filosofia unisinos
Unisinos Journal of Philosophy
ISSN 1984-8234

Artigo
doi: 10.4013/fsu.2026.271.17

Climate justice, land-use change emissions and global health*

Justiça climática, emissões decorrentes da mudança no uso da terra e saúde global

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* The author gratefully acknowledges the support of the PQ-CNPq scholarship (CNPq 303202/2022-0) and the project *BIOJUSPAN – Bioethics, Distributive Justice and Pandemics* (project number 409953/2022-9, CNPq). An earlier version of this article was presented at the III Workshop BIOJUSPAN, held at the Praia Vermelha campus of the Universidade Federal do Rio de Janeiro (UFRJ).

Como citar:
Tonetto, M. C. 2026. Climate justice, land-use change emissions and global health. *FilosofiaUnisinos,27*(1):1-20,e27117. doi: 10.4013/fsu.2026.271.17

ABSTRACT: Climate change is one of the most pressing global challenges, demanding strong ethical commitments to address its interconnected environmental and health risks. In Brazil, the leading source of greenhouse gas emissions is the land use, land-use change, and forestry (LULUCF) sector, particularly deforestation in the Amazon rainforest. This not only accelerates global warming but also increases the risk of epidemics and infectious disease spillovers, as highlighted by the IPCC in 2023. As the global carbon budget rapidly shrinks, the need for urgent and equitable climate action becomes increasingly evident, especially in countries like Brazil. This paper proposes a hybrid responsibility model that incorporates three key considerations: historical emissions (polluter pays), national capacity to act (ability to pay), and the ethical imperative to protect biodiversity, particularly due to its role in preventing future pandemic risks. While grounded in the principle of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC), this model offers a more just and practical framework to guide both mitigation and adaptation efforts. Brazil's dual role as a major emitter due to deforestation and as a crucial steward of global biodiversity requires climate policies that are ethically robust and ecologically informed. In alignment with the One Health approach, which emphasizes the interdependence of human, animal, and ecosystem health, this paper examines Brazil's ongoing deforestation crisis in the Amazon as a case study in the fair distribution of global climate responsibilities.

Keywords: land-use change emissions, climate justice, deforestation, epidemics, biodiversity, One Health, adaptation, mitigation, CBDR-RC.

RESUMO: A mudança climática é um dos desafios globais mais urgentes, exigindo compromissos éticos robustos para enfrentar seus riscos ambientais e de saúde interconectados. No Brasil, a principal fonte de emissões de gases de efeito estufa é o setor de uso da terra, mudança no uso da terra e florestas (LULUCF), particularmente o desmatamento na Floresta Amazônica. Isso não apenas acelera o aquecimento global, mas também aumenta o risco de epidemias e de transbordamentos de doenças infecciosas, conforme destacado pelo IPCC em 2023. À medida que o orçamento global de carbono se reduz rapidamente, torna-se cada vez mais evidente a necessidade de uma ação climática urgente e equitativa, especialmente em países como o Brasil. Este artigo propõe um modelo

híbrido de responsabilidade que incorpora três considerações centrais: as emissões históricas (o princípio do poluidor-pagador), a capacidade nacional de agir (capacidade de pagamento) e o imperativo ético de proteger a biodiversidade, particularmente devido ao seu papel na prevenção de futuros riscos pandêmicos. Embora fundamentado no princípio das Responsabilidades Comuns, mas Diferenciadas e das Respectivas Capacidades (CBDR-RC), esse modelo oferece uma estrutura mais justa e prática para orientar tanto os esforços de mitigação quanto de adaptação. O papel dual do Brasil, como grande emissor devido ao desmatamento e como guardião crucial da biodiversidade global, exige políticas climáticas que sejam eticamente robustas e ecologicamente informadas. Em consonância com a abordagem One Health, que enfatiza a interdependência entre a saúde humana, animal e dos ecossistemas, este artigo examina a atual crise de desmatamento na Amazônia brasileira como um estudo de caso na distribuição justa das responsabilidades climáticas globais.

Palavras-chaves: emissões por mudança no uso da terra, justiça climática, desmatamento, epidemias, biodiversidade, One Health, adaptação, mitigação, CBDR-RC.

