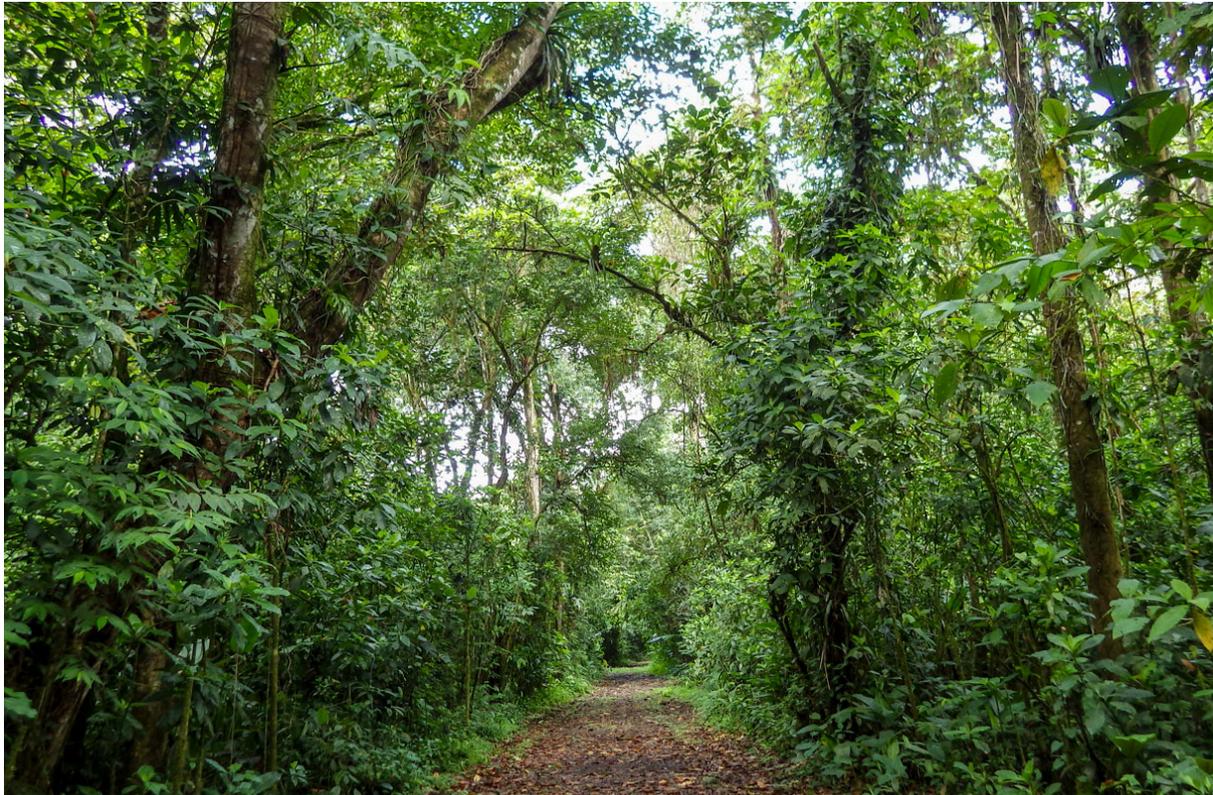


Reforestation means more than just planting trees

Scientists are figuring out the best strategies to regrow lost f



A forest has regrown all by itself in a former pasture in northern Costa Rica over the past 3 decades. ROBIN CHAZDON

The world is set to get a lot greener over the next 10 years. The United Nations has designated 2021–30 the Decade on Ecosystem Restoration, and many countries, with help from donors, have launched ambitious programs to restore forests in places where they were chopped down or degraded. At the U.N. Climate Change Conference in Egypt last week, the European Union and 26 nations **pledged \$16 billion** in support of forests, banking on trees' ability to slow climate change by storing carbon. A significant chunk will be spent on reforestation.

“It’s a really exciting time,” says Susan Cook-Patton, a restoration researcher at the Nature Conservancy. “We’ve got an opportunity to really

restore forests at scale, and that’s really encouraging.” But little is known about how best to achieve that.

Between 2000 and 2020, the amount of forest **increased by 1.3 million square kilometers**, an area larger than Peru, according to the World Resources Institute, with China and India leading the way. But **about 45%** of those new forests are plantations, dense aggregations dominated by a single species that are less beneficial for biodiversity and long-term carbon storage than natural forests.

