

Positive tipping points for Amazonia: the urgent need for forest solutions through innovation

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Opinion

The Amazon rainforest is essential part of the Earth's ecosystem. The Amazon rainforest is important in terms of biological diversity, and ecological balance – including water and carbon storage – and provide the livelihood base for Indigenous Peoples and local communities. The problem is that Amazon rainforest is undergoing a change in its land use a being quickly turned into areas for global grain, vegetable oil, and beef production. Sadly, we are turning Amazon rainforest into CO₂ emitter and particulate emitter?

The synergistic combination of deforestation, forest degradation, wildfires, and climate change is causing irreversible damage to the physical and biological structure of the forest. If deforestation continues at the rates of recent decades and global warming significantly exceeds 1.5°C, the forest will surpass the tipping point. Amazonia is very close to reaching a tipping point that can lead to more than 50% of the forest becoming open canopy, highly degraded ecosystems.

I was the first scientist to publish science articles on the risk of Amazonia tipping point, as early as 1990. Now, many observations in Amazonia show how close the forest is to a tipping point: the dry season is now 4-5 weeks lengthier over all of southern Amazonia since 1979, tree mortality is increasing over large portions of Amazonia; over southeastern Amazonia, the longer dry season is 2-3° C warmer, 20-30% drier, and the forest has become a carbon source. These factors have significant impacts at regional and global scales, creating uncertainties regarding crucial ecosystem services provided by forests, including rainfall recycling, atmospheric cooling, natural disaster mitigation, and food provision.

Undoubtedly, there is an urgent need to halt deforestation and degradation in this World's most important forest ecosystem and promote solutions through education, science, and technological innovation. I will discuss the pathways that can lead to the "Arcs of Restoration" and the "Socio-Bioeconomy" of Amazonia, which have the potential to create positive tipping points for environmental sustainability and socio-economic development.

Transforming Amazonia through 'Arcs of Restoration'

The restoration of native vegetation emerges as an unprecedented opportunity to diversify agroforestry production in the Amazonia. This potential supported the launch of the "Arcs of Restoration" a Policy Brief of the Science Panel for Amazonia released at COP27 in 2022. The initiative calls for restoring of at least 500,000 km² in two highly deforested Amazonian regions.

The first Pan-Amazonian government to endorse the Arcs of Restoration initiative was Brazil and seeks to restore 24 million hectares of Brazil's Amazonia rainforest by 2050.

It is important to mention that growing Amazonian secondary forests after deforestation can remove 11 to 18 tons of carbon dioxide per hectare per year for at least 30-35 years.

Forest regeneration and restoration through agroforestry using native species can offer numerous benefits, including biodiversity conservation, climate mitigation, and improved livelihoods.

A Socio-Bioeconomy of healthy standing forests and flowing rivers for the whole Amazonia

The current unsustainable development model in Amazonia must be replaced by a new model that prioritizes the protection, restoration, and creation of healthy standing forests and flowing rivers.

Socio-bioeconomies are economies based on the sustainable use and restoration of healthy standing forests and flowing rivers to support the well-being, knowledge, rights, and territories of Indigenous Peoples and local communities, residents of Amazonia, and the global community. Socio-bioeconomy places justice, especially for Indigenous women and youth, and biological and cultural diversity as core values of development.

A Socio-bioeconomy of healthy forests and flowing rivers can be more profitable than conventional economies that contribute to deforestation in the Amazonia. Here are some examples: Pasture requires 1-2 workers per 100 hectares and yields a profit of US\$50 to 100 per hectare per year. Soybean cultivation requires 0.5-1 worker per 100 hectares and yields a profit of US\$100 to 300 per hectare per year. On the other hand, managing agroforestry systems and collecting non-timber forest products requires 20-40 workers per 100 hectares and yields a profit of US\$300 to 700 per hectare per year.

Fostering Science, Technology and Innovation

Facilitating a transition towards a regenerative socio-bioeconomy in the Amazon requires addressing bottlenecks in science, technology,

and innovation specific to the region. We are developing two interconnected projects related to the positive tipping points for Amazonia. The Amazonia 4.0 Institute (www.amazonia4.org) shows the potential of value-adding biodiversity-based products through bio-industrialization. It will also combine science and Indigenous Peoples' and local communities' knowledge to create innovative technologies for implementing an innovative socio-bioeconomy of healthy standing forests and flowing rivers. This project has developed an Amazonia Creative Lab for the Cocoa-Cupuaçu value chains in the current phase. Two Brazilian communities have been trained, and a modern bio-factory will be constructed in the first trained community (RESEX Tapajós-Arapiuns).

We plan to develop the capacity of an Indigenous community before this year's end, the Paiter-Suruí community of the Brazilian Amazonia Rondônia state, southwestern Amazonia. That will be the first Indigenous community in Brazil to advance to that level. We also have designed creative labs for Brazil Nuts, four high-quality cooking oils, portable systems for DNA sequencing of plants, animals, and microorganisms, and a blockchain system to register the DNA. We seek funding to construct such labs and take them to Amazonia to train many communities.

The second project aims to implement the Amazonia Institute of Technology-AmIT, a Pan-Amazonia high-tech science and technology institute with many innovation hubs in several Amazonian countries. By November 2024, we will have finished the full-fledged feasibility study for this AmIT. This study shows five thematic areas of AmIT: forests and socio-biodiversity, water, sustainable infrastructure, altered landscapes, and urban Amazonia. This Institute must provide science and education innovation for the socio-bioeconomy of standing forests and flowing rivers.

Another factor for this socio-bioeconomy is the modern value addition to forest products through bio-industrialization in the communities managing forest restoration and the remaining forests. This value addition is 10 to 20 times greater than the commercialization of primary products. Therefore, bio-industrialization is essential to predominantly building a middle-class society throughout Amazonia.

The major challenge is to significantly increase investments in technology across the Amazonia. Since 2017, we have been identifying bio-factories that utilize technology to enhance the value of native Amazonian products. Currently, there are approximately only 171 companies in all Amazonia – 6.5 million km² – using technologies capable of converting primary forest products such as roots, seeds, and fruits into higher-value products like flour, oil, fat, and chocolate with much more possible.

Therefore, to avoid irreversible environmental and social changes leading to tipping points, it is necessary to shift to a new regenerative and innovative model based on socio-biodiversity, fostering positive tipping points. It is crucial to include Indigenous Peoples and their knowledge in this new model. In this transition, technologies, commitment from governments, social justice, equitable benefit sharing, and reducing inequalities play central roles.

Our final message to all of you:

- 1) Let Us Save the Amazon Rainforest.
- 2) Let Us Save the Amazonian People.
- 3) Amazon is needed for our Planet Earth.

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Conflicts of interest

The author declares no conflict of interest in writing the manuscript.