

Voices

# Trees as Nature-Based Solutions: A Global South Perspective

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 have 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.

## Policymakers Must Listen



**Jayashree Ratnam**  
National Centre for Biological Sciences

## Work with Local Communities



**Margaret Awuor Owuor**  
South Eastern Kenya University

## Thinking beyond Trees



**Michelle Greve**  
University of Pretoria

Even as high-profile campaigns for planetary-scale tree planting (such as the Bonn Challenge and A Trillion Trees) gain momentum, voices against this narrative have grown to a crescendo. The past 5 years have seen a welter of scientific and popular writing alerting us to the negative consequences of tree planting in the wrong places: the loss of Earth's ancient grasslands and savannas and the heritage biodiversity that they support; the loss of livelihoods associated with these biomes; reduced groundwater recharge and stream flow in arid and semi-arid areas, where trees are not the norm; and local warming effects where dark trees absorb more heat than lighter grasslands and so offset their carbon capture. The reasons to pause and take a nuanced approach to tree planting are loud and clear; the most compelling is that the benefits of carbon capture from planting trees simply cannot match the benefits from leaving carbon in the ground.

Despite this chorus, policymakers have not been listening, and policies for tree planting at global and national scales continue apace—with huge economic investments at stake. This deafness is now our primary challenge and urgently needs to change before trees planted in the wrong places compromise biodiversity, livelihood, water, and climate at scales from which we might not be able to pull back. Although we must embrace forest protection, reforestation of degraded natural forests, and tree planting in urban areas and farmlands, elsewhere, these must be closely examined for costs, and nowhere must we be misled into thinking that tree planting can replace reductions in fossil fuel emissions.

Forest ecosystems are important sources of livelihoods to the local communities living around them and to the globe because they help mitigate the effects of climate change and are sources of firewood and medicine. However, forests continue to face anthropogenic pressures, such as cutting down trees for firewood and brick making. These challenges are heightened by a lack of or limited involvement of people living around the forests in conservation and management. In cases where they are involved, the majority are challenged by not being able to express themselves clearly, not being able to speak English, or being unfamiliar with the technicalities of conservation, so they are shunned.

Many countries and bodies such as the UN encourage tree planting to mitigate climate change. For example, the government of Kenya aims to attain a 10% increase in tree cover by 2022 (2 years away). How can we achieve this if we do not work closely with the local communities living around forest ecosystems? Community-based approaches to managing natural resources propose the need to work with the local communities living adjacent to or within forests to plant trees and protect forests. Therefore, let us bring the local individuals who are semi-illiterate but rich in local knowledge to the conservation agenda.

Over vast tracts of Earth, tree planting is *not* a nature-based solution. Tree planting can cause more harm than benefit in ecosystems where forests never existed. These include, for example, grasslands and savannas.

The vegetation of vast areas of Earth is determined not only by climate but also by natural disturbances, such as fire and herbivory, which open up the physiognomy of the vegetation. These vegetation types support a rich diversity of species that are uniquely adapted to open habitats and invest heavily in tolerating and surviving the natural disturbances that occur in these systems.

Global tree-planting initiatives, and some high-profile scientific studies, identify and recommend areas suitable for tree planting by determining the potential tree biomass that can be supported on the basis of climatic conditions. Therefore, they disproportionately target open vegetation types, such as savannas and grasslands, which have climates for forests if natural disturbances are suppressed. However, planting trees in such areas has dire consequences for their biodiversity and can, in effect, result in the transformation of these systems. Therefore, tree-planting initiatives should steer away from such areas.

Additionally, and importantly, evidence is emerging to suggest that the underground storage structures of savanna and grassland plants, which are often ignored in carbon budgets, store more carbon than trees! Thus, the good news is that by keeping these open habitats treeless—and by conserving their diverse plant life—we can maximize the ability of these systems to capture carbon.

### Great Potential, Tough Job



**Congbin Fu**  
Nanjing University

China has implemented multiple large-scale afforestation projects in the last several decades. Although these projects were not specifically designed only for mitigating climate change, they do provide vivid lessons with implications for potential afforestation initiatives, including planting a trillion of trees globally.

Forests are more than carbon sinks and can provide many environmental benefits. For example, the Three-North Shelterbelt Program in China contributed to 30.14 million ha of forest by 2018, remediating 33.06 million sandy lands and lowering the frequency of dust storm from 6.8 to 2.4 days per year. Moreover, afforestation is beneficial to soil conservation, air cleaning, and biodiversity and has the potential to mitigate local warming through biophysical processes.

