (REDD) is now central to discussions of global and national mitigation strategies.

Policy options

The resulting policy implications based on this diagnosis of forests as a source of emissions are as follows:

- First, we must bring REDD into the global climate regime. This is already under way as a big part of the Bali road map agreed last December, which provides the necessary negotiating framework.
- Second, we need to give priority attention to countries with high deforestation rates and to peatlands. The Australian government is DOIng exactly this with a significant financial commitment to Indonesia and a specific focus on peatlands in Central Kalimantan.

- Finally, we need to address the underlying causes of deforestation, most of which lie outside the forestry sector narrowly defined. An economy-wide effort is needed to overcome the challenge.

Forests as a casualty of climate change

Forests are also a casualty of climate change. Forests are vulnerable to the extreme weather events that are likely to become more frequent with climate change. The mitigation potential of forests could itself be affected. A warmer, drier climate could trigger a positive feedback loop that results in the dieback of forests, and thus increased emissions and further warming (Bonan 2008). In other words, warmer, drier weather could lead to a vicious circle in which increased incidence of burning renders forests less able to recover and sequester carbon in forest vegetation, which in turn would accelerate climate change. Some models predict that a significant portion of the carbon-rich Amazon rainforest will be replaced by carbon-poor savannah ecosystems if global warming is allowed to proceed beyond a certain threshold, thus releasing significant amounts of carbon into the atmosphere (Mayle *et al.* 2007, p. 299; WHRC 2008).

Forests are also vulnerable to the increases in temperatures and rainfall variability likely to result from climate change. For example, longer and more severe droughts will lead to more frequent and severe forest fires, which are often catalysed by burning in adjacent agricultural lands. Damaged and fragmented forests are more vulnerable to these impacts because they are less resilient to these new pressures.

CIFOR scientists and our partners (Guariguata *et al.* 2008) suggest several steps to help forests adapt to climate change including increased use of reduced-impact logging to maintain ecosystem integrity, increased attention to fire prevention and management, and increased development of silvicultural options to facilitate genetic adaptation in plantations. A bigger policy implication, however, is the need to toughen up targets for reducing emissions overall. For this, of course, responsibility falls mostly with the industrialised economies and mostly in the fossil fuels sector. If some immediate changes are not made, we may lose many of the mitigation options that are currently available from forests.

Forests are also important to adaptation in other sectors. CIFOR is examining the different ecosystem goods and services, outlined by the Millennium Ecosystem Assessment, that are provided by forests to determine what sectors of the economies in different parts of the world are vulnerable to compromises in those services.

Maintenance of forest-based ecosystem services that support other economic sectors can strengthen societies' resilience to climate change. For example, forests play an important role in moderating the quantity and quality of water that flows out of watersheds. As rainfall patterns change, the hydrological services provided by forests will be increasingly important to maintaining municipal drinking water systems, agricultural water supplies and the production of hydroelectric power. This set of potential contributions to climate change adaptation has been ranked as especially important in Central America (TroFCCA 2008). In parts of South-East Asia, where droughts are anticipated to be more severe and episodes of heavy rainfall more likely, maintaining the role of intact natural forest vegetation in controlling forest fires and landslides is a priority (TroFCCA 2008).

In Indonesia, for example, a priority for adaptation is greater attention to keeping the forests healthy so they will be more resistant to forest fires as drought becomes more frequent and severe. The catastrophic forest fires experienced over the last decade have had a profound effect — not only on the forests, but on the health of the people inhaling the smoke and on economic activities where airports have shut down for days at a time while the haze cleared.

A second adaptation priority in Indonesia is landslides, a particular problem on Java. Trees serve as a natural adaptation option as they help bind and anchor the soil (at least from shallow landslides) — so maintaining natural vegetation is an important adaptation option.

Accordingly, the adaptation strategies of other economic sectors such as agriculture and hydropower (which are affected by forest hydrology) and air and land transportation (which are affected by haze from forest fires and landslides, respectively) need to be linked to sustainable forest management.

Co-benefits

There are several opportunities to capture additional co-benefits, such as managing forests better for climate change mitigation and adaptation, reflecting some potential win-wins. The first is that forests are a significant source of rural livelihood. Estimates show that 50–60 million people live on forest lands and derive income from forests. The World Bank estimates that 90% of the 1.2 billion people living in extreme poverty depend on forest resources for some part of their livelihood (World Bank 2004; UNDP *et al.* 2005). Forests are also particularly important as a safety net for vulnerable communities and individuals. Forests have proven to serve as important ‘safety nets’ for communities in times of economic stress. During the financial crisis in the late 1990s in Indonesia many households turned to the forest for supplementary cash and subsistence income (Sunderlin 2002).

