SCIENCE POLICY

Amazon tipping point: Last chance for action

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Although 2019 was not the worst year for fire or deforestation in the Amazon, it was the year when the extent of fires and deforestation in the region garnered full global attention. This year, the winds brought smoke from the fires into São Paulo, so thick that—after encountering moist air blowing from the ocean—the afternoon skies were darkened and street lights had to be lit 3 hours early for the city to continue to function. The rampant winds awoke the Brazilian populace and indeed the world to the harsh reality that the precious Amazon is teetering on the edge of functional destruction and, with it, so are we.

For more than 50 years, scientists and policy makers have known unequivocally (*1*) that the hydrological cycle of the Amazon depends squarely on the transpiration of the forest's multitude of leaves and on the evaporation from the complex surfaces of the rain forest. When it rains on the Amazonian forest landscape, at least 75% of the moisture is returned to the westward-moving air mass. The rainforest recycles the moisture five to six times before it turns southward, feeling the proximity of the high wall of the Andes. Over the whole basin, the air rises, cools, and precipitates out close to 20% of the world's river water in the Amazon river system.

The moisture of the Amazon is not confined to the basin but is a core and integral part of the continental climate system with specific benefits for critical Brazilian agriculture in the south. In fact, every country in South America other than Chile (blocked from this moisture by the Andes) benefits from Amazon moisture.

When the existence of the Amazon's essential hydrological cycles was recognized, a new problem became immediately apparent since when the land is deforested, more than 50% of rainwater runs off and is not available to recycle. How much deforestation could the forest—equal to the 48 continental U.S. states—withstand before there would be insufficient moisture to support tropical rain forests or before big portions of the landscape would convert to tropical savannah?

Researchers predict that deforestation will lead to developing savannahs mainly in the eastern and southern Amazon, perhaps extending into central and southwestern areas, because these zones are naturally close to the minimum amount of rainfall required for the rain forest to thrive. Forests would also be pushed toward savannah configurations due to negative synergies with human-driven global warming, which leads to reduced rainfall and increased temperatures compounded with extensive use of fire (*2*).

The loss of forest will lead to staggering losses of biodiversity, carbon, and, in turn, human well-being. In addition, although deforestation anywhere in the Amazon diminishes its hydrological cycle, what happens in the Brazilian Amazon is particularly important because of the sensitivity of that part of the forest to incremental and cumulative impacts of vegetative decline from dieback. Current deforestation is substantial and frightening: 17% across the entire Amazon basin and approaching 20% in the Brazilian Amazon.

Already, there are ominous signals of it in nature. Dry seasons in Amazonian regions are already hotter and longer. Mortality rates of wet climate species are increased, whereas dry climate species are showing resilience. The increasing frequency of unprecedented droughts in 2005, 2010, and 2015/16 is signaling that the tipping point is at hand. Bluntly put, the Amazon not only cannot withstand further deforestation but also now requires rebuilding as the underpinning base of the hydrological cycle if the Amazon is to continue to serve as a flywheel of continental climate for the planet and an essential part of the global carbon cycle as it has for millennia.

The good news is that we can build back a margin of safety through immediate, active, and ambitious reforestation particularly in the deforested regions that are largely abandoned cattle ranches and croplands, about 23% of destroyed forest territory. These areas, which now lay fallow, are probably the main reason why the Amazon has not already become an expanding savannah.

The only sensible way forward is to launch a major reforestation project especially in the southern and eastern Amazon, actions that could be part of Brazil's implementing its commitments under the Paris agreement. Embarking on such efforts would not only qualify Brazilian states for support under the new California Tropical Forest Standard, which allows states not only to get financial support from carbon-capped California companies but could also bring positive attention to the country and draw support and assistance from the rest of the world. Efforts in Brazil would empower other countries with Amazonian territories to follow suit. Any additional increment of deforestation should be matched by three times as much reforestation, with details tailored at national levels.

Citizens and leaders across South America and around the world must create and promote a new vision of the Amazon, one that recognizes that the natural and economic assets of the region must be managed to maintain its essential role for South America and in sustaining the health of the planet. This new vision will need to respect

and protect its natural infrastructure and include a thoughtful review of all related commercial activities.

A new vision of the Amazon will require a biologically based view of economic development, which would immediately eliminate illogical and short-sighted economies such as the unreliable monocultures of cattle, soybeans, and sugarcane. A modern vision of the Amazon must include truly innovative elements to create profitable bioeconomies through, for example, sensible use of intact forests, the harnessing of power from its massive flowing rivers, or the sustainable harvesting of biological and biomimetic assets within Amazonian biodiversity.

The economic potential held untapped in the Amazon ranges from sustainable aquaculture that lifts Amazon fish to the same global status as salmon, tuna, or codfish to industries based on the molecular properties of the extraordinary biodiversity. Fungicides found in the Amazon are an obvious but not exclusive way to start. Amazon aquarium fish have already gone from destructive collection and shipping to sustainable exports. A fraction of deforested areas can be transformed into sustainable agroecological systems generating well-being to Amazonian populations. A sustainable Amazon requires sustainable cities based on appropriate economic activities and sensible management will be part of the solution; there is no sustainable Amazon without an adequate quality of life in Amazon cities.

We are scientists who have been studying the Amazon and all its wondrous assets for many decades. Today, we stand exactly in a moment of destiny: The tipping point is here, it is now. The peoples and leaders of the Amazon countries together have the power, the science, and the tools to avoid a continental-scale, indeed, a global environmental disaster. Together, we need the will and imagination to tip the direction of change in favor of a sustainable Amazon.

– Thomas E. Lovejoy and Carlos Nobre

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