1 Introduction

Climate change is one of the most urgent and complex global challenges of our time. It demands not only coordinated political and technological efforts but also robust ethical commitments to address its far-reaching environmental and health impacts. The accelerating rise in global temperatures, biodiversity loss, and the intensification of climate-related disasters reveal the interdependence of ecological systems and human well-being. Among the foundational principles guiding international climate governance is the principle of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC), enshrined in the Paris Agreement (UNFCCC, 2015). This principle recognizes that, although all countries share a duty to combat climate change, their responsibilities vary according to their historical contributions to the problem, financial and technological capacity, and current development needs.

Philosophers working on climate justice have largely endorsed differentiated responsibilities, emphasizing fairness in global burden-sharing. They typically consider three dimensions: (1) historical emissions, which support the Polluter Pays Principle (PPP); (2) accrued benefits from carbon-intensive development, aligned with the Beneficiary Pays Principle (BPP); and (3) economic capacity to act, reflected in the Ability to Pay Principle (APP). However, differentiation does not imply that low- and middle-income countries, such as Brazil, are exempt from responsibility. On the contrary, countries with high emissions from land-use change and deforestation play a crucial role in any ethically robust climate strategy.

A critical element in understanding the fairness and urgency of global climate responsibilities is the concept of the remaining carbon budget. This budget represents the total amount of carbon dioxide that can still be emitted while keeping global temperature rise below critical thresholds—1.5°C or 2°C above pre-industrial levels, as targeted by the Paris Agreement. The Global Carbon Budget (2024) warns that, at current rates, the 1.5°C threshold will likely be exceeded within the next six years. This reality underscores the need for immediate, decisive mitigation efforts, not only from industrialized countries but also from major land-use emitters.

In Brazil, the land use, land-use change, and forestry (LULUCF) sector, particularly deforestation in the Amazon rainforest, remains the dominant source of the country's greenhouse gas emissions (Friedlingstein et al., 2022). In 2024, widespread wildfires, driven by severe droughts and land-clearing activities, have intensified this trend. However, the impacts go far beyond carbon outputs: tropical deforestation increases the risk of biodiversity loss and poses serious public health threats, including the rise of zoonotic and vector-borne diseases and the potential for future epidemics. According to

the Intergovernmental Panel on Climate Change (IPCC, 2023), environmental disruption in high-biodiversity areas substantially raises the chances of infectious disease spillovers. This intersection of ecological degradation and health vulnerability, highlighted by the *One Health* framework (WHO, 2021), underscores the need to place biodiversity conservation at the heart of climate action.

This paper proposes a hybrid responsibility model to developing countries with significant land-use emissions. The model integrates three key considerations: historical responsibility for emissions (PPP), current capacity to act (APP), and the ethical imperative to halt deforestation and preserve biodiversity to prevent cascading impacts to climate, ecosystems, and human health. It argues that if emerging economies can pursue sustainable development**1** without extensive deforestation or fossil fuel use, especially at a reasonable cost, then maintaining high levels of emissions becomes ethically indefensible. Choosing low-emission pathways may thus be understood as a *prima facie* duty**2**. This hybrid responsibility model, which emphasizes the preservation of biodiversity, aims to complement the principles of justice and equity outlined in Article 4 of the Declaration of Ethical Principles in Relation to Climate Change (UNESCO, 2017).

To develop this argument, the paper is structured in four parts. The first section explores the main ethical and philosophical challenges raised by climate change. The second section analyzes the principle of Common but Differentiated Responsibilities and its evolving role in shaping international climate policy. The third section examines different approaches to the fair allocation of climate responsibilities, including PPP, BPP, APP, and hybrid models, and proposes an additional principle focused on biodiversity protection. It argues that countries such as Brazil, and others that share the Amazon basin, have a duty to end deforestation as a central mitigation strategy. The final section considers the implications of these ethical commitments for both national governments and citizens and uses Brazil's ongoing deforestation crisis as a case study in the fair distribution of global climate responsibilities.