In sub-Saharan Africa, households unable to afford high prices for modern energy sources revert to collecting fuelwood from the forest. Research in sub-Saharan Africa suggests that bushmeat from the forest provides an important source of protein to children orphaned by AIDS (Shackleton *et al.* 2006).

Forests are very significant for biodiversity conservation. The island of Borneo occupies less than 1% of the world’s land area, but harbors about 6% of the world’s flowering plant, bird and mammal species. Research suggests the livelihood and biodiversity aspects are quite interconnected. In East Kalimantan, Indonesia, research conducted with local communities identified more than 2100 forest species with 3642 different uses, including food, traditional medicine, hunting equipment, construction materials, and culturally-significant ornamentation. One hundred and nineteen of these species had no known substitute for the particular use (Sheil *et al.* 2001). If those species are lost, it will be of both economic and cultural significance.

Forests are also significant for dealing with broader government challenges in many countries. Tacconi (2007) (Fig. 2) discusses the interrelationship between problems such as illegal logging and the broader governance challenges that democracies, such as Indonesia, are trying to surmount. Challenges include issues of corruption, the need for increased transparency

and inclusiveness in decision making, the need to clarify tenure and property rights, the challenges of decentralisation and the need to build capacities of all kinds on the part of local communities and governments.

REDD opportunities

We need to find a way for money to grow on trees left standing. Can we put ATM machines in the forest for people who currently have to cut down the trees to make some money? There are real opportunities to harness REDD finance for global financial transfers in order to achieve emissions reductions and simultaneously improve rural livelihoods, biodiversity conservation and governance:

- Firstly, we can make payments for environmental services that compensate communities for their forest stewardship.
- Secondly, the final D in REDD represents degradation; if we can improve logging practices, and provide additional income to compensate for additional carbon sequestered, we will also be able to save associated biodiversity and maybe tip the balance against current incentives to convert logged-over forests to other uses.



Figure 2. An analysis of illegal logging

- Thirdly, we can increase community-based fire management. There are some promising examples in Indonesia of work with local communities to bring them on the front lines of fire prevention, detection and suppression in a way that strengthens their sense of ownership over the forests and responsibility for that stewardship.

The bad news is that REDD readiness is going to require lots of work, including the technical capacity to establish baselines and monitor changes in forest carbon. Equally challenging, however, is the necessary strengthening of governance and institutional mechanisms that are now quite weak. On these efforts, I want to commend the Australian government for not only designing a program of experimentation with such projects, but also for funding parallel research on the part of my and other organisations to make sure that we build on our current knowledge and learn as we go along to get it right.

REDD controversy revolves around concerns regarding the seriousness of the international community about REDD and how to capture the benefits for the forested countries. A World Bank (2007) press release from the Bali meeting alludes to activists concern about how market mechanisms for forest carbon might negatively affect the poor or the rights of indigenous people. Clearly, there is a lot of political legitimacy still needing to be built at the global level, as well as practical problems needing to be resolved on the ground.

Conclusion

In summary, deforestation is a significant cause of emissions and reducing it has got to be part of the global mitigation strategy. Forests and their potential contributions to climate mitigation and adaptation are themselves at risk from the impacts of climate change. However, there are potential co-benefits that can be captured for poverty, biodiversity and governance.