However, the afforestation in China has raised increasing concerns as well. To combat land degradation, trees are commonly planted in water-limited regions. The maladaptation of exotic species, as well as poor management, can lead to a low survival rate of planted trees. In addition, the excessive water demand due to the planted trees further threatens water safety over these regions.

Afforestation has great potential to mitigate climate change. At the same time, the potential side effects of tree-planting and -management systems should be carefully evaluated on the basis of regional climate and ecological conditions before the implementation of large-scale afforestation.

### Troubles with Too Many Trees



**Nicola Stevens**  
University of Oxford

The restoration of recently deforested and degraded forests through tree-planting initiatives can restore forests, increase resilience to climate change, and help to reduce further increases in atmospheric carbon. However, in the rush to plant trees, campaigns, including the Bonn Challenge, are also targeting areas that are incorrectly identified as degraded and deforested. This broadly includes vast areas of open ecosystems—such as savannas, grasslands, and shrublands—that dominate the Global South. In Africa, for example, the AFR100, an implementation of the Bonn Challenge, plans to plant at least 1 million km<sup>2</sup> of trees by 2030. Some of the target area includes degraded tropical and subtropical forest. Yet, the target area also includes grassland-dominated ecosystems that have incorrectly been identified as degraded. Many of the “new” forests will be at the expense of valuable ecosystem services that serve millions of people and will result in large-scale losses of biodiversity, reduced streamflow, and loss of ecosystem services and further exacerbate social inequalities.

The urgency of implementing large-scale tree planting is prompting the release of funding into inadequately assessed projects that will most likely have negligible sequestration benefits and cause potential human and ecological harm. For tree planting to be positive, it needs to be the right trees in the right places. These actions also shouldn't serve as a distraction or a substitute, and we need to remain focused on addressing the root cause of the problem and reducing fossil fuel use.

### Exclosures for Land Restoration



**Wolde Mekuria**  
International Water Management Institute

The use of exclosures has gained widespread acceptance as a method of restoring degraded ecosystems in many of the world's semi-arid rangelands. For example, in Ethiopia, exclosures are common land areas, which are traditionally “open access,” where wood cutting, grazing, and other agricultural activities are forbidden or strictly limited in an effort to promote restoration and natural regeneration. Numerous studies have provided evidence of the multiple benefits of exclosures, including increased vegetation cover and biodiversity, enhanced ecosystem carbon stocks, reduced soil erosion, and improved livelihoods of small-holder farmers over the medium to long term. These benefits suggest that exclosures could be one of the nature-based solutions for mitigating and adapting to climate change while also improving agricultural productivity and livelihoods.

Studies have also demonstrated that local communities generally have positive opinions and believe that exclosures support restoration of degraded landscapes and improve ecosystem services. However, some community members have concerns about the recent expansion of exclosures because of the limited short-term benefits and reductions in fuelwood availability. This suggests that in poor communities, such as rural communities in developing countries, balancing the short-term economic returns and long-term sustainability and environmental goals is critical to sustaining the establishment of exclosures. Without clear evidence of such benefits, local communities have no real incentive to support government efforts to establish exclosures, putting their success at risk.

**The Forest View of the World**



**Alessandra Fidelis**  
Universidade Estadual Paulista

We now have the solution for climate change and mitigating CO<sub>2</sub> emissions: planting trees. Not one or two but a trillion trees. Everywhere! If we do so, we could hypothetically sequester 205 Gt of carbon and restore 0.9 billion ha. Problem solved—let’s take our shovels and start planting our tree seedlings. I wish the solution were that simple and that climate-change and restoration solutions could be based on planting trees alone. But it gets complicated.

Uncritical tree planting not only overestimates the potential of carbon sequestration but also fails to acknowledge the diversity of tropical ecosystems. One usually visualizes tropical ecosystems as magnificent closed forests and often ignores ancient and highly valuable grassy ecosystems. This largely Northern Hemisphere view of most of the tropical open ecosystems misclassifies millions of hectares of grasslands and savannas as potential areas for closed tropical forests. As such, native grassy ecosystems are targeted for tree planting as restoration opportunities for the World Resources Institute. In other words, afforestation—not a true restoration of the native ecosystem.

According to the Bonn Challenge, 150 million ha of degraded land should be restored by 2030. However, tree planting in grassy biomes will lead to an environmental disaster. It will seriously compromise water recharge in the groundwater reserves and extirpate shade-intolerant species endemic from open ecosystems. Thus, we should review our “magic” tree-planting solution to mitigate climate change and start by reducing fossil carbon and greenhouse gases.

