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Emissions from tropical deforestation neutralise large carbon sink

A new study suggests that, although the global terrestrial carbon sink remained relatively stable from 1990 to 2007, the effects of tropical forests were virtually neutral because CO_2 emissions from deforestation offset their carbon sink.

Understanding how much atmospheric CO_2 is absorbed by forests and other land, known as the 'terrestrial carbon sink', is a critical component in modelling and predicting future climate change. Scientists know that the sink is large, but its size and geographical variation have remained very uncertain.

In this new study, scientists used long-term, permanent observation sites, comprehensive forestry inventory data and complex statistical models to estimate the size of the global forest sink, i.e. how much CO_2 forests absorb per year, and how it has changed over nearly two decades (1990-2007). The study took into account different forest types (tropical, boreal and temperate) and forest maturities (established and re-growing following disturbance). It also took into account carbon in various biomass pools, such as living biomass, dead wood, litter, soil and harvested wood products.

For all types and ages of forest, the gross carbon sink was estimated at around 4 Petagrams of carbon per year, (PgC yr^{-1}, 1 Petagram = 1 billion tons). However, this benefit is partially offset by the carbon losses from tropical deforestation, estimated to be approximately 2.9 PgC yr^{-1}. This highlights the potential for Reducing Emissions from Deforestation and Degradation (REDD+) for reducing the risk of climate change.

The observed decrease in tropical forest sinks is attributed to severe deforestation, which reduced forest cover by 8% for the period 1990-2007, and an Amazon drought in 2005. Despite an increase in the rate of tropical reforestation in the last decade, CO_2 emissions from deforestation for the period 1990-2007 mean that the net carbon balance for tropical forests was virtually zero, i.e. they were 'carbon neutral', leading to a net global forest carbon sink of around 1.1 PgC yr^{-1}, located outside the tropics. Temperate and boreal forests also experienced changes in dynamics. For example, increases in the US carbon sink (33%) were mainly a result of natural recovery from past agricultural management, while increases in the Chinese sink (34%), were the result of reforestation programmes in historically intensively grazed or harvested areas.

In boreal forests, there was no significant change overall in the gross carbon sink: a decrease in the biomass sink of 50% in Canada caused by increased wildfires and insect outbreaks was offset by an increase in other areas, particularly in European Russia (+35%), owing to reduced harvesting.

Despite carrying out the most comprehensive study to date, the scientists make several recommendations to improve estimates of carbon sinks in the future. These include expanding monitoring networks in North American boreal forests and South East Asian tropical forests, where data are currently lacking. They also recommend improved methods to estimate the carbon sink in non-living components, particularly soil, which may currently lead to uncertainties of 10-20% in estimates.

Source: Pan, Y., Birdsey, R. A, Fang, J. *et al*. (2011). A large and persistent carbon sink in the world's forests, 1990-2007. *Science*. DOI: 10.1126/science.1201609.

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