2 Practical and ethical challenges of climate change

Since the early 20th century, evidence of climate change has gradually emerged, revealing patterns that cannot be explained solely by natural influences. Scientific research now confirms that these changes are primarily driven by human activities, with an anthropogenic origin. The most recent IPCC Synthesis Report clearly states:

> A.1. Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850-1900 in 2011-2020. Global greenhouse gas emissions have continued to increase, with unequal historical and ongoing contributions arising from unsustainable energy use, land use and land-use change, lifestyles and patterns of consumption and production across regions, between and within countries, and among individuals (high confidence). (IPCC, 2023, p. 04)

This warning aligns with the observed changes and impacts (Copernicus, 2024; NOAA, 2024), confirming the unequivocal contribution of human activities to climate change. Climate change driven by human activity is already affecting numerous weather and climate extremes in every region globally.

1 Sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. See: (WCED, 1987).

2 A *prima facie* duty is an ethical concept popularized by philosopher W.D. Ross, referring to a moral obligation that should be fulfilled unless it conflicts with a stronger duty in a given situation. See: (Ross, 2002, p.19-20).

"A.2 This has led to widespread adverse impacts and related losses and damages to nature and people (high confidence). Vulnerable communities who have historically contributed the least to current climate change are disproportionately affected (high confidence)" (IPCC, 2023, p. 05). More specifically, section A.2.2 highlights that Least Developed Countries (LDCs), Indigenous Peoples, small-scale food producers, and low-income households are among the most severely impacted. These groups face heightened food insecurity and reduced access to water, which in turn exacerbate existing economic inequalities and social injustices. Additionally, A.2.5 points out that across all regions, "increases in extreme heat events have resulted in human mortality and morbidity (…). The occurrence of climate-related food-borne and water-borne diseases (…) and the incidence of vector-borne diseases (…) have increased," (IPCC, 2023, p. 06) further compounding the vulnerabilities of disadvantaged populations and reinforcing the urgent need for ethical and equitable climate responses.

An adequate analysis of the ethical dimensions of global climate change requires an account of the different ways it affects people's fundamental interests, that is, those interests that a theory of justice should seek to protect. Therefore, a normative question that arises is how we can assess the impacts of climate change. One relevant criterion (but not the only one) is that human activities contributing to climate change undeniably infringe upon *human rights*. In the article "Climate Change, Human Rights and Moral Thresholds", Simon Caney argues that anthropogenic climate change threatens the enjoyment of three fundamental human rights: the right to life, to health, and to subsistence. Caney bases his argument on a negative conception of rights—specifically, the right not to be harmed by others (Caney, 2010a, p.166). Since climate change is caused by human actions, the principle of not causing harm would be sufficient to defend the *right to live in an unpolluted environment*, which encompasses the rights to life, *health,* and subsistence. Caney does not reject a more expansive or positive interpretation of human rights. His argument is that we do not need to rely on a more ambitious conception of rights to see that climate change threatens these three rights. They are minimum requirements to gain the greatest possible political and theoretical consensus.

In addition to raising issues related to respecting human rights, climate change presents other ethical problems. For example, Stephen Gardiner compares climate change to a "perfect moral storm." In his metaphor, there are three distinct "storms," each representing significant obstacles to our capacity for ethical behavior. "The first storm is global" (Gardiner, 2011, p. 07). Its defining characteristic is that the wealthiest nations and their affluent individuals wield significant power to influence outcomes in ways that primarily serve their own interests, often to the detriment of poorer nations and their populations. "The second storm is intergenerational" (Gardiner, 2011, p. 07). This "storm" is marked by a similar but more pronounced asymmetry of power, where the current generation has a significant impact on the prospects of coming generations, while those future generations cannot affect the present. In his view, the intergenerational "storm" is the most critical of the three, presenting profound opportunities for exploitation. "The third storm is theoretical". (Gardiner, 2011, p. 07). Ideally, in facing the first two storms, we would have well-established general theories to guide us. Unfortunately, that's not the reality. Current theories are notably underdeveloped in key areas such as intergenerational ethics, international justice, scientific uncertainty, and the human relationship with animals and nature.

