Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
In the search for ways to address sustainability challenges, there is growing interest in nature-based solutions. Among these are calls to plant a trillion trees globally, which has been met with mixed responses. In this Voices, we ask researchers about the potential role of trees in mitigating and adapting to global change, as well as doing so in a way that does not compromise other Sustainable Development Goals.

Planting trees has been in the news recently as a great example of how nature can help us solve climate change. This is great for your neighborhood, but don’t forget how resilient nature is. In the vast landscapes beyond our neighborhoods, the key is releasing forests to regenerate on their own. Livestock use 70% of agricultural lands yet contribute 5% of food. A move toward plant-based diets would free up land, unlocking most of the potential for global reforestation without active planting. Better diets and land-use policies are critical to another, even bigger climate win that should be easier: avoiding destruction of ecosystems in the first place. Restoration of 2 million km² of forests and wetlands would deliver 2 billion metric tons of CO₂ mitigation per year, whereas avoiding their destruction across 0.1 million km² each year could deliver 4 billion metric tons of CO₂. The third, largest, and least-talked-about type of natural climate solution is better management of forests and farms, which can deliver 5 billion metric tons of CO₂e per year while maintaining or increasing yields of wood, food, and fuel. I think this third option can be unlocked the fastest considering the huge opportunities for private-sector investment to improve existing land-use business models. Together, these three keys to solving climate change naturally can cost-effectively unlock 11 billion metric tons of CO₂e of climate mitigation per year, over a quarter of what’s needed. Imagine that we lived on a greener, wilder, and more resilient Earth with smarter, more sustainable farms and working forests. This is not just a nice idea—it is a requirement if we want a safe, stable climate.

Forest protection and restoration have always played important roles in climate solutions. Deforestation still contributes a tenth or more of annual CO₂ emissions. Trees do much more than store carbon, too. They enhance biodiversity, stabilize soils and climate, and clean and recycle our water. For these and other reasons, policies such as the Bonn Challenge, which aims to restore 350 million ha of degraded forest by 2030, remain critical climate solutions. Planting trees also engages and inspires the public—benefits we should embrace. There are dangers to forest hyperbole. Fossil-fuel companies claim forests as core offsets to their (and our) emissions, but few scientists would argue that planting trees is the same as leaving oil and natural gas in the ground. Another danger is “carbon blinders.” Grasslands, shrublands, and other ecosystems are not vessels to be filled with trees. Afforestation can drain streams and warm the earth locally by planting darker trees over lighter grasslands, offsetting some of their carbon benefits. Finally, global CO₂ emissions are now 37 billion metric tons annually. Planting trees can help, but no amount of tree planting can possibly replace the need for emission cuts.

If we protect and restore forests worldwide, especially in the tropics, we’ll store carbon and reap many benefits. If we plant a trillion trees where they don’t “belong,” we could waste money and jeopardize ecosystem services and human livelihoods. Nothing is better for climate than keeping carbon in the ground, not even trees.

Trees are the quintessential nature-based solutions. They provide a combination of essential ecosystem services that make our communities healthier, more resilient, and more vibrant. Urban forests help adapt cities to climate change, e.g., by cooling urban heat islands. Their contributions to our health and well-being are highlighted during the current pandemic, although some of us can view trees only from our windows.

Although large-scale, often politically driven tree-planting campaigns create considerable excitement and mobilize communities and funding, some caution is needed. First of all, tree planting makes sense only if it’s done properly with the appropriate skills and species. Moreover, the trees’ future maintenance needs to be ensured, which requires putting community stewardship and maintenance funding in place before the first shovel goes into the soil. Finally, and most importantly, much more attention needs to be given to protecting and properly managing our existing tree populations. Every single day, many trees are falling victim to urban development, overexploitation, and a range of abuses. Many of these trees, especially the mature ones, provide a range of ecosystem services that are difficult to replace in the short term.

Planting trees is commendable but not without first ensuring that appropriate stewardship is in place, as well as taking care of our existing canopy.
Whether a specific tree-planting project will result in the anticipated climatic effects (e.g., temperature, precipitation, wind, and radiation) depends not only on its C-budget but also on the water needs of the tree species, the structure of the forest, the physiology of the planted species, the available soil and surface water, and the climatic zone of the project. Assessing the climate impact of tree planting solely on the basis of analyzing its C-budget ignores basic plant physiology and biophysics and is unlikely to be a reliable predictor of its impact on the Sustainable Development Goals (SDGs). In the temperate and boreal zones, the C-storage potential of a forest has even been shown to be a poor predictor of its climate impact.