References

- Bonan, G. (2008) Forests and climate change: forcings, feedbacks, and the climate benefits of forests. *Science* **320**, 1444–1449. DOI²: 10.1126/science.1155121
- FAO (Food and Agriculture Organization of the United Nations) (2005) *Global Forest Resources Assessment 2005*. FAO, Rome.
- Fargione, F., Hill, J., Tilman, D., Polasky, S. and Hawthorne, P. (2008) Land clearing and biofuel carbon debt. *Science* **314**, 1598, and *Science Express* 2008 <http://www.sciencemag.org/cgi/data/1152747/D1/1>; DOI: 10.1126/science.1152747
- Guariguata, M., Cornelius, J., Locatelli, B., Forner, C. and Sanchez-Azofeifa, G. (2008) Mitigation needs adaptation: tropical forestry and climate change. *Mitigation and Adaptation Strategies for Global Change* **13**, 793–808. Available at: http://www.cifor.cgiar.org/publications/pdf_files/articles/AGuariguata0801.pdf; DOI: 10.1007/s11027-007-9141-2.
- Hooijer, A., Silvius, M., Wosten, H. and Page, S. (2006) Peat–CO₂ emissions from drained peatlands in SE Asia. Delft Hydraulics report Q3943. <http://www.wldelft.nl/index.html>
- IPCC (2007) *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M. and Miller, H.L. (eds). Cambridge University Press, Cambridge and New York.
- Mayle, F., Langstroth, R., Fisher, R. and Meir, P. (2007) Long-term forest-savannah dynamics in the Bolivian Amazon: implications for conservation. *Philosophical Transactions of the Royal Society B* **362**, 291–307.
- Naylor, R., Liska, A., Burke, M., Falcon, W., Gaskell, J., Rozelle, S. and Cassman, K. (2007) The ripple effect: biofuels, food security and the environment. *Environment* **49**, 30–43.
- PEACE (PT Pelangi Energi Abadi Citra Enviro) (2007) *Indonesia and Climate Change: Current Status and Policies*. Available at: http://siteresources.worldbank.org/INTINDONESIA/Resources/Environment/ClimateChange_Full_EN.pdf.

² Some references are accompanied by a ‘DOI’: their digital online index number. Put ‘DOI: ...’ into a search engine and you will be taken to the paper (or abstract) on the web.

- Searchinger, T., Heimlich, R., Houghton, R.A., Dong, F., Elobeid, A., Fabiosa, J., Tokgoz, S., Hayes, D. and Yu, T. (2008) Use of U.S. croplands for biofuels increases greenhouse gases through emissions from land use change. *Science* **319**, 1238–1240; DOI: 10.1126/science.1151861
- Shackleton, S., Kaschula, S., Twine, W., Hunter, L., Holding-Anyonge, C. and Petheram, L. (2006) *Forests as Safety Nets for Mitigating the Impacts of HIV/Aids in Southern Africa*. CIFOR Livelihood Brief 4, CIFOR, 4 pp. Available at: <http://www.cifor.cgiar.org/Publications/Detail.htm?&pid=2163>.
- Sheil, D., Puri, R.K., Basuki, I., van Heist, M., Saefuddin, Rukmiyati, Sardjono, M.A., Samsoedin, I., Sidiyasa, K.D., Chrisandini, Permana, E., Angi, E.M., Gatzweiler, F., Johnson, B. and Wijaya, A. (2001) *Exploring Biological Diversity, Environment and Local People's Perspectives in Forest Landscapes: Methods for a Multidisciplinary Landscape Assessment*. CIFOR. Available at: http://www.cifor.cgiar.org/mla/_ref/publications/detail/exploring_biological_diversity.htm.
- Stern, Nicholas (2006) *The Economics of Climate Change: The Stern Review*. Cambridge University Press, Cambridge.
- Sunderlin, W. (2002) Effects of crisis and political change, 1997–1999. In: Colfer, C.J.P. and Resosudarmo, I.A.P. *Which Way Forward? People, Forests and Policymaking in Indonesia*. Resources for the Future/Center for International Forestry Research, pp. 246–276.
- Tacconi, L. (ed.) (2007) *Illegal Logging: Law Enforcement, Livelihoods and the Timber Trade*. Earthscan, London.
- TroFCCA (2008) *CIFOR — Tropical Forests and Climate Change Adaptation, Central America*. Available at: www.cifor.cgiar.org/trofcca/_ref/america/index.htm
- UNDP *et al.* (United Nations Development Program, United Nations Environment Program, World Bank, World Resources Institute) (2005) *The Wealth of the Poor — Managing Ecosystems to Fight Poverty*. WRI, Washington DC, 264 pp. <http://www.wri.org/publication/world-resources-2005-wealth-poor-managing-ecosystems-fight-poverty>.
- WHRC (Woods Hole Research Center) (2008) *South America: Fire and savannization*. Retrieved on 10 September 2008. Available at: www.whrc.org/southamerica/fire_savann/index.htm.
- World Bank (2004) *Sustaining Forests. A Development Strategy*. World Bank, Washington, DC. Available at: siteresources.worldbank.org/INTFORESTS/Resources/SustainingForests.pdf
- World Bank (2007) Press release. Available at: www.bicusa.org/en/Article.3620.aspx