

Local climate benefits of tropical forests

Issue date
August 2024

Key Messages

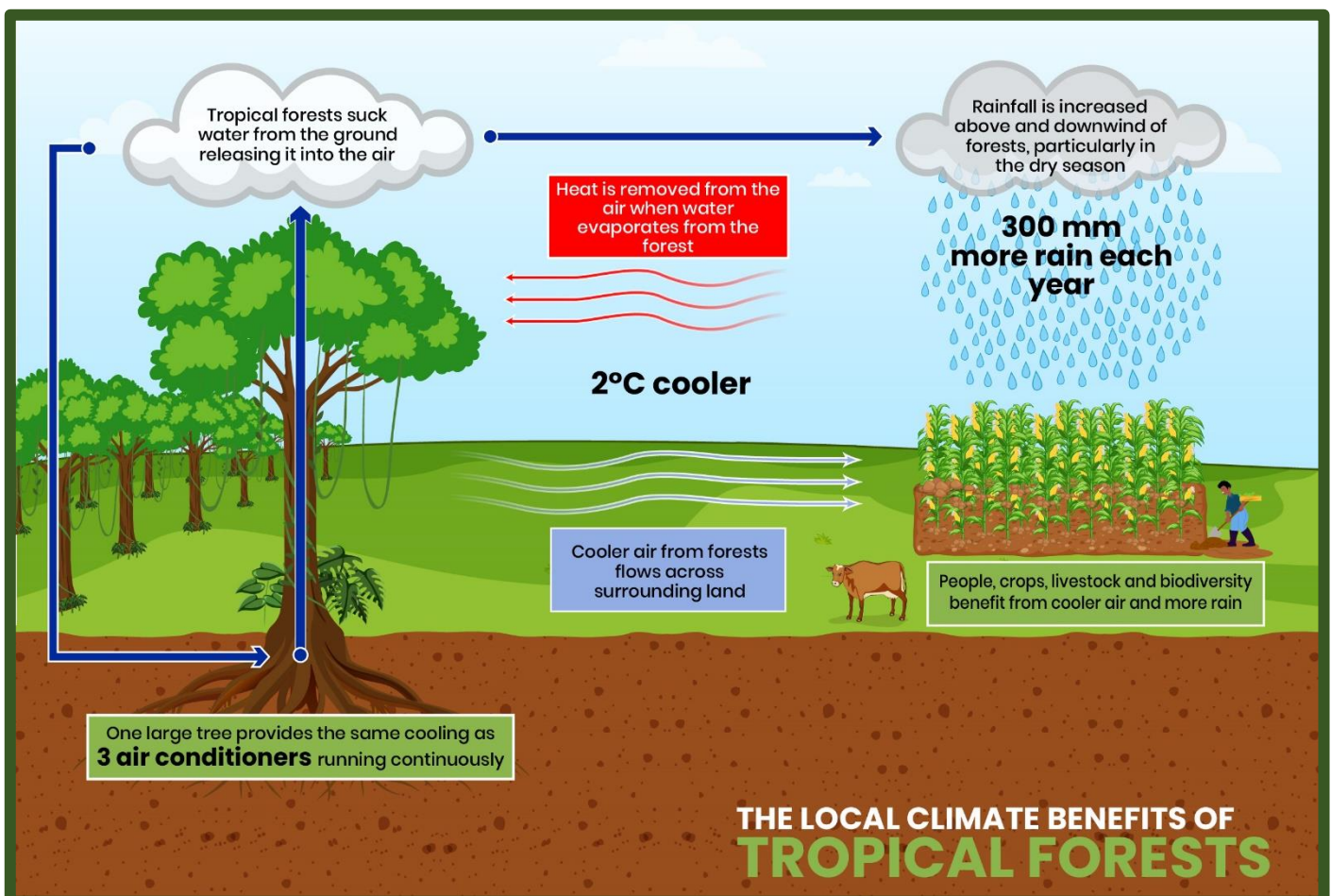
- Protecting tropical forests enhances local rainfall and reduces air temperatures across a wide area. This benefits people, crops, livestock and biodiversity.
- People living in forested landscapes will be less affected by droughts and heatwaves, including those linked to global climate change.
- Policies protecting the local climate benefits of forests are needed across multiple sectors including agriculture, health, land and environment.
- More awareness and locally relevant information on the local climate benefits of forests is needed.

Local climate benefits of tropical forests

Tropical forests affect local rainfall and temperature. Research shows a direct relationship between the proportion of land that is covered in forest, and downwind rainfallⁱ. By retaining tropical forest, up to 300 millimetres more rain falls each year, compared with a non-forest land coverⁱⁱ.

