Climate benefits of planting forests might be overestimated

The warming avoided by planting CO_2-absorbing forests could be around 15 to 30 per cent lower than previously estimated due to feedbacks such as dark trees reflecting less sunlight

By Michael Le Page on February 22, 2024



Planting trees can help limit global warming. PG Arphexad / Alamy

Planting forests will help limit further warming of the planet by soaking up some of the carbon dioxide we pump into the atmosphere. But the climate benefits on a global level could be around 15 to 30 per cent smaller than previous estimates because of other effects, such as trees absorbing sunlight.

"We are not saying don't plant trees," says James Weber at the University of Sheffield in the UK. It is just that the climate benefits aren't as large as we thought, he says.
The impact trees have depends in part on what other actions are taken to tackle climate change. The more that is done, the greater the benefits of planting forests, Weber and his colleagues have shown. "It's more positive and more efficient if we also do other things as well," he says.

It has long been known that plants can have both warming and cooling effects. In particular, dark foliage can have a warming effect by soaking up light that would be reflected back into space if no foliage was present. This effect is strongest where trees replace snow and ice, but can occur in other situations too.

Plants also emit volatile organic compounds into the air. “They are the chemicals that produce the smell of the forest,” says team member James King, also at the University of Sheffield.

These biogenic compounds can affect the climate in many ways. One key example is that they can react with chemicals in the atmosphere that would otherwise react with methane. “So methane hangs around for longer, and methane is a strong greenhouse gas,” says Weber.

The compounds released by plants can also react with nitrogen oxides to form ozone, another greenhouse gas.

These effects result in more warming. But biogenic compounds can also form aerosol particles that reflect sunlight and thus have a cooling effect.

To get an idea of the overall impact of forest planting on the climate, the team included these processes and others in a climate model where all available land is forested. That means trees in areas that are currently grassland, for instance, but not on farmland or in built-up areas.

“To our knowledge, this is the first time this has been done on a global scale, and with a plausible forestation scenario,” says King.

The researchers modelled two scenarios. In one, little is done to tackle climate change besides tree planting. In this case, the avoided warming from forests absorbing CO_2 was reduced by 23 to 31 per cent when the other forest effects were taken into account.

In the second, more optimistic scenario, strong action is taken to reduce further warming. In this case, the avoided warming was reduced by 14 to 18 per cent.

One reason for the difference is that cutting fossil fuel emissions will reduce aerosols from air pollution. In a polluted world, adding more aerosols from forests doesn’t make much difference, but in a cleaner world, the cooling effect is larger.

The model is still incomplete and doesn’t include all feedback effects, the team acknowledges. For instance, it includes the greenhouse effect of ozone, but not its effect on vegetation. High levels of ozone can kill trees, meaning less CO_2 is removed from the atmosphere. The model also doesn’t include the effect of wildfires.

“It’s very, very complex,” says King. “It’s not really possible in one study to consider every single set of feedbacks.”

“Importantly, the study shows that preventing deforestation is a far more efficient way to mitigate climate change compared to reforestation, and should therefore be prioritised,” says Stephanie Roe, a climate scientist at WWF in Washington DC.

Another missing feedback in the model is the cooling effect of water evaporating from leaves, says Roe, which can be large in tropical regions. So while the climate benefits of forestation might have been overestimated, this study still doesn't give the full picture, she says.

What's more, forestation has numerous other benefits for people and wildlife, including reducing erosion, maintaining water supplies and water quality, providing food and jobs, reducing local heat extremes and more. "Forestation, and specifically reforestation in forest biomes with native species, is absolutely worth pursuing," says Roe.

"We have always known that forests have warming effects under certain conditions and they have cooling effects under others. What this study shows is that the overwhelming net effect of forests is a cooling one," says Thomas Crowther at ETH Zurich in Switzerland.

"But most importantly, even if they didn't have such a cooling impact, we would still need to save natural forests to support Earth's biodiversity, and the billions of people who depend on them," he says.

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