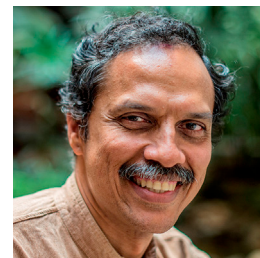
**Regenerate Africa’s Dry Forests**



**Vera De Cauwer**  
Namibia University of Science and Technology

Nature-based solutions in low- and middle-income countries have to strengthen the first three Sustainable Development Goals (SDGs): No Poverty, Zero Hunger, and Good Health and Well-Being. If trees provide direct services—especially fruit, medicines, and timber—there is a motivation to plant and protect them while realizing the additional benefits of carbon sequestration and soil protection. However, tree planting is inefficient in the semi-arid areas of Africa, where erratic rainfall and yearly fires cause high seedling mortality. Planting is relevant only near homesteads or with resilient indigenous species. Encouragement to use indigenous species is needed because mainly exotics are planted, and the local view is that “the forest can take care of its regeneration.” Unfortunately, this is not the case anymore for sub-Saharan Africa’s dry tropical forest, which is at the edge of the woodland biome and sensitive to climate change. Regeneration of long-living tree species is limited, and climate projections predict that some species will be pushed northward. It is difficult to grow many indigenous tree species in nurseries, and transplanting them in the forest is even more difficult. Hence, protecting the remaining dry tropical forests and assisting natural forest regeneration, e.g., through fencing or direct seeding, are more efficient than tree planting at mitigating climate change. However, this will require international financial support. Mitigating climate change is a responsibility of high-income countries but provides little incentive for low- and middle-income countries that need to address their population’s basic needs.

**Afforestation: Who Decides?**



**Sharachchandra Lele**  
Ashoka Trust for Research in Ecology & the Environment

It is easy to estimate the carbon benefits of afforestation by using plausible-sounding numbers for afforested area, planting densities, and growth rates. But tree planting and afforestation are socio-ecological activities and not mechanical ones. They require land, which has alternative socio-ecological uses: agriculture, grazing, or a natural savanna. Afforestation further involves socio-ecological choices: maximize biodiversity, timber production, firewood, or sequestered carbon. Each choice results in winners and losers, making forestry, especially in the Global South, a highly contentious issue affecting billions of people. Whether, where, and what kind of afforestation should happen and at what and whose cost are normative decisions rather than technical choices.

Such decisions must be taken democratically, and those closest to forests and the most marginalized should have the greatest say; that is also when they are likely to succeed. But current structures of forest governance in much of the Global South—the region targeted by most tree-planting proposals—are far from democratic. Forest dwellers, often indigenous communities, are socio-economically marginalized and lack secure tenure. Funding for forestry has tended to strengthen the power of colonial-era bureaucracies at their expense. Payment programs also require clear tenure and are still embedded in unequal economic relations.

Simplistic calculations about carbon from afforestation are at best one-sided estimates ignoring social and ecological costs. At worst, they threaten to increase the undemocratic nature of forest governance while also making forest dwellers in the Global South pay the cost of sequestering emissions by the Global North.

**Trees inside the Production System**



**Rodrigo Anzolin Begotti**  
Ecology Researcher, Brazil

Ambitious plans to plant a billion trees globally to mitigate climate changes were recently unveiled. But trees also provide an invaluable opportunity to improve agriculture and forestry practices in line with the SDGs. In this case, tree planting would not necessarily aim for the full restoration of the original forest structure but instead bring some of the wider ecosystem functions provided by forests into the agricultural setting through approaches such as agroforestry. The global climatic changes expected over the coming decades will affect agricultural production in many ways, such as by reducing precipitation and increasing drier periods and pest outbreaks. These changes endanger the food security and livelihoods of small and traditional agricultural producers, particularly in the Global South. Lines of trees embedded in field crops and pastures reduce the soil evapotranspiration and provide refuges for natural enemies of plagues. Regular pruning of trees incorporates organic matter and nutrients in the soil. High diversity of agroforestry systems can provide multiple and continuous yields from the production of natural fibers, fruits, and essential oils. The last stage of agroforestry establishment will provide high-quality timber that might otherwise come from native forests, often by illegal logging. Some agroforestry systems—such as cocoa, mango, and banana—have reached higher yield gains than ordinary tropical fruit monocultures without fertilizers and pesticides. Agroforestry can help us achieve the SDGs. The challenge now is to improve the management of trees in conjunction with producing cereal crops, making the system economically sustainable and independent of external inputs.