Building on this framework, the concept of an "ecological storm" emerges as a distinct yet related issue within the broader context of climate ethics. While Gardiner hesitates to classify the ecological storm as a primary component of the "perfect moral storm" for the sake of simplicity, this paper asserts its importance. Acknowledging the ecological storm as a vital ethical concern is crucial for a comprehensive understanding of climate ethics. This view reflects the *convergence thesis,* which emphasizes the deep interdependence between human flourishing and the health of ecosystems. According to this perspective,

what benefits human beings, especially in the long term, will generally converge with what benefits nonhuman nature. Therefore, adopting sustainable practices to mitigate climate change is imperative not only for human well-being but also for the integrity of the natural world. This interconnected understanding is further reinforced by the One Health approach. As we will explore in section 3.5, the One Health definition developed by the One Health High-Level Expert Panel (OHHLEP, 2023) recognizes that the health of humans, domestic and wild animals, plants, and the wider environment, including ecosystems, are closely linked and mutually dependent.

Given these ethical challenges, it becomes clear that climate change represents a significant issue of justice. The concept of justice, particularly in the context of international environmental agreements, has evolved and been adopted by states to address climate change. Governments have broadly agreed on the principle of Common but Differentiated Responsibilities (CBDR). However, it remains abstract and needs to be concretely defined by specific principles of global climate ethics to ensure its effective application. The following section will explore the philosophical foundations of CBDR and present some of its limitations.

3 The Principle of Common but Differentiated Responsibility (CBDR)

The CBDR first gained international recognition in the 1992 Rio Declaration on Environment and Development. Principle 7 of the Rio Declaration explicitly says:

> States shall co-operate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of the different contributions to global environmental degradation, States have *common but differentiated responsibilities*. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command. (United Nations, 1992, Art. 9)

This formulation is significant not only for establishing a differentiated framework of responsibility but also for its explicit reference to the health of the Earth's ecosystem. The inclusion of the term "health" signals a broader ethical concern that extends beyond environmental preservation to encompass human well-being. It underscores the interdependence between ecological systems and public health, highlighting how environmental degradation, through air and water pollution, food insecurity, can undermine the conditions necessary for human flourishing.

As articulated in the Rio Declaration, CBDR recognizes that while all states share a common responsibility to address environmental degradation, the extent of that responsibility varies according to each state's historical contribution to the problem. It also highlights the two key reasons why developed countries should bear greater responsibility in the international pursuit of sustainable development. *First,* it acknowledges that these countries exert significant pressure on the global environment due to their historical and ongoing industrial activities. *Second,* it highlights that they possess advanced technologies and greater resources, equipping them to lead in addressing environmental challenges. Therefore, the passage underscores the expectation that developed nations should take the lead in sustainable development efforts, both because of their larger environmental footprint and their greater capacity to effect change.

CBDR is also a key principle in international climate policy, as outlined in the United Nations Framework Convention on Climate Change (UNFCCC, 1992). Article 3.1 of the convention states:

> The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities. Accordingly, the developed country Parties should take the lead in combating climate change and the adverse effects thereof. (UNFCCC, 1992)

This articulation of CBDR also underscores that developed countries, due to their historical emissions and greater financial and technological capabilities, have a greater obligation to lead in the fight against climate change for the benefit of present and future generations. This principle was applied with the Kyoto Protocol, adopted in 1997, which set legally binding emission reduction targets for developed countries. These nations committed to cutting their greenhouse gas emissions by 5.2% from 1990 levels by 2008–2012, reflecting their historical responsibility for climate change and greater financial and technological capacity. The treaty did not impose binding targets on developing countries, acknowledging their lower historical emissions and prioritizing their economic development. The Protocol was ratified in 2001 and became a legal treaty, but the United States, a major emitter, withdrew from the negotiations, weakening the agreement. Despite this, the Kyoto Protocol came into force in 2005 after Russia's ratification ensured the participation of countries representing over 55% of global emissions. As previously noted, although the protocol represented a significant step forward, its effectiveness was undermined by the absence of major emitters such as the United States. These countries were expected to take on greater responsibilities, given their substantial historical and ongoing contributions to global emissions.

