

# Forests have a major role to play in climate adaptation<sup>1</sup>



Source: Samruol Im / United Nations Development Programme Cambodia.  
Note: Cambodian Forest.

## Science offers new actionable insight into forests and adaptation

In 2019, the Trillion Trees campaign<sup>3</sup> (launched by the World Economic Forum) and the UN Decade of Ecosystem Restoration<sup>4</sup> aimed to combat deforestation and respond to a warming climate. Since then, scientists have debated forests' role in mitigating climate change. This debate, however, has overlooked a central issue that should be a focal point: For billions of people around the world, particularly people who live in hot or dryland regions, trees are not just important for climate mitigation. They can also be essential for local survival.

To create the most comprehensive picture to date of forests' roles in helping ecosystems adapt to climate change, a newly appointed KAUST researcher led a review and synthesis of current research on the subject. The study aimed to reframe the debate over forests and climate change to focus on how forests contribute to human survival and how they can help humans adapt to climate change effects, such as extreme temperatures, droughts, and floods.

### The bottom line

- A newly appointed KAUST<sup>2</sup> researcher and international collaborators argue for preserving old-growth forests and reversing deforestation to support climate change adaptation.
- Pursuing these two strategies can moderate extreme temperatures and reduce the risk of floods and droughts. In turn, the benefits can improve human health, food security, and the economy.
- As climate change accelerates, combining evidence from forest management projects with local knowledge will be critical to informing action.
- Monitoring forests' ecological and social impacts will allow for well-designed, equitable policies and the implementation of tailored, effective solutions.



## Climate adaptation plans should incorporate forests

The study argues for integrating forests into national plans for adapting to climate change. It emphasizes two paths: conserving forests and reversing losses, while remaining conscious of local conditions.

### Conserving existing forests maximizes climate benefits

When growing naturally, forests buffer against extreme temperatures. They have local warming effects in freezing areas, and local cooling effects in hot areas. People experience the cooling effects when they take shelter under the shade of a tree to avoid intense sun. For many people around the world, these local effects can already be the difference between life and death, but cooling is becoming increasingly important as the climate warms.

### Regenerated or new forests can complement conservation goals

Forest regeneration should prioritize areas that are well suited ecologically. Restoration works best when aligned with native vegetation that maximizes carbon storage and minimizes downstream water loss.

Sustainable tree plantations, as illustrated in the photo below, can play a limited role in fighting climate change. Their wood can replace construction materials, whose production is emissions-heavy. However, plantations also pose trade-offs: In nonforested regions, they can reduce biodiversity and the availability of water. More generally, any negative impacts of forests tend to be observed when forests are introduced in unnatural settings.



**Source:** The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD).

**Note:** Palm Plantation in Kampar, Malaysia.

### Local context matters

As the discussion of tree plantations suggests, a well-planned strategy would consider local context, synergies, and trade-offs. For example, planting trees to cool wetter urban areas could also improve rainwater management, while doing so in drier areas could aggravate water scarcity because trees absorb large amounts of water.

## Forests provide global and local climate protections

The study identified the scope and scale of forest benefits.

### Forests moderate temperatures

Forests reduce daytime temperatures in two ways: by reducing the sun's rays below the canopy and by increasing the cooling processes of evaporation and water-vapor release by plants.

Globally, forests and other tree cover reduce daytime temperatures under the canopy by as much as 4.1°C (estimates vary and the minimum estimated effect is a 1.1°C increase). Moreover, this cooling effect increases in warmer areas. With every 1°C increase in temperatures, the cooling effect of trees increases by 0.3°C. Urban tree cover also cools temperatures in the daytime by an average of 1.5-1.7°C daily.

### Forests regulate the water cycle

Forests and other tree cover influence the water cycle.