**Global Problems, Global Efforts**



**Aline Soterroni**  
International Institute for Applied Systems Analysis

The Global South is home to the richest and most megadiverse ecosystems on Earth. But we are witnessing an alarming increase in ecosystem losses, such as the recent fires and deforestation spike in the Brazilian Amazon. Still in Brazil, fewer than 20% of the remnants of the Cerrado biome—the most biodiverse tropical savanna on the planet and a global breadbasket—remain undisturbed. Those losses are mainly due to unsustainable human activities, including agricultural expansion to provide food, fiber, feed, and fuel to domestic and international markets.

Nature-based solutions have the potential to help address our societal challenges, especially if they are implemented appropriately in those regions. But under no circumstances should they be limited to planting trees. This is only one approach in this umbrella concept, which includes actions to protect, restore, and sustainably manage a variety of natural and modified ecosystems.

To promote and properly implement nature-based solutions, appropriate policies, both public and private, are essential. Good governance is critical to ensuring environmental protection and scaling up ecosystem restoration. Economic incentives must compensate for the loss of local opportunities or provide benefits to affected actors in a fair and equitable way. In addition, consumers should learn the value of sustainable products in order to change their choices. Likewise, global trade and supply-chain agreements must be sustainable and responsible. Much like the coronavirus disease 2019 (COVID-19) pandemic, in a very globalized world the climate crisis will not be restricted to only one country or region. Global problems require global efforts, and everyone shares part of the blame for indirectly promoting ecosystem losses and has a role to play.

**Socio-ecology Matters**



**Natasha S. Ribeiro**  
Eduardo Mondlane University

Although planting trees to mitigate and adapt to global changes and to attain the SDGs can be positive in some ecosystems, enabling the regrowth of existing woodlands is key in sub-Saharan Africa and should be done with other socio-ecological factors in mind. Sub-Saharan Africa is home to more than half of the world's extreme poor, and many depend on natural ecosystems to sustain their livelihoods. One such ecosystem is the Miombo woodlands, which occupy ca. 2 million km<sup>2</sup> across seven countries (Democratic Republic of the Congo, Angola, Zambia, Zimbabwe, Tanzania, Malawi, and Mozambique). Miombo has the potential for carbon sequestration (18–24 Pg across its range) but also sustains high biodiversity and provides key ecosystem services (e.g., timber, food, medicines, and culture) to over 80% of the region's population. However, the ecosystem is being either lost or degraded as a result of unsustainable practices (e.g., infrastructure development) and fast human growth.

Because woodlands such as the Miombo are social ecosystems with intrinsic socio-ecological relationships, planting trees alone cannot be the solution. In general, Miombo tree species recover faster from vegetative regrowth (10–15 years) than from seedlings (30+ years). This is because underground rootstocks and cut stems produce fast-growing shoots upon disturbance cessation. It is also important to understand that traditional practices have shaped the woodlands over centuries, and thus any successful nature-based solutions need to be aligned with existing local knowledge. Such knowledge includes the multiple uses of species, cutting sizes and parts, regeneration times, and animal-plant interactions, among many others.

## Reforestation Needs Diversity



**Anping Chen**  
Colorado State University

It is generally accepted that planting trees has potential as a nature-based climate solution. The questions are, how large is the potential, and where should trees be planted to maximize this potential? Many have argued that planting one billion trees might not have the carbon-sequestration potential as was originally claimed and that it alone is not necessarily the best way to fight climate change. Here, I also argue that we need to diversify reforestation efforts to gain maximum benefits.

First, not all degraded ecosystems are suitable for planting trees. Revegetation with grasses or shrubs, for example, is a better way to restore degraded arid and semi-arid ecosystems. Second, growing trees does not always mean planting trees. Forests can naturally return when people move out in some regions, bringing higher species diversity and less disturbance to the soil carbon pool. Third, reforestation should prioritize native species over fast-growing introduced ones and prioritize polycultures over monocultures. Research has shown that reforestation with native tree species and polycultures has more ecological benefits.

Finally, more than ever, we need a global alliance with diversified partnership for the ambitious reforestation goal. The Global South is the key frontline for protecting the remaining forests and revegetating degraded ecosystems. Millions of people rely on the unsustainable use of forests for a living. Unless we lift these people out of poverty, something that industrialized countries can help achieve, we will continue to see more forest loss than gain.