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EDITED BY
Nophea Sasaki,
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Federal University of Amazonas, Brazil
Eduardo Maeda,
University of Helsinki, Finland

*CORRESPONDENCE
Claudia Azevedo-Ramos
claudia.azevedoramos@gmail.com

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Editorial: Amazon rainforest future under the spotlight: Synergies and trade-offs between conservation and economic development

Claudia Azevedo-Ramos[1]*, Metodi Sotirov[2] and Ludmila Rattis[3,4]

[1]Center for Advanced Amazonian Studies (NAEA), Federal University of Pará, Belém, Brazil, [2]Faculty of Environment and Natural Resources, Institute of Environmental Social Sciences, University of Freiburg, Freiburg im Breisgau, Germany, [3]Amazon Environmental Research Institute (IPAM), Belém, Brazil, [4]Woodwell Climate Research Center, Falmouth, MA, United States

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Editorial on the Research Topic
Amazon rainforest future under the spotlight: Synergies and trade-offs between conservation and economic development

The Amazon biome, which accounts for 6.7 million km^2, encompasses the largest tropical forest in the world. The region is shared by eight countries—Brazil, Bolivia, Peru, Ecuador, Colombia, Venezuela, Guyana and Suriname—and is well known for its impressive sociobiodiversity, fresh water and carbon stocks. However, the Amazon is also home to more than 30 million people, with different demands and needs for their survival. Its landscape has faced intense land-use changes, resulting in forest loss and fragmentation (Matricardi et al., 2020; Mapbiomas, 2021).

Drivers of deforestation and associated socio-environmental impoverishment in the Amazon have been widely denounced over time (Geist and Lambin, 2002; Morton et al., 2006; DeFries et al., 2010; Macedo et al., 2012; Brando et al., 2020). In turn, the strategies for solving the problem have been implemented spastically, depending on the government on duty, and unevenly across the region. In this way, measures of success come like hiccups and do not last long. The result materializes in the loss of 750,000 km² of natural vegetation cover in the Amazon region from 1985 to 2020 (Mapbiomas, 2021).

Tropical deforestation leads to ca. 24% of global greenhouse gas emissions, the second-largest source after fossil fuels (IPCC, 2019). Forest degradation, although less studied, is also assumed to be relevant for greenhouse gas emission estimation in tropical regions, accounting for 25% of total emissions from deforestation and degradation in 74 developing countries studied (Pearson et al., 2017). Forests, thus, play an important role in achieving the Nationally Determined Contributions of many tropical countries,

in line with the signed agreement during the United Nations Conference of the Parties in 2015 (UNFCCC, 2015), as well as in the Sustainable Development Goals of the United Nations 2030 Agenda (Katila et al., 2020), since much of the emissions from these countries come from land use changes. It has also been pointed out that transnational agricultural and forestry commodity trade is behind much of the emissions from tropical deforestation (Pendrill et al., 2019a). Since the economies of many forest-rich tropical countries directly depend on the conversion of forests into agriculture, mining and other land uses, consuming countries' trade rules allowing the import of deforestation-free commodities may contribute to curbing deforestation (Pendrill et al., 2019a,b). For instance, European Parliament proposed regulatory actions to tackle EU-driven global deforestation, still pending approval by the plenary (European Parliament, 2022). Therefore, good governance in the deforestation-free tropical commodity trade would request coordinated transnational policy action (Sotirov et al., 2020), yet to be put into practice.

The contributions to this special issue of Frontiers in Forests and Global Change are gathered to address a major question: How to conserve the Amazon rainforest while contributing to a deforestation-free economy? Without claiming to exhaust such a broad topic, the special issue contains eight papers where the contributing authors offer suggestions from various disciplines, including policy and governance; economics, trade, and territorial planning.

The study of Cardona et al. argues for the importance of protected areas (PAs) in the Amazon (390 million hectares of PAs). However, following principles established in the Aichi Biodiversity Targets under the Global Convention on Biological Diversity, the authors assess the effectiveness of governance in five transboundary PAs in Brazil, Peru, and Bolivia. The authors acknowledge the progress in benefit-sharing in these PAs but draw attention to the confrontation between conservation and economic development in national policies.