One way they do this is by intercepting rainfall. At the local level, canopies capture between 3% and 74% of annual rainfall, depending on the types and density of trees, as well as canopy structure and local precipitation. Globally, forests intercept an estimated 6% of continental precipitation. This process improves the absorption of water into the soil, thus reducing evaporation, promoting greater water retention, and reducing runoff.

Forests can also influence the water cycle by shaping regional rainfall. Deforestation typically reduces precipitation; reforestation can increase it downwind, though the effects vary by location.

## Forests can improve human well-being

Beyond their role in climate adaptation, forests can deliver ancillary health, food security, and economic benefits.

### Improving human health

Tree cover, particularly in urban areas, can reduce health and safety risks posed by extreme heat and floods. Specifically:



- Urban tree cover can prevent heat-related deaths, including 1,030 to 1,454 deaths per year in the United States alone.
- On balance, reforestation reduces flooding in 82% of cases. Reduced flooding lowers the risk of death and injury, both from the disaster itself and the spread of infectious disease that may follow.

- Tree cover offers tangible agricultural benefits. In the Amazon basin, for example, preserving tree cover and its associated rainfall could help Brazil avoid \$1 billion in annual agricultural losses.
- Forests, by reducing flooding, can also reduce the escalating costs of flood damage.

## Enhancing food security

Integrating tree cover into agriculture can boost crop resilience and improve water quality. In particular:

- The temperature effect of tree cover can shield plants from extreme heat and cold, increasing crop yields.
- Tree cover can also shield plants from damaging solar radiation.
- Trees have mixed effects on water for crops. They can reduce downstream water availability, but also spur crop growth by improving the survival of nearby plants and filtering groundwater.

## Boosting the economy

Forests and tree cover generate economic benefits by enhancing labor productivity, securing billions of dollars in agricultural revenue, and reducing the financial toll of flood damage. Notably:

- Trees improve working conditions for laborers by reducing heat stress, thus improving output.

## Summing up

The study demonstrates the beneficial impacts of forests where they naturally exist and warns of the potential for harm when they are introduced into inappropriate settings without regard to local context. Among the many benefits, they can protect against extreme temperatures and reduce the risk of flood and drought. They can also increase rainfall and improve water distribution and retention throughout the soil. Further, they stand to improve human well-being by enhancing human health, boosting food security, and avoiding economic costs.

As decisionmakers consider how to spend global budgets on nature's protection, the study sends a clear message that forests affect the well-being and survival of billions of people across the globe. It also suggests placing a high priority on forest preservation and reforestation initiatives. Scientists, in turn, will need to monitor the impacts of forest preservation and reforestation initiatives to build a deeper understanding of how forest climate protections play out in local contexts and how they can best serve climate adaptation.



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1. This policy brief summarizes findings from Josephine Elena Reek, Constantin M. Zohner, Gabriel Reuben Smith, Susan C. Cook-Patton, Pieter De Frenne, Paolo D'Odorico, Marius G. Floriancic, Robert B. Jackson, Julia A. Jones, James W. Kirchner, Marysa Laguè, Yuting Liang, Yuta J. Masuda, Robert I. McDonald, Luke A. Parsons, Benedict Probst, June T. Spector, Thales A. P. West, Nicholas H. Wolff, Florian Zellweger, and Thomas W. Crowther, "More than mitigation: The role of forests in climate adaptation," *Science*, Volume 396, February 12, 2026. <https://www.science.org/doi/10.1126/science.ads4361>. All rights and any third-party permissions remain with the respective rights holders.
2. King Abdullah University of Science and Technology (KAUST).
3. Robin Pomeroy, "One trillion trees - World Economic Forum launches plan to help nature and the climate," *World Economic Forum*, January 22 2020, <https://www.weforum.org/stories/2020/01/one-trillion-trees-world-economic-forum-launches-plan-to-help-nature-and-the-climate/>.
4. For more information on the UN Decade on Ecosystem Restoration, see the materials available at "Preventing, Halting and Reversing Loss of Nature," <https://www.decadeonrestoration.org/>.