The Paris Agreement (2015), which followed the Kyoto Protocol, built on the CBDR principle by expanding the scope of global cooperation to include all countries in the fight against climate change. It further develops this principle within a contemporary framework, emphasizing the necessity for international cooperation to limit the rise in global temperature to well below 2°C above pre-industrial levels, while pursuing efforts to restrict the increase to 1.5°C. In this context, CBDR is not only reiterated but also adapted to reflect the evolving economic and political realities of the 21st century. This emphasis on equity and differentiation is reflected in key provisions of the agreement:

> Article 2.2: The Agreement emphasizes that the implementation of its provisions will reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances. (…)

> Article 4.3: It requires developed countries to continue taking the lead by undertaking economy-wide absolute emission reduction targets, while developing countries are encouraged to enhance their mitigation efforts, reflecting their different capacities and levels of development. (UNFCCC 2015)

One of the most significant innovations of the Paris Agreement is its adoption of a bottom-up approach to the substance of climate change policy, allowing parties to nationally determine their contributions to address climate change. This contrasts with the Kyoto Protocol, which prescribed emissions limitation targets from the top-down through international negotiations (Bodansky, 2021, p. 01). Under the Kyoto framework, emission reduction commitments were centrally negotiated and binding, whereas the Paris Agreement enables each country to set its own Nationally Determined Contributions (NDCs) based on its political, economic, and environmental circumstances.

During the preparatory phase of the Paris negotiations, each country submitted its NDC outlining specific mitigation measures and goals to be achieved within a given timeframe. Once this period concludes, the pledges are subject to international review and are expected to be revised upward. The agreement encourages states to act according to their "highest possible ambition" (UNFCCC, 2015, Art. 4.3), interpreted in light of their own national circumstances and consistent with the CBDR principle. The term "national circumstances" acknowledges the wide disparities among countries in terms of economic development, technological capacity, and vulnerability to climate impacts. In summary, although the Paris Agreement promotes broad participation and aspirational targets, its reliance on self-determined goals results in considerable variation in the ambition and effectiveness of national commitments. This flexible framework enhances inclusivity but also raises concerns about its adequacy in responding to the urgency of the climate crisis.

Several shortcomings have been identified in the approaches of the UNFCCC and the Paris Agreement. First, despite decades of negotiations, the UNFCCC has yet to establish an effective and enforceable global framework (Maslin, 2021, p. 115). Even if all current pledges under the Paris Agreement are fully implemented, global temperatures are still projected to rise by at least 3°C. As highlighted by the Global Carbon Budget 2022 (Friedlingstein *et al.,* 2022), global emissions continue to increase, despite reductions in some regions—underscoring the slow progress of international climate mitigation efforts. Similarly, the Emissions Gap Report 2023 (UNEP, 2023) warns that meeting the Paris targets would require drastic reductions in emissions. Without such reductions, it is likely that the critical 1.5°C threshold will be exceeded, with severe and potentially irreversible consequences for the global climate.

Second, there is a significant issue regarding the lack of effective enforcement mechanisms (Maslin, 2021, p.115) in international agreements, which often end up being voluntary. Regional and national policies are essential for translating these agreements into concrete actions. For instance, the ongoing American unpredictability (Williston, 2024, p. 65), evidenced by its withdrawal from the Paris Agreement under the Trump administration, its re-entry under President Biden, and a second withdrawal under Trump in 2025, undermines the global effectiveness of such treaties. However, even if countries like the U.S. withdraw from the Paris Agreement, American citizens can still play an active role in combating climate change.

Thirdly, the UNFCCC's nation-state-centered approach faces significant challenges in a globalized world. The lack of global coordination in specific sectors, such as heavy industry and commodities trade, can undermine the efforts of individual countries to reduce emissions. While it is true that emerging countries now produce more greenhouse gas emissions (China has even surpassed the United States as the largest national source) these emissions are often driven by global consumption patterns. Developing countries are burning fossil fuels and increasing emissions through land use changes and deforestation, not only to meet domestic demands but also to produce goods for global markets. Brazil exemplifies this issue, where the Amazon rainforest and the Cerrado biome, both crucial for mitigating global climate change, are threatened by deforestation primarily driven by cattle ranching and soy production. According to the Global Carbon Budget 2022, "the highest emitters during 2012–2021, in descending order, were Brazil, Indonesia, and the Democratic Republic of Congo, with these three countries contributing more than half of the global total land-use emissions" (Friedlingstein *et al*. 2022). This underscores the need for a more coordinated global response that addresses the underlying drivers of emissions, particularly those linked to international trade and consumption.

