

US trees may provide over \$100 billion dollars in savings via environmental benefits—but face growing threats

April 5 2022



An oak tree (*Quercus ellipsoidalis*) under threat by oak wilt disease (*Bretziella fagacearum*). Credit: Jeannine Cavender-Bares (CC-BY 4.0, creativecommons.org/licenses/by/4.0/)

The concept of ecosystem services allows researchers to quantify the benefits that nature contributes to people into monetary units. A study publishing April 5th in the open-access journal *PLOS Sustainability and Transformation* by Jeannine Cavender-Bares and Stephen Polasky at the University of Minnesota, St. Paul, United States, and colleagues suggests that trees provide greater economic value when used to regulate climate and air quality than the value they produce as wood products, food crops, and Christmas trees.

Trees sequester and store greenhouse gasses, filter air pollutants, provide wood, food, and other products, among other benefits. However, the service value of 400 individual tree species and tree lineages growing in forests and plantations in the contiguous U.S. was not previously known. To determine the ecosystem services value of U.S. [trees](#), researchers mapped the value of trees and calculated the economic contributions to these services of every US tree species and lineage. They measured the net value of five tree-related ecosystem services by calculating the value of benefits provided, minus the direct costs incurred to produce these services. The five key ecosystem services included climate regulating services from carbon storage, filtration of particulate matter from the air that harms [human health](#), and provisioning services from production of [wood products](#), [food crops](#), and Christmas trees.

The researchers found that the value of these five ecosystem services generated by trees totaled \$114 billion annually. Carbon storage in tree

biomass comprised 51% of the net annual value, while preventing human health damages via air quality regulation, contributed to 37% of the annual value. The remaining 12% of the net annual value came from provisioning services. Trees in the pine and oak families were the most valuable, generating \$25.4 billion and \$22.3 billion in annual net benefits, respectively. The study had several limitations that likely contributed to an undervaluing of ecosystem services since the researchers did not have access to data for many ecosystem services such as erosion control, flood regulation, and shade-related energy savings. They also did not evaluate disservices of trees. Future studies may provide more accurate estimates of the monetary value of these benefits.

According to the authors, "This study shows that the 'hidden' value of trees—the nonmarket value from [carbon storage](#) and air pollution filtration—far exceeds their commercial value. Sustaining the value of trees requires intentional management of forests and trees in the face of myriad and simultaneous global change threats. Our study provides information and an approach that can contribute to precision forestry practices and ecosystem management."

Cavender-Bares adds, "The fact that tree lineages have evolved to inhabit different ecological niches across the continent is important for sustaining the [ecosystem services](#) that we depend on for our life support systems. These benefits from trees, however, are increasingly at risk. Our research team found that climate change threatens nearly 90 percent of tree species, while pests and pathogens put 40 percent of the combined weight of all U.S. trees at risk. We also found that the species and lineages of greatest ecosystem service value are the most at risk from pests and pathogens, climate change, and increasing fire exposure."

More information: Cavender-Bares JM, Nelson E, Meireles JE, Lasky JR, Miteva DA, Nowak DJ, et al. (2022) The hidden value of trees: Quantifying the ecosystem services of tree lineages and their major

threats across the contiguous US. *PLOS Sustain Transform* 1(4):
e0000010. doi.org/10.1371/journal.pstr.0000010

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