

OPINION

Integrating biodiversity into climate policy: From ecosystem services to food security in Brazil

Carlos Eduardo V. Grelle¹, Cecília R. Vieira², Guarino R. Colli², William E. Magnusson³,
 Adrian A. Garda⁴, Gerhard Overbeck⁵, Helena G. Bergallo⁶, Alberto Akama⁷, Leandro Juen⁸,
 José Alexandre F. Diniz-Filho⁴, Mariana P.C. Telles⁹, Rogério R. Silva¹⁰, Clarissa Rosa³,
 Domingos J. Rodrigues¹¹, Fernando L. Mantelatto¹², and Geraldo W. Fernandes¹³

¹*Departamento de Ecologia, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil.*

²*Departamento de Zoologia, Universidade de Brasília, Brasília, DF, Brazil.*

³*Coordenação de Biodiversidade, Instituto Nacional de Pesquisas da Amazônia, Manaus, AM, Brazil.*

⁴*Departamento de Ecologia, Universidade Federal de Goiás, Goiânia, GO, Brazil.*

⁵*Departamento de Botânica, Universidade Federal do Rio Grande do Sul, Porto Alegre, RS, Brazil.*

⁶*Departamento de Ecologia, Universidade do Estado do Rio de Janeiro, Rio de Janeiro, RJ, Brazil.*

⁷*Coordenação de Zoologia, Museu Paraense Emílio Goeldi, Belém, PA, Brazil.*

⁸*Instituto de Ciências Biológicas, Universidade Federal do Pará, Belém, PA, Brazil.*

⁹*Escola de Ciências Médicas e da Vida, PUC Goiás; Departamento de Genética, ICB, UFG, Goiânia, GO, Brazil.*

¹⁰*Museu Paraense Emílio Goeldi, Belém, PA, Brazil.*

¹¹*Instituto de Ciências Naturais, Humanas e Sociais, Universidade Federal de Mato Grosso, Sinop, MT, Brazil.*

¹²*Departamento de Biologia, Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto, Universidade de São Paulo, Ribeirão Preto, SP, Brazil.*

¹³*Departamento de Genética, Ecologia e Evolução, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil.*

Corresponding author: Carlos Eduardo V. Grelle (cevgrelle@gmail.com)

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ABSTRACT. Biodiversity and food security are often perceived as conflicting objectives, yet they are deeply interdependent through ecological processes. Biodiversity regulates soil quality, water, climate dynamics and ecological processes—such as pollination—thereby influencing food security, economic development, and resilience to climate risks. In Brazil, the conservation of ecosystems and pollination services exemplify how biodiversity underpins key agricultural commodities such as soy and coffee. Aligning biodiversity conservation with climate policy is therefore crucial, particularly in megadiverse countries that are major commodity producers. With COP30 taking place in Brazil, there is a unique opportunity to integrate biodiversity into global climate agendas, strengthen governance and legislation, and attract investment through sustainable frameworks. This perspective emphasizes that protecting biodiversity is not only an environmental priority but also a strategic pathway for food security, climate resilience, and sustainable economic development.

KEYWORDS. Biodiversity conservation, climate change, ecosystem services.

Biodiversity conservation and food security are often framed as competing objectives. However, they are deeply interdependent, as human-dominated landscapes depend on ecological processes sustained by natural ecosystems (Díaz et al. 2015). Agriculture—the cornerstone of food supply and a major component of the economy—depends on soil functions, reliable water, and pollination, all maintained

by intact and restored ecosystems; consequently, protected areas and ecological restoration that secure the continuity of these services are integral to food security (e.g., Melo et al. 2021). Anthropogenic climate change critically exposes agriculture to hydroclimatic extremes (Koberle et al. 2021, World Bank 2025) and can, for example, disrupt plant-pollinator interactions (Gonzalez et al. 2021), thereby threatening

both food security and the economy. Because biodiversity regulates water, soils, and biotic interactions that support production, it directly influences economic development and the capacity to manage climate risks. Aligning biodiversity conservation and climate policy through effective governance and legislation is therefore essential to sustain these services and bolster resilience (e.g., Hipólito et al. 2021, Pereira et al. 2024).

Robust theoretical and empirical evidence shows that biodiversity is foundational to human well-being and societal development (IPBES 2019). Biodiversity sustains multiple classes of ecosystem services—including **provisioning** (food, medicines, freshwater, energy), **regulating** (pollination, seed dispersal, nutrient cycling and decomposition, pest and pathogen transmission regulation, air and water quality), **cultural** (recreation, aesthetics, spiritual and heritage values), and **habitat/supporting** services (soil formation, primary production)—as synthesized in classical and recent frameworks (Millennium Ecosystem Assessment 2005, Díaz et al. 2018, Haines-Young 2023, Vale et al. 2023). Biodiversity also underpins nature-based solutions (NBS)—the protection, restoration, and management of ecosystems, including urban green infrastructure—that help mitigate climate risks and reduce social vulnerability (Seddon et al. 2020, Girardin et al. 2021). Consequently, conserving biodiversity is a credible pathway to advancing the United Nations Sustainable Development Goals (Tallis et al. 2018). By maintaining the ecological processes that support production and health, biodiversity generates direct benefits for people and measurable contributions to national economies through natural capital and ecosystem accounting approaches (King et al. 2021).