The next section will explore how principles of justice can address the climate change challenges discussed previously. This discussion will also examine the implications of these principles for the governments of nation-states and their citizens, whether acting as individuals or through organizations.

4 Principles for climate ethics

Principles of climate justice can be categorized into four main types: a) the polluter pays' principle (PPP), b) beneficiary pays' principle (BPP), c) the ability to pay principle (APP), and d) a hybrid approach. Each of these principles offers a distinct ethical basis for allocating responsibilities in the context of climate change.

4.1 The polluter pays' principle (PPP)

The Polluter Pays Principle (PPP) asserts that those responsible for causing climate change should bear the costs associated with addressing its adverse impacts. As a principle grounded in corrective justice, PPP assigns responsibility to individuals or entities whose actions have caused environmental harm. This principle embodies the widely accepted ethical view that those who cause damage ought to be accountable for its remediation. Given their earlier industrialization and significant historical contributions to present atmospheric CO_2 levels, developed countries are generally regarded as bearing a greater degree of responsibility under the PPP framework. Accordingly, it is commonly argued that these nations should assume a disproportionately larger share of the costs related to climate mitigation.

Despite its strong ethical intuition, the Polluter Pays Principle (PPP) faces significant practical challenges. First, there is the difficulty of precisely measuring the harmful effects of climate change and identifying who is responsible. Unlike incidents such as illegal toxic waste dumping—where the polluter can be directly identified and held accountable—climate change stems from cumulative emissions produced by countless sources over many decades. Moreover, its impacts, such as extreme weather events, often occur far from the original points of emission, further complicating efforts to trace liability. These complexities make it difficult to establish direct compensation and clear accountability within the framework of the PPP.

Second, a significant point of contention concerns whether polluters should be held accountable for emissions that occurred before the adverse consequences of such actions were widely understood. This raises the issue of excusable ignorance: can agents be held morally responsible for harms they could not reasonably have anticipated, given the limited scientific understanding of climate change prior to the establishment of the UNFCCC in 1992? Imposing responsibility for unforeseeable harm may appear unjust, thereby weakening the Polluter Pays Principle's foundational appeal to fairness and moral accountability.

Third, imposing payments based on emissions risks unfairly burdening those for whom emissions are essential to survival due to lower living standards. Henry Shue argues that "those living in desperate poverty ought not to be required to restrain their emissions, thereby remaining in poverty, in order that those living in luxury should not have to restrain their emissions" (Shue, 2014, 50). Such an approach may perpetuate intolerable inequality, prioritizing the affluence of a few over the developmental needs and progress of the world's poorest nations.

Additionally, the PPP faces significant challenges in addressing the climate impacts of emissions produced by past generations, many of whom are no longer alive. Holding the present generation accountable for these historical emissions appears to conflict with the core logic of the PPP, since current individuals were not the agents responsible for pollution in, for example, 1850 and the years that followed. As Caney (2005, p. 756) argues, requiring present individuals to bear the costs of these past emissions "violates the PPP." In response to this limitation, Henry Shue has long defended the view that those who have imposed costs on others without their consent, such as major historical emitters, should bear greater burdens in addressing climate change. His "first principle of equity," formulated in earlier work, states:

> When a party has in the past taken an unfair advantage of others by imposing costs upon them without their consent, those who have been unilaterally put at a disadvantage are entitled to demand that in the future the offending party shoulder burdens that are unequal at least to the extent of the unfair advantage previously taken, in order to restore equality (Shue, 2014, p. 183).

This view reflects a compensatory logic and has been interpreted by Caney as a version of the Polluter Pays Principle (Caney, 2005, p. 753; 2010b, p. 223; 2015, p. 380). In more recent work, however, Shue presents a different moral framing for climate responsibilities, emphasizing distributive justice instead. He writes: "This is a question neither of retributive justice nor compensatory justice, but of distributive justice—basic fairness" (Shue, 2021, p. 38), emphasizing a forward-looking concern with how burdens should be allocated among those currently capable of acting.