Many reforestation projects focus on the number of trees planted, with less attention to how well they survive, how diverse the resulting forests are, or how much carbon they store. “We still know relatively little about what is working well or not, where, and why,” says Laura Duncanson of the University of Maryland, College Park, who studies carbon storage in forests.

A **theme issue** of the *Philosophical Transactions of the Royal Society* published last week offers guidance, in the form of 20 articles—both original research and reviews. One **in-depth look at reforestation projects** in South and Southeast Asia details the challenge. Co-editor Lindsay Banin, a forest ecologist at the UK Centre for Ecology & Hydrology, and her colleagues examined data on how well newly planted trees survived at 176 reforested sites that differed in soil and environmental conditions as well as in what was planted. In some places, fewer than one in five saplings survived, and on average only 44% lasted more than 5 years.

The study did offer one encouraging hint: When seedlings were planted near mature trees, an average of 64% survived, possibly because those spots were not as degraded. Other research has shown that measures such as fencing out cattle and improving soil conditions can boost saplings’ chances of survival as well, but they can be costly.

Planting a couple of species **that establish themselves easily can also help.** These vanguard species pave the way for others to settle in on their own—an approach “sort of halfway between natural forest regeneration and intensive tree planting,” Duncanson says. A study by plant ecologists Stephen Elliott and Pimonrat Tiansawat of Chiang Mai University concluded that the early species should be native to the area, thrive in exposed areas, grow fast, inhibit the growth of weeds, and attract seed-dispersing animals. One effective kick-starter used in Australia is a rainforest shrub named bleeding heart (*Homalanthus novoguineensis*). Its roots loosen the soil and its leaves add nutrients, allowing other species to take hold, while its fleshy green fruits attract animals that can spread seeds.

Picking the right place to plant is important as well. Ecologists Louis König and Catarina Jakovac of Wageningen University & Research examined reforestation efforts in the wastelands left behind by closed tin mines in Brazil the past 25 years. Trees have a **hard time growing on piles of tailings**, where the soil layers are disrupted and toxic, they report; the planted seedlings do better in mining pits and close to remnant forests.

A possible cost-saving measure is not to replant an entire site, but to set out discrete bunches of seedlings, creating “islands of regeneration” around which a new forest will grow by itself. A **comparison of 13 experimental sites** in Costa Rica by Andy Kulikowski and Karen Holl of the University of California, Santa Cruz, showed this approach, called “applied nucleation,” can be as good or better at promoting the regrowth of a diverse forest than densely planting an entire area with one or just a few species. Nucleation allows more space for the trees as well as light, says forest ecologist Robin Chazdon of the University of the Sunshine Coast (USC), a co-editor of the special issue: “Trees like that!” But forests can even recover all on their own. Since 1997, Chazdon has monitored a former pasture in northern Costa Rica where not a single tree was planted. A healthy natural forest has sprung up.

How reforestation affects local people—and vice versa—is an important factor in planning a project. Reforestation can reduce the land available for farming, but local communities can be compensated—and the new forest can provide timber, wildlife hunting opportunities, and other sources of income. “We need to make sure restoration is beneficial and wanted by local communities,” Banin says.

University of York conservation scientists Robin Loveridge and Andrew Marshall, also at USC, studied the well-being of people involved in reforestation projects in eastern Tanzania. They compared the satisfaction of people who sell timber certified as sustainable with that of communities that did not have a sustainability program. The **better a forest was managed**, the happier those doing the managing were, the team found. “It’s not just about getting the ecological dynamics right, but also the social and economic dynamics,” Cook-Patton says.

Many other **issues need attention** as well, says Marshall, also a co-editor of the theme issue. They range from the role of lianas and vines—which can both hamper reforestation by hindering light and help it by offering protection from storms—to how to measure success and manage the projects. The answers will depend on local conditions. “You can have a trillion dollars,” says Bill Laurance, a forest ecologist at James Cook University, Cairns, “but there’s no simple answer that fits all.”

Forest ecologist Simon Lewis of University College London is excited about the momentum behind reforestation but worries about the quality of the new forests. “There is a risk that as countries try to meet tough targets on curbing deforestation, old-growth forests are still cut but are replaced elsewhere,” Lewis says. That means no net deforestation, “but a high-carbon, high-biodiversity forest is replaced by lower carbon and lower diversity forest.”