

World view



By Carlos
A. Nobre

To save Brazil's rainforest, boost its science

My country's government is squeezing research and pushing the rainforest to the brink.

This August, the skies outside my office in São Paulo, Brazil, were filled with smoke from the fires in the Amazon rainforest. I recalled the forest that I saw in the 1970s as a teenager on family holidays – its beauty, powerful rivers, Indigenous peoples and continuous rains – and thought of how much my country (and the world) could lose. Bishops throughout the Amazon region gathered in the Vatican this month to pray and strategize on behalf of “integral ecology, the cry of the Earth and the poor”. Reversing the situation in Brazil is essential for the “good living” the synod seeks.

The smoke has disappeared from my city, for now, but Brazil's rainforest has never been in greater peril. Nor has its science – so badly needed to buttress sustainable agribusiness and invent an economy centred on an intact forest. Last month, thousands of graduate students learnt their scholarships would not be renewed.

Since he came into power in January, Brazil's President Jair Bolsonaro has relaxed the enforcement of laws that prohibit most of the clearing and burning of the Amazon. Analyses of satellite imagery show that this year's dry season brought nearly twice as many fires as last year's, and that the flames were bright on satellite images – as expected from burning a large amount of biomass from recently clearcut forest. Initial estimates indicate that more than 90% of these fires were illegal. Rather than face such alarming data, Bolsonaro fired the director of the agency that monitors deforestation.

These are huge setbacks. From 2005 to 2014, Brazil reduced its annual rate of deforestation by about 75%. Over the same timeframe, the value of agricultural production increased by about 200%. Science and technology fostered this progress. Satellite-based monitoring developed by Brazil's National Institute of Space Research provided daily alerts of deforestation. This facilitated effective law enforcement and incentive programmes for protecting the forest.

My country's example had served as inspiration for others. Without Brazil as a model, I expect deforestation will accelerate across the Amazon. It is already increasing in Colombia, Peru and Bolivia. Twelve years ago, my colleagues and I calculated that, if the rainforest's area shrunk by 40% of its expanse in the 1970s, it could not grow back – and as much as 70% of the original forest could transform to drier, hotter savanna (G. Sampaio *et al. Geophys. Res. Lett.* **34**, L17709; 2007). With rising global temperatures, deforestation, fires and concomitant dryness, that margin has shrunk.

Across most of the Amazon basin, the dry season is already several weeks longer, particularly over deforested areas;

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Carlos A. Nobre is a climate scientist at the University of São Paulo's Institute for Advanced Studies in Brazil and former president of the Brazilian Federal Agency for Support and Evaluation of Graduate Education. e-mail: cnobre.res@gmail.com

these return less moisture to the atmosphere than the rainforest does overall. If deforestation continues, the rainforest could collapse. Many livelihoods will be impossible to maintain. Less rain will fall, temperatures will rise and tens of thousands of species will be lost along with the forest's power to absorb as much as 5% of the world's carbon emissions.

Deforestation to increase agricultural lands is no longer necessary. The Brazilian Amazon has an estimated 17 million hectares of degraded and non-productive lands that could be restored and used for sustainable agriculture, including new forest products. Land already in production has the capacity to raise yields severalfold. Innovative technologies and smart management could deliver a 'bio-economy' based on the sustainable extraction of materials for goods, ranging from pharmaceuticals to foods (açai is the most famous example), cosmetics and other materials. With effective monitoring and enforcement, these 'bio-industries' can boost the economy, respect social rights and traditional peoples and protect the Amazon's ecosystems.

All this will be impossible if Brazil's scientific capacity withers. In 1998, fewer than 4,000 PhD students graduated. Last year, there were more than 22,000. Government funds for science grew steadily from the 1980s, but declined under the economic recession of 2015. Unlike countries such as South Korea, China and Germany that invested more in science to build resilience to economic turbulence, Brazilian science has faced severe budget cuts year after year.

Now, instead of watching younger compatriots build our scientific establishment, I see them all but forced to leave. The government is also changing the direction of research. It aims to replace the forest with livestock farming, monoculture crops, mining operations and huge hydropower plants.

For much of my career, I have worked to reconcile apparently opposing views of land use: some people advocate setting aside large tracts for conservation, and others champion 'resource-intensive development' based on agriculture, livestock, energy and mining. I feel we must instead focus on building a different, sustainable paradigm in which the forest contributes to well-being. Beyond the progress that has already happened in slowing deforestation and boosting sustainable agribusiness, I see much promise in an initiative called Amazonia 4.0, after the Fourth Industrial Revolution of biotechnologies, digital technologies and material science. To realize that promise, we will need scientists and engineers more than ever.

I fear both Brazil's science and the Amazon rainforest are approaching a tipping point – from which recovery is probably impossible. To avoid it, scientists in and outside Brazil should protest vigorously against the anti-science movement and speak clearly to society about how important science and the Amazon are for human well-being and the sustainability of the planet.