This reframing does not disregard the importance of past emissions, or the benefits accumulated from them. Rather, Shue incorporates these historical factors into his understanding of fairness: he argues that those who have contributed most to the problem and profited the most from a carbon-intensive economy should assume a greater share of the costs involved in moving beyond it. His view, therefore, bases current responsibilities both on present capacity and on the lasting moral relevance of historical contribution and unjust advantage. Although he places greater weight on forward-looking considerations, the logic of compensation remains an integral part of what fairness now requires.

This perspective is reinforced by the argument that current generations continue to benefit from the emissions of their predecessors. On this view, some have proposed complementing the PPP by maintaining that "members of industrialized countries should pay for emissions of earlier generations" because they inherit the advantages created by past industrial activity. Accordingly, the PPP on its own may be insufficient, and further considerations, such as the historical benefits received, may be required to guide a fair distribution of burdens.

4.2 The beneficiary pays' principle (BPP)

Unlike the Polluter-Pays Principle (PPP), which assigns responsibility directly to those who caused or are causing environmental harm, the Beneficiary-Pays Principle holds that those who have derived significant benefits from activities that contributed to climate change should bear the costs of adaptation, mitigation, and preventing further damage. However, this principle does not imply that beneficiaries are morally or causally responsible for past emissions. Rather, it argues that justice requires those who have benefited from environmentally harmful activities to contribute to addressing their consequences. For example, a country that continues to benefit from infrastructure projects, such as power plants, built by past generations who were unaware of climate change still has an obligation to support those harmed by the resulting pollution (Widdows, 2011, p. 245). This obligation arises not because the country directly caused or failed to prevent the emissions, but because it continues to enjoy advantages from past activities while others bear the costs.

The Beneficiary-Pays Principle is introduced as a response to the challenge of historical emissions discussed in the previous section. Since many of the largest contributors to climate change belong to past generations and can no longer take responsibility for its consequences, a fundamental question arises: who should bear the costs when the original polluters are no longer alive? Shue (2014) argues that current generations are not entirely disconnected from their predecessors and can, therefore, take responsibility for the actions of their ancestors. He highlights that present and future generations continue to benefit from past industrial activities: "current generations benefit, and future generations are likely to continue benefiting from past industrial activity" (Shue, 2014, p. 186).

Eric Neumayer (2000) advances a related position, emphasizing that developed countries should not be exempt from responsibility merely because the emissions in question occurred in the past. He contends that these countries continue to enjoy the high standards of living made possible by earlier fossil-fuel-driven industrialization and thus must also accept responsibility for its environmental consequences. As he puts it, "the current developed countries readily accept the benefits of past emissions in the form of their high standard of living and should therefore not be exempted from accountability for the detrimental side-effects with which their living standards were achieved" (p. 11). Neumayer's argument is not based on direct causal responsibility but on the moral relevance of ongoing benefit—holding that reaping the rewards of harmful actions imposes corresponding obligations.

Axel Gosseries (2004) reinforces this general idea but frames it in terms of the "free-rider" problem. He argues that if members of developed societies are net beneficiaries of their ancestors' emissions, while those in developing countries are net victims, then obligations of compensation can be grounded even without attributing past emissions to current individuals. As Gosseries explains,

> we can alternatively base our obligation to pay more on an interactive interpretation of free-riding, as long as we can show that we are net beneficiaries of our ancestor's emissions while current members of developing countries are net victims of them. This can be done without assuming that our ancestor's emissions were our emissions (...) (Gosseries, 2004, p. 26).

This highlights that benefit alone can ground compensatory duties without needing to attribute direct causal responsibility, addressing the "free-rider" problem where beneficiaries avoid responsibility despite profiting from harmful activities.

Nevertheless, the BPP is not without controversy, and its foundational logic has been critically examined by several theorists. Caney (2005) challenges this perspective, arguing that holding industrialized economies accountable based on inherited benefits is unjust, as it fails to ensure that the actual polluters bear the costs. He contends that this approach "is not a revision of the PPP [polluter-pays principle], but an abandonment of it" (Caney, 2005, p. 757). The main concern is that the BPP could justify imposing burdens on individuals or nations that did not cause environmental harm but merely benefited from it. Instead, Caney argues that the distribution of burdens to address climate change should reflect both the ability to pay and direct contributions to the problem. This view suggests that even if benefiting from past emissions creates some moral pressure, it may not be a sufficient or fair ground for allocating responsibilities. This leads to an alternative framework that avoids disputes over historical causation or benefit and instead focuses on present capabilities: the Ability to Pay Principle.