If global temperature and precipitation regimes change substantially, the basis of forest-based solutions, i.e., the forest, might have to become the target of the adaptation efforts. Adaptation should then reduce the vulnerability of the forests to unprecedented environmental conditions, changing mitigation from an objective of tree planting to a co-benefit at best. A possible loss of the mitigation potential of tree planting would not render it useless for climate action (SDG 13), but the likely need to introduce de novo species assemblages could diminish its contribution to ecosystem restoration and protection of biodiversity (SDG 15). Integrative frontier research should inform us on whether large-scale tree planting is a prerequisite for or an obstacle to reaching the SDGs.

Mangrove forests are a potential win-win nature-based climate solution. Mangroves contribute to mitigation through the sequestration and storage of carbon at densities higher than that in other vegetated ecosystems. Mangroves also help coastal communities adapt to climate-change hazards; for example, by consolidating sediments, they help the intertidal zone potentially keep pace with rising sea levels. Mangroves provide these ecosystem services while also contributing to SDG targets related to food security and poverty alleviation.

The recognition of mangroves as a key nature-based solution has generated substantial national and international policy interest, e.g., within the context of international initiatives such as the Paris Agreement and the Sendai Framework for Disaster Risk Reduction. Efforts to reduce mangrove loss and increase rehabilitation are ongoing. A recent study has suggested that as much as 800,000 ha could be biophysically suitable for mangrove restoration globally; if this is feasible, mangroves could contribute to large-scale habitat restoration targets.

We have to be honest about the limitations of nature-based solutions, and mangroves are no exception. Their true scale of carbon sequestration and storage is limited by their small areal extent globally. There exist several socioeconomic constraints to their large-scale rehabilitation, such as unclear land tenure and high opportunity costs of alternative land uses. However, mangroves will be able to contribute to climate-change mitigation and adaptation for many countries alongside specific SDG targets.

The Trillion Trees Initiative, which aims to restore or protect 1 trillion trees globally by 2050, has captured the imagination of world leaders—with good reason. Reforestation and other nature-based solutions could remove a third of the carbon needed to reach the Paris Agreement goals. Trees benefit human health by filtering pollution—at a value of nearly $7 billion per year in the US alone. And growing trees means creating jobs, just when governments are confronting the economic crisis wrought by the coronavirus disease 2019 (COVID-19) pandemic. In the US, every $1 million invested in forest restoration can support nearly 40 jobs, more than a similar investment would yield in industries such as aviation or oil and gas.

But in order to succeed, initiatives such as Trillion Trees require the right growing conditions. First, national governments must make significant investments. The World Resources Institute found that in the US, an annual federal investment of $4–$4.5 billion could restore up to 60 billion trees over 20 years in degraded forests, agroforestry systems, and rural and urban communities—creating over 150,000 jobs in the process. Second, a pipeline of shovel-ready projects must be ready to receive investment. Initiatives such as Cities4Forests are already connecting projects with resources to help them qualify for loans, grants, and other forms of financing. Third, robust safeguards and monitoring strategies are needed to ensure that tree-planting campaigns also protect existing forests, support healthy ecosystems, and benefit communities.

Trees can transform the world, but only if we cultivate them carefully.
On Not Seeing the Forest for the Trees

Nathalie Seddon
Nature-Based Solutions Initiative, University of Oxford

Can we stop talking about trees and get back to talking about forests? Trees are, of course, essential components of our life-support system. They produce oxygen, draw down CO₂, regulate water cycles, bind soils and slopes, and support countless organisms ranging from nutrient-cycling microbes to animals that pollinate crops, control pests, and disperse seeds. But the capacity of trees to perform these vital functions depends on the overall health, diversity, and resilience of the ecosystems in which they grow. Moreover, when it comes to protecting us from the impacts of droughts, floods, storm surges, and more, it is the forest—not the tree—that counts.

For the first 10 years, the concept of nature-based solutions concerned working with nature in a way that supported human adaptation and disaster-risk reduction. Recently, the focus shifted to tree planting. Although global recognition of the value of trees is to be welcomed, tree planting is not a silver-bullet climate solution. Unless we rapidly decarbonize our economies, global heating will damage us and our ecosystems beyond recovery.

Headlines about trillions of trees distract us from the importance of other ecosystems—peatlands, mangroves, and reefs—and pave the way to land grabs and violations of the rights of Indigenous and local communities who have been working with nature for millennia. Those investing in nature-based solutions must recognize that the extent to which nature can provide solutions and support sustainable development is not a function of the numbers of trees planted. Instead, it’s a function of the quality and diversity of ecosystems restored and protected and the well-being of those who depend upon them.