

## MANAGING TROPICAL FORESTS FOR TIMBER, CARBON, AND BIODIVERSITY CONSERVATION

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Tropical forests that are managed sustainably provide a continuous flow of wood products and many long-term employment opportunities in forests and along the forest product market chain while they maintain biodiversity and retain or even enhance carbon stocks. Although most projects associated with the Reducing Emissions from Deforestation and Forest Degradation (REDD+) program being developed for climate change mitigation focus on avoided deforestation and reforestation, the substantial carbon and other benefits from application of improved forest management deserves more attention from researchers and policy-makers. To motivate this consideration, we used available data on logging practices, damage and logging and wood waste in the 403 million ha of production forests in International Tropical Timber Organization (ITTO) producer countries to calculate the annual production of end-use wood, logging damage, and wood waste. We then estimate the reduction of carbon emissions that could be achieved by switching from conventional logging (CVL) to reduced-impact logging (RIL) practices. We also compare the impacts of three selective cutting cycle durations (25, 40, and 50 years) on carbon stocks and wood production, and to propose an appropriate cutting cycle for under the REDD+ scheme.

Data of forest carbon stocks from 28 production forests across the tropics were used to assess timber harvests and associated waste, timber supply, and forest carbon stocks with RIL and CVL. In addition, inventory data were analyzed to assess how commercial tree species may be selectively harvested under RIL and CVL.

With the application of a cutting cycle of 25 years to the 403 million ha of production forests (with 50% operable area) in ITTO's timber producing countries, both RIL and CVL generated an average of 200 million m<sup>3</sup> year<sup>-1</sup> (182–217) of end-use wood product between 2010 and 2070, declining about 2.3 million m<sup>3</sup> year<sup>-1</sup> (2.0–2.7) (0.9%). The short cutting cycle resulted in a higher harvest than forest growth could sustain and therefore it results in rapid degradation of the forests. As only highly valued timber species are targeted under CVL, biodiversity loss is unavoidable. In terms of wood waste (logging damage and waste in the forest plus wood waste in processing facilities), CVL produced 371 million m<sup>3</sup> year<sup>-1</sup> (338–403) over the 2010–2070 period, whereas RIL produced only 170 million m<sup>3</sup> year<sup>-1</sup> (155–185), an average reduction of about 201 million m<sup>3</sup> year<sup>-1</sup>. Wood waste under CVL resulted from sawmill wastes and a huge amount of logging wastes, especially wastes caused by employment of untrained and poorly supervised workers in tree felling, log skidding, bucking, and transport.

To determine the sustainable and financially acceptable cutting cycle for maintaining wood supplies and reducing carbon emissions, timber and carbon revenues for managing 403 million ha were analyzed. Without incentives such as the REDD+ scheme, the shortest cutting cycle (25 years) is financially the most attractive.

By switching from CVL to RIL under a 40-50 year cutting cycle, ITTO producer countries could prevent the carbon emissions due to forest degradation by about 1.5-2.1 billion tCO<sub>2</sub> year<sup>-1</sup> while still producing about 82.5-140.5 million m<sup>3</sup> of end-use wood under a 50-year carbon project cycle, with the results being dependent on the chosen cutting cycles. Furthermore, as socially and environmentally sensitive areas are excluded from logging under the RIL, biodiversity conservation could also be achieved with the right incentives and enforcement.

This study suggests that switching from destructive CVL logging practices to RIL can substantially reduce carbon emissions while still producing wood for commercial use and protecting biodiversity. Longer cutting cycles maintain higher carbon stocks but reduce wood production, whereas short cycles increase wood production at the expense of carbon stocks, long-term timber availability, and biodiversity. Longer cycles than 40 years would discourage investors as well as project developers because of political and financial uncertainty, thus also discouraging long-term political commitment in developing countries. Nevertheless, without the right incentives, developing countries are likely to continue to allow the use of destructive logging practices because of the high short-term returns. It is therefore important that the REDD+ agreements explicitly include RIL and sustainable forest management (SFM) as key components along with appropriate guidelines, and SFM projects should be promoted. Forest product certification and payments for ecosystem services in addition to carbon will likely reduce illegal logging, thereby increase government revenue from timber royalties and taxes, and create more jobs in the legal logging industry.