4.3 The ability to pay principle (APP)

The APP assigns responsibilities based on the capacity to finance climate change mitigation and adaptation, rather than assigning blame for past actions (Caney, 2005, p. 769). It is grounded in the idea that justice requires those who are most capable of helping, regardless of whether they contributed to the problem, to do more to solve it. Proponents argue against delving into historical injustices if identified parties cannot or will not pay, advocating instead for pragmatic solutions that focus on those who can afford necessary changes. This principle contends that "the costs of climate change should be borne by the rich and should be divided in proportion to their wealth" (Caney, 2005, p. 769). By emphasizing current capacity rather than past responsibility or benefit, the APP provides a forward-looking and action-oriented framework for addressing climate change.

Despite its practical appeal, the APP raises important normative concerns. Critics argue that assigning burdens solely on the basis of wealth appears unjust, especially when those asked to contribute have neither caused the harm nor benefited from it. As Widdows (2011) observes, the principle deviates from conventional understandings of justice, which typically link responsibility to causation or benefit. Yet, in contexts where inaction would result in severe and irreversible harm to those least responsible and least equipped to respond, distributing burdens based on capacity may be the least unjust option. Moreover, in many cases, the categories of polluter, beneficiary, and wealthy overlap, mitigating the concern that the principle targets entirely unrelated agents.

Nonetheless, as Caney (2005) cautions, conflating these groups can be misleading, as in the case of countries like China and India, which are significant current emitters but have neither historically polluted at comparable levels nor possess the same wealth as long-industrialized nations. Still, a major strength of the APP lies in its ability to circumvent the epistemic and moral complexities of tracing historical causation, offering a more straightforward basis for urgent global cooperation.

One of the APP's central strengths lies in its ability to sidestep the epistemic and moral difficulties associated with tracing historical causation—challenges that often limit the effectiveness of backward-looking principles such as the Polluter Pays or Beneficiary Pays. Nonetheless, the question remains: why should those who are not at fault shoulder the burden? As Caney (2010b, p. 214) notes, "Whatever the scenario of climate change in the future, someone will always be assuming a burden that is not theirs.". In response, Caney suggests a hybrid approach that considers both historical contributions to climate change and the ability to pay.

4.4 Hybrid principles (PSPPP, HSAPP)

So far, we have seen that there are well-founded reasons to argue that the distribution of costs to address climate change should reflect both the ability to pay and the contribution to the problem. Caney emphasizes the significance of the justice aspect of the PPP and adopts it as *a primary* method for funding the necessary mitigation and adaptation efforts to tackle climate change (Caney, 2010b, p. 214). However, he argues that this principle alone is insufficient due to issues like uncertainty and the difficulty of addressing pollution caused by previous generations. These challenges limit the PPP to addressing only a portion of climate change effects. There will always be some causes of pollution that cannot be traced or are impractical to pursue. For example, Caney argues that contemporary polluters may not be financially capable of paying reparations for their emissions. Therefore, he asserts that climate change duties should not push people below a certain standard of living. Thus, the PPP should serve as a foundational principle but should be qualified to ensure that people are not forced to pay for emissions necessary for survival or if payment would cause them to fall below a minimum standard of living.

In this way, Caney formulates a qualified version of the principle, namely, the Poverty-Sensitive Polluter-Pays Principle (PSPPP): "*Principle 1: Persons should bear the burden of climate change that they have caused so long as doing so does not push them beneath a decent standard of living*" (Caney, 2010b, p. 218). Given that the PPP cannot cover all aspects of the problem, as we have the "remaining issues" (for instance, the emissions from past generations), Caney combines this principle with the History-Sensitive Ability-to-Pay Principle (HSAPP): "*Principle 2: The duties to bear the Remainder***3** *should be borne by the wealthy but we