Tropical forests also reduce local land and air temperatures. Landscapes with forests have temperatures as much as 2 degrees centigrade lower than a nearby deforested area. The amount of cooling increases with the proportion of the land covered in forestsⁱⁱⁱ.

The climate benefits of forests extend beyond the local region. Scientists can detect the cooling influence of forests across a landscape at scales ranging from 2 to 100 kilometres^{iv}. Forests' impact on rainfall becomes increasingly evident when looking at areas of up to 200 kilometresⁱⁱ. This shows that the local and regional climate benefits of forests can be felt by people living across a district, province or sub-national region. It is particularly beneficial to have a mosaic of forested patches throughout a landscape, avoiding extensive areas without forest. This can be achieved through forest management and retaining natural forests in protected areas.



How do forests affect local climate?

Forests reduce local temperatures by drawing heat from the air to evaporate water from trees' leaves in a process called transpiration.

Forests' cooling influence is greatest in the dry season when tree roots can draw up water from deep underground, like a straw. The evaporation of this water absorbs heat from the air, causing cooling. The air is further cooled by the breezes created when air passes over the rough surface of a forest canopy.

Forests increase rainfall by steadily pumping water from the soil, into the air. This moisture from forest trees contributes to clouds and rainfall. The forests' influence on rainfall can be felt locally, and hundreds of kilometres away.

Policy implications

Agriculture. The local climate benefits of forests are especially relevant to the agricultural sector given the sector's dependence on temperature and rainfall. Trees in livestock grazing areas provide cooling services benefiting herders and livestock. Maintaining and increasing trees in pasturelands can help to reduce the impact of increased temperatures caused by climate change (doi.org/10.1038/s41467-022-28388-4).

Forests' cooling services benefit crops across a broad landscape. For example, forest cooling services can increase maize yields by 10% (pnas.org/doi/epdf/10.1073/pnas.1222463110).

Similarly, forest-induced rainfall benefits crops in the surrounding landscape. Proactive policies to protect forests in agricultural landscapes are needed to safeguard local climate benefits of forests. As agriculture is the main driver of tropical deforestation, pro-forest shifts in agricultural policy are a priority.



UNIVERSITY OF LEEDS

Health and economy. Forests' cooling services help farmers and other outdoor workers to be more productive and protect workers from heat stress (doi.org/10.1038/s41467-021-21779-z). Protecting forests in the vicinity of outdoor workspaces has relevance for health and safety across multiple sectors including agriculture, mining and construction, with relevance to the health sector.

Biodiversity. Many plants and animals depend on the cooler air provided by tropical forests. Maintaining forests benefits biodiversity across multi-use landscapes, particularly for species close to their heat tolerance limits. This has implications for policies seeking to protect biodiversity.

Land. Forests' local climate services enhance sustainable land management. Land policies that designate areas for forest protection with secure tenure, will enhance overall land values.

Recommendations

- Recognition of forests' local climate services is relevant to sectoral policies on agriculture, health, environment, land and water. Policies should include action to protect and restore forests and their local climate services.
- Awareness of forests' local climate benefits should be increased, particularly in the context of increasing resilience to climate change and land use planning.
- Support for locally-led forest management can create mosaics of natural forest, avoiding extensive areas of non-forest. This is a particularly effective way of enhancing forests' local climate benefits.
- Silvopastoralism, combining livestock grazing with forests and woodlands, is a recommended strategy in the agriculture sector.
- More research is needed to understand the scale and dynamics of forests' local climate services. Knowledge gaps are greatest for dry tropical forests.

This policy note is based on research by the University of Leeds including:

ⁱ Spracklen, D., Arnold, S. & Taylor, C. Observations of increased tropical rainfall preceded by air passage over forests. *Nature* **489**, 282–285 (2012). <https://doi.org/10.1038/nature11390>

ⁱⁱ Smith, C., Baker, J.C.A., Spracklen, D.V., 2023. Tropical deforestation causes large reductions in observed precipitation. *Nature* **615**, 270–275. <https://doi.org/10.1038/s41586-022-05690-1>

ⁱⁱⁱ Smith et al, 2023. Observed and simulated local climate responses to tropical deforestation. *Environ. Res. Lett.* **18**, 104004. <https://doi.org/10.1088/1748-9326/acf0da>

^{iv} Butt, E.W., et al., 2023. Amazon deforestation causes strong regional warming. *Proc. Natl. Acad. Sci. U.S.A.* **120**, e2309123120. <https://doi.org/10.1073/pnas.2309123120>