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Forgetting the Forest for the Trees

Many governments are promising to reforest the world to address the interconnected issues of biodiversity loss, climate change and rural poverty. Nevertheless, efforts to plant huge numbers of trees could backfire, according to a new study led by UC Santa Barbara's Robert Heilmayr and his colleagues.

The study, published in Nature Sustainability, is the first paper to estimate the climate and ecological effects of subsidies in such schemes.

"People are thinking at an incredible scale, which is why it has captured so much of the public's imagination," said Heilmayr, an assistant professor in Environmental Studies and the Bren School of Environmental Science and Management. But without clearly defining what the objective is, it runs the risk of becoming everything to everyone and, in the process, failing to live up to its promises, he added.

The analysis reveals how efforts such as the global Trillion Trees campaign and a related initiative under consideration by the U.S. Congress could lead to more biodiversity loss and little, if any, climate change upside. The researchers emphasize, however, that these efforts could have significant benefits if they include strong subsidy restrictions, such as prohibitions against replacing native forests with tree plantations.

"If policies to incentivize tree plantations are poorly designed or poorly enforced, there is a high risk of not only wasting public money but also releasing more carbon and losing biodiversity," said Stanford professor Eric Lambin, one of the study's

coauthors. “That’s the exact opposite of what these policies are aiming for.”

There is no question that forests have an outsized role to play in efforts to slow global biodiversity loss and combat climate change by sequestering carbon. So it makes sense that planting trees has gained traction as a solution in recent years with ambitious commitments. For instance, the Bonn Challenge seeks to restore an area of forest more than eight times the size of California by 2030, and Trillion Trees aims to plant as many trees as its name implies.

A closer look reveals faults in the optimistic plans. For example, nearly 80% of commitments to the Bonn Challenge involve planting monoculture tree plantations or a mix of trees that produce products such as fruit and rubber rather than restoring natural forests. Plantations typically fall significantly short of natural forests in terms of carbon sequestration, habitat creation and erosion control. The potential benefit dwindles further if planted trees replace natural forests, grasslands or savannahs — ecosystems that have evolved to support unique, local biodiversity.

In the new study, the researchers critically examined another aspect of some mass-tree planting efforts: subsidies designed to encourage private landowners to plant trees. Payments are widely proposed as a promising solution to a variety of environmental challenges.

The scientists looked at one of the world’s longest-running and most influential afforestation subsidy policies, Chile’s Decree Law 701. The law — in effect from 1974 to 2012 and currently being considered for reintroduction — has served as the model for similar policies in a number of South American countries and international development projects.

“A lot of these projects take decades to actually have impacts,” said Heilmayr, “so if we’re thinking about designing policies now it’s useful to look at something that was adopted 20-30 years ago.”

“Chile’s experience can help us understand the climactic, ecological and economic impacts that might occur when governments pay landowners to establish tree plantations,” he added.

Chile’s Decree Law 701 subsidized 75% of afforestation costs and provided support for ongoing plantation management. Unfortunately, lax enforcement and budgetary limitations hobbled prohibitions on the use of subsidies on already-forested lands.

This resulted in situations where the government actually subsidized the replacement of native forests with profitable tree plantations.

Anecdotal evidence indicated the law's subsidies further reduced native forest cover by encouraging the establishment of plantations on shrublands or marginal agricultural lands where forests might have naturally regenerated.

The researchers set out to quantify the full impact of the afforestation subsidies and calculate their effects on net carbon and biodiversity changes across the entire country. They compared the area of Chilean forests under three scenarios: actual observed subsidy patterns, no subsidies and subsidies combined with fully enforced restrictions on the conversion of native forests to plantations.

They found that, relative to a scenario of no subsidies, afforestation payments expanded the area covered by trees, but decreased the area of native forests. Since Chile's native forests are more carbon dense and biodiverse than plantations, the subsidies failed to increase carbon storage, and accelerated biodiversity losses.

"Nations should design and enforce their forest subsidy policies to avoid the undesirable ecological impacts that resulted from Chile's program," said study coauthor Cristian Echeverría, a professor at the University of Concepción in Chile. "Future subsidies should seek to promote the recovery of the many carbon and biodiversity-rich natural ecosystems that have been lost."

"Ultimately, planting trees will be one part of a broader effort to address climate change," Heilmayr said. "And you really have to design policies carefully so that you get the biodiversity, poverty alleviation and climate impacts you intended."

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