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SOURCES AND SINKS OF CARBON
FROM LAND-USE CHANGE AND MANAGEMENT:
A GLOBAL SYNTHESIS

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SUMMARY

Land management and land-use change can either release carbon (as CO₂) to the atmosphere, for example when forests are converted to agricultural lands, or withdraw carbon from the atmosphere as forests grow on cleared lands or as management practices sequester carbon in soil. The purpose of this work was to calculate the annual sources and sinks of carbon from changes in land use and management, globally and for nine world regions, over the period 1850 to 2000. The approach had three components. First, rates of land-use change were reconstructed from historical information on the areas of croplands, pastures, forests, and other lands and from data on wood harvests. In most regions, land-use change included the conversion of natural ecosystems to cultivated lands and pastures, including shifting cultivation, harvest of wood (for timber and fuel), and the establishment of tree plantations. In the U.S., woody encroachment and woodland thickening as a result of fire suppression were also included. Second, the amount of carbon per hectare in vegetation and soils and changes in that carbon as a result of land-use change were determined from data obtained in the ecological and forestry literature. These data on land-use change and carbon stocks were then used in a bookkeeping model (third component) to calculate regional and global changes in terrestrial carbon.

The results indicate that for the period 1850-2000 the net flux of carbon from changes in land use was 156 PgC. For comparison, emissions of carbon from combustion of fossil fuels were approximately 280 PgC during the same interval. Annual emissions from land-use change exceeded emissions from fossil fuels before about 1920. Somewhat more than half (60%) of the long-term flux was from the tropics. Average annual fluxes during the 1980s and 1990s were 2.0 and 2.2 (± 0.8) PgC yr⁻¹ (30-40% of fossil fuel emissions), respectively. In these decades, the global sources of carbon were almost entirely from the tropics. Outside the tropics, the average net flux of carbon attributable to land-use change and management decreased from a source of 0.06 PgC yr⁻¹ during the 1980s to a sink of 0.03 PgC yr⁻¹ during the 1990s. According to these analyses, changes in land use were responsible for sinks in North America and Europe and for small sources in other non-tropical regions.

Products

The results of the work were published in *Tellus*, and all of the data (changes in land use, carbon stocks, annual fluxes) have been incorporated in a revised numerical data package at CDIAC.

Houghton, R.A. Revised estimates of the annual net flux of carbon to the atmosphere from changes in land use and land management 1850-2000. *Tellus*.

Houghton, R.A., and J.L. Hackler. 2001. Carbon Flux to the Atmosphere from Land-Use Changes: 1850 to 1990. ORNL/CDIAC-131, NDP-050/R1. Carbon Dioxide Information Analysis Center, U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, Tennessee, U.S.A.