

# There's far less land available for reforestation than we think, study finds



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- *In recent years, policymakers have made pledges for huge tree-planting projects a cornerstone for meeting national carbon reduction goals, while doing little to seriously cut fossil fuel emissions. But a new study shows the carbon sequestration estimates made for those forestation projects may be wildly optimistic.*
- *The new research determined that land found suitable for forestation in past studies — an area about the size of India — shrank by as much as two-thirds when adverse impacts on biodiversity, food security and water resources were taken into account.*
- *When the new study figured in environmental and social constraints, the potential for existing tree-planting pledges to store a promised 40 gigatons of carbon by 2050, was reduced to just 12.5 gigatons — a significant sum, but far from what's needed to offset continued fossil fuel use.*
- *The new study urges policymakers to be more pragmatic in their planting strategies, and prioritize lands best slated for permanent reforestation. Other researchers urge decision-makers to put more effort and money into protecting already existing biodiverse forests, which hold high carbon storage potential.*

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Josep “Pep” Canadell, executive director of the Global Carbon Project, says he believes countries large and small need to think twice before pledging to collectively plant billions of trees as a primary emissions-reduction strategy to meet climate action goals.

“We have somehow sold reforestation as a kind of easier path [to fighting climate change], and it’s not easy at all,” [Canadell](#) told Mongabay. “In my view, it’s not even easier than carbon capture and storage, a technology we’re still developing. That’s because when you bring humans into landscapes and try managing landscapes where people live, all of a sudden, this stuff becomes very complex.”

Canadell is the co-author of a [new study](#) in *Science* that found, among other things, that the amount of

land deemed suitable for newly planted and restored forests — an area roughly the size of India — quickly shrinks by as much as two-thirds when taking into account adverse impacts on biodiversity, food security and water resources.

The study used new modeling tools to create global maps of soil carbon change that show carbon gains and losses, especially in topsoil. Researchers mapped the global carbon sequestration rates after forestation based on existing tree-planting pledges, then compared that with the realistic limits of those pledges. They also sorted through permanent land use changes after deforestation — for agriculture and ranching, for example — and recognized that ever returning those lands to forests was highly unlikely.

In real terms, the study found that the potential to store an additional 40 gigatons of carbon by 2050 (as predicted by existing tree-planting pledges) shrinks to just 12.5 gigatons once environmental and social constraints are taken into account.

That 12.5 gigatons isn't nothing: Those new forests, if wisely planted and maintained for decades, would be about the size of South Africa, the study notes, and would play an important, though modest role in the overall mitigation efforts required by the climate crisis.

But that stored carbon is far short of the 40 gigatons of previous estimates, an amount deemed essential to help slow the alarming, ongoing pace of climate change.



Shifting small-scale agriculture creates a patchwork of crops and vegetation regrowth among mature tropical forest. The return of large swaths of existing agricultural lands to forest could reduce food production. Image by Rhett A. Butler for Mongabay.

## The importance of how and where to plant trees

“Over the last five years, we’ve seen quite a few global assessments of reforestation potential,” Canadell said, explaining why the new study was undertaken. “They often come with huge numbers, and they often come with a profound lack of ecological understanding. They might be very good at global modeling of satellite data, but they have no understanding of the reality on the ground.”

Africa is a prime example. The vast continent harbors many of the world’s largest mammals, which often live in [savannas and grasslands](#) — appealing but ecologically detrimental targets for reforestation. The new *Science* study found that half the 230 million hectares (568 million acres) pledged globally for forestation by 2030 are in Africa, despite just 4% of the continent actually being suitable for such massive tree planting.

The new study comes as similar peer-reviewed [research](#) by scientists with The Nature Conservancy finds that no matter how popular tree-planting pledges are among policymakers and the public, their effectiveness depends on how and where forestation takes place. Even under ideal circumstances, the positive impact of forestation is limited.



Oil palm plantation (left) and native tropical rainforest on the island of Sumatra in Indonesia. Image by Rhett Ayers Butler/Mongabay.

### ‘Impressive modeling’

Katherine Sinacore, a restoration ecologist at James Madison University in Virginia, reviewed the *Science* study for Mongabay. She researches tropical reforestation through an ecological and economic lens.

“It’s quite an impressive piece of modeling work,” Sinacore said. “I really appreciate that it’s correcting some previous estimates that might have inflated how much land is truly available for reforestation. Overall, we’re just getting better at modeling and layering in other biophysical characteristics.”

The *Science* study points out that developed nations with large tree-planting pledges, including the United States and EU countries, have only identified small patches within their own borders for reforestation. In contrast, South America, primarily Brazil, holds significantly more potential for viable reforestation given the large swaths of [degraded Amazon forest](#) that have not flipped permanently to a new treeless use (i.e., for crops or pasture).

Sinacore agreed with this finding, but echoing Canadell, added: “It’s not so challenging to plant a tree. But it’s actually really challenging to grow one for a long period of time without it dying or being cut down.”

The *Science* study’s top-line message to policymakers, Canadell said, is to deflate the unrealistic optimism around tree-planting pledges as a significant means of offsetting increasing carbon emissions without actually reducing fossil fuel burning.

But seeing as [these pledges already exist](#), the study emphasizes that policymakers and land managers should prioritize and accelerate forestation initiatives where they’re truly viable.

“The effectiveness of forestation as a natural climate solution ultimately depends on taking action: acting faster, setting higher targets, prioritizing areas with greater benefits, and coordinating global efforts for the right places with suitable [tree] species,” the study notes.



Native trees stand in a forest near the Interoceanic Highway BR-317, in the rural area of Rio Branco, Acre state, Brazil, in May 2023. The paving of such roads creates access and incentives for human expansion into previously untouched tropical forest. (AP Photo/Eraldo Peres)

## Emphasis on natural forests

Replanting with native tree species and trying to replicate native forests is essential for any long-term enhancement of carbon sequestration, Canadell said. In contrast, monoculture tree plantations tend to look good on paper — and in national replanting pledges — but they sequester relatively little carbon and [harbor even less biodiversity](#).

William Moomaw, a forest expert not involved in the *Science* study, has a different view regarding tree planting. Moomaw, an environmental policy professor emeritus at Tufts University and contributor to U.N. climate change assessment reports, has long championed far greater protections of existing biodiverse forests globally as a more urgent and effective climate action priority as compared with reforestation.

“I am not saying there is no role for tree planting,” Moomaw told Mongabay, “but at best, it can do little during the coming decades, when it is essential to remove as much carbon from the atmosphere as possible.

“People do not understand how much the world has benefitted from the ongoing growth of existing forests,” he said. “Had these forests not been removing an amount of atmospheric CO<sub>2</sub> equal to almost 30% of annual fossil fuel emissions, today’s [atmospheric carbon] concentrations would be nearly double preindustrial levels.”

**Banner image:** A participant plants local green plants in a park as part of Ethiopia’s Green Legacy Initiative, which aims to plant 7.5 billion trees by the end of the year, at Jifara Ber site, Addis Ababa, Ethiopia, in July 2025. (AP Photo/Amanuel Birhane)

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