Although well-documented, the relationships between biodiversity, climate, and agricultural production are often complex and diffuse, and the magnitude of their effects remains subject to debate. The links between Amazonia conservation and agricultural production show a clear example of the strong connection between biodiversity and food security in Brazil. Atmospheric moisture recycling associated with Amazonian forests transports water vapor across South America—the “flying rivers”—supplying vast agricultural regions in Brazil (Nobre et al. 1991, Arraut and Satyamurty 2009, Arraut et al. 2012, Nobre 2014, Khanna et al. 2017). This process is strongly dependent on global climate dynamics, such as La Niña or El Niño events, which affect water security in central and southern Brazil. Moreover, animal pollination supplied by diverse bee assemblages enhances yields and stabilizes production in multiple Brazilian crops (Giannini et al. 2020). For instance, more than 60% of Brazilian crop species

depend on or benefit from animal pollination (Giannini et al. 2015). In soy, the absence of pollinators reduces yield by ~30% on average (Cunha et al. 2023); in coffee, proximity to native vegetation and associated wild bees increases fruit set and production by 12–28%, with a mean gain of nearly 18% (De Marco and Coelho 2004, Saturni et al. 2016). These examples involving two of Brazil’s flagship commodities make pollination one of the largest biodiversity-mediated contributions to agricultural GDP in the country.

In megadiverse countries, which are generally commodity providers, the best strategy to maintain agricultural productivity and increase landscape sustainability is to protect biodiversity and promote ecological science, which is critical for managing natural resources and optimizing their coexistence (Grelle et al. 2022). Without a solid understanding of biodiversity and its role in providing ecosystem services, it is challenging to design and implement effective, long-term conservation actions (Magnusson et al. 2018, Bustamante et al. 2019, Rosa et al. 2021, Guimaraes et al. 2024). Being intrinsically interdependent, the agendas of biodiversity and climate change must advance in tandem, especially in megadiverse countries, as recognized in the joint IPBES and IPCC workshop (Pörtner et al. 2021). In short, it is essential to enhance our understanding of how biodiversity services influence climate regulation, as well as how sensitive the distinct components of biodiversity are to climate change at various spatial scales (Urban 2024). This understanding is not just important—it is urgent—as it can guide our actions in mitigating the impacts of climate change on biodiversity.

The proposal of joining biodiversity and climate change is not new (Pettorelli et al. 2021). Biodiversity plays a crucial role in climate change mitigation (Pereira et al. 2024), and the Brazilian research network on Biodiversity (PPBio, in its Portuguese acronym) is strategically positioned to bridge existing gaps by linking biodiversity research in different biomes with climate action. Through studies that address nearly all 23 targets of the Kunming-Montreal Global Biodiversity Framework (Rosa et al. 2021, Guimaraes et al. 2024), this initiative provides an essential pathway for integrating biodiversity into efforts to mitigate climate change.

With COP30 set to take place in Brazil—the world’s most megadiverse country—there is a unique and timely opportunity to firmly integrate biodiversity into the climate agenda. Doing so would not only strengthen global strategies to mitigate and adapt to climate change but also unlock international financial resources by aligning biodiversity conservation with economic priorities. Clear and effective environmental policies, backed by legislation, are crucial

to position developing countries as leaders in attracting investment through Environmental, Social, and Governance (ESG) frameworks, thereby reinforcing biodiversity as a cornerstone of both climate resilience and sustainable economic development.

Integrating biodiversity and climate-change agendas is a necessary step toward environmental compliance and food security, consistent with the One Health framework that links ecosystem integrity with human and animal health. Legislation promoting biodiversity protection is therefore fundamental for effective governance and should advance toward comprehensive and interdisciplinary legislation (Hipólito et al. 2021). On the other hand, the dismantling of existing environmental laws undermines both biodiversity protection and climate commitments in Brazil and other megadiverse countries (Barbosa et al. 2021, Fernandes et al. 2023).

In conclusion, integrating the biodiversity and climate agendas is essential for ecological, social, and economic sustainability, particularly in megadiverse countries. Achieving this goal demands coordinated action and genuine dialogue among research institutions, universities, governments, the private sector, and civil society. As COP30 approaches, Brazil can lead by incorporating biodiversity metrics and safeguards into its climate policy, finance, and implementation.

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Competing Interests

The authors have declared that no competing interests exist.

Data Availability

Datasets generated or analyzed in this study are available from the corresponding author on reasonable request.

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