Tropical peatland carbon losses from oil palm plantations may be underestimated

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Peatland forest draining exposes the upper peat layer to oxygen, raising decomposition rates and soil carbon losses.

Draining tropical peatlands for oil palm plantations may result in nearly twice as much carbon loss as official estimates, according to a new study by researchers from the University of Minnesota Institute on the Environment and the Union of Concerned Scientists in the journal *Environmental Research Letters*.

Peatlands—waterlogged, organic soils—have developed over thousands of years as carbon storage systems. In Southeast Asia, peat swamp forests cover about 250,000 square kilometers, a land area about the size of Michigan. In the past 15 years, peatland forests have been rapidly drained and cleared to make way for oil palm and pulpwood plantations. Draining exposes the upper peat layer to oxygen, raising decomposition rates and soil carbon losses. Most of that carbon is emitted to the atmosphere, speeding up climate change.

Kimberly M. Carlson, a postdoctoral research scholar with IonE's Global Landscapes Initiative, and UCS researchers Lael K. Goodman and Calen C. May-Tobin designed their research to support site-specific greenhouse gas emissions assessments in tropical plantations. "We wanted to know whether water table depth could be used as a proxy for soil carbon loss in peatland plantations," Carlson explained.

Major international companies that buy and sell products sourced from peatland plantations have committed to reducing their climate footprints. These companies can now trace a product through the supply chain back to its source. Consequently, specific information about the carbon balance of a producing plantation helps companies and consumers better understand the climate implications of purchasing choices.

The study, a comprehensive analysis of scientific literature on tropical plantation peatland carbon balance, found a correlation between long-term water table depth (the distance from the soil surface to the water surface) and soil carbon loss rate. This finding suggests that peat water table monitoring could help companies more accurately measure their greenhouse gas emissions.

The researchers compared two measurements of carbon loss: subsidence and mass balance. To find the subsidence rate, scientists measure how much the land has sunk over time and how much carbon is stored in the soil. Subsidence models alone cannot inform the global warming potential of peatland drainage.

Mass balance models estimate carbon emissions from the balance of carbon gains such as leaf decomposition and losses such as soil carbon dioxide emissions. With this method, both carbon dioxide and methane—a much more potent greenhouse gas—can be measured, permitting more accurate global warming potential assessments.

Carbon losses calculated from mass balance and

subsidence methods differed substantially for oil palm plantations. At plantation drainage depths of 70 centimeters, the annual rate of carbon loss determined from the subsidence method is about 20 tons of carbon per hectare per year. This is almost twice the rate of 12 tons of carbon per hectare per year that the International Panel on Climate Change uses to calculate emissions from oil palm land use. This rate, as put forth in the 2013 Supplement to the 2006 Guidelines for National Greenhouse Gas Inventories: Wetlands, is partly based on the mass balance method.

The researchers caution that additional field studies are needed to reconcile these estimates. "While our calculations take advantage of an exciting set of newly published data, a serious lack of research in tropical peatlands means that such estimates of peat carbon loss from plantation systems remain uncertain, and are frequently based on assumptions rather than empirical measurements," Carlson said.

Water table depth is only one of many factors, such as fertilizer application, that should be considered when quantifying carbon losses from cultivated peatlands.

Key findings of the study:

- The lower the water table, the higher the rate of carbon loss.
- More studies in tropical peatland plantations are needed to reduce uncertainty about the global warming potential of peat drainage.

The authors emphasize that reducing greenhouse gas emissions from peat requires preventing plantation expansion into intact peat swamp forests. "Our findings lend weight to the idea that draining peat soils should be avoided at all costs, due to the impact on global climate," Goodman said.

More information: "Modeling relationships between water table depth and peat soil carbon loss in Southeast Asian plantations," *Environmental Research Letters*, iopscience.iop.org/1748-9326/10/7/074006/article

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