Also concerned about potentially ineffective environmental governance (EG), Morales-Giner et al. argue about the need for multi-case comparative analyses of EG in different parts of the Amazon after identifying the violation of common criteria across five case studies in the Amazon. Unpacking the requirements and comparing cases, thus, may unveil EG issues. The integrated framework proposed by Morales-Giner et al., based on 11 criteria for the systematic assessment of the effectiveness of EG, allowed a comparative analysis across cases to identify unmet criteria (e.g., lack of transparency and access to information, accountability, public participation). While the authors recognized the still preliminary nature of the analytical framework in the Amazon context, comparative analyses identified possible targeted conservation actions.

In turn, Kleinschmit et al. deal with governance issues regarding illegal logging in the Brazilian Amazon. The study reviews the policy frameworks and governance responses steering illegal logging in Brazil since 2012. In a national context with a strong focus on command-and-control instruments, the authors highlight the injustice against indigenous peoples and forest victimization.

Land insecurity encourages rural violence, misuse of natural resources, and preclude long-term investments in land (Blackman et al., 2017; Robinson et al., 2018; Azevedo-Ramos et al., 2020). Kruid et al.'s policy review draws attention to land tenure and the need to report carbon losses from forest degradation and disturbance, which account for 44% of losses in the Brazilian Amazon. Land grabbing in undesignated forestlands accounts for 82% of the carbon losses, and hence cannot be ignored as a growing driver of forest carbon emissions.

Policy instruments may be broadly distinguished among regulation (sticks), incentives (carrots) and information (sermons) (Bemelmans-Videc et al., 1998). Carrots are usually more appreciated, especially if served with attractive economic incentives. In their study, Stabile et al. focus on a proposal solution for slowing deforestation in the Amazon region through *legal* (authorized) deforestation in private properties, and a financial compensation mechanism to convince landowners to reduce deforestation. The mechanism is being tested in Brazil and promises to minimize leakage while gaining scale.

In a mix of sticks, carrots and sermons, a strong legal and political framework can be an ally in strengthening forest conservation. However, Moraes et al. show that recent changes in the legal and political framework in Brazil may ease socio-environmental protective measures, with special consequences for the Amazon. In the absence of political favorable circumstances, the authors suggest the strengthening of institutions to safeguard key measures from political interferences and using of international trade policies on commodity-driven deforestation to influence sustainable/legal commodity production in Brazil.

Non-state market-driven governance (e.g., self-regulation; voluntary environmental agreements) has been identified as effective in reducing deforestation. For instance, Brazil's Amazon Soy Moratorium, a voluntary coalition between the industrial sector and civil society around production guarantees in deforestation-free areas since 2006 (Gibbs et al., 2015). However, Rausch and Gibbs take another perspective. They argue that the opportunity cost of adhering to the agreement on current soy farms was low relative to market access benefits, as only 1% of soy farms in the Amazon Biome have soy-suitable forested areas that could be deforested legally.

Brazil has historically had a large share of its GDP associated with the agricultural sector, which plays an important role in the country's export balance. Richards's paper discusses

the relationship between economic stagnation and economic growth in reaching environmental goals in Brazil. According to the author, economic stagnation devalues the national currency, encouraging exports of agricultural products, which increases incentives for land clearing. The opposite occurs in periods of economic growth. Thus, economic growth may be a great ally of forest conservation in the Amazon region, and beyond.

Overall, this Research Topic highlights the need to conserve the Amazon rainforest for its recognized contribution to human well-being and socioeconomic development of the people who live there. The authors conclude about the need for effective governance of PAs and the sustainable use of natural resources; the need to control land insecurity to discourage deforestation and forest degradation; the use of targeted compensating mechanisms; institutional and coalition strengthening; the effects of trade-related policies; and the links between economic development and conservation. Naturally, the authors' contributions do not exhaust the multiple aspects of the topic or possible solutions.

As threats to the integrity of the Amazon rainforest are already mapped, it is now necessary to focus efforts on effective long-term conservation strategies, with special emphasis on how and why a given policy and market intervention is expected to achieve the desired change (Bager et al., 2021). Measures should be transnational, multi-criteria, cross-border, multi-stakeholder and multi-institutional. Likewise, conservation strategies that do not offer economic alternatives for those living in the region may encounter resistance in different levels but specially by residents and local politicians. As they must be considered important allies for the effectiveness of local conservation strategies, they need to be engaged and participating in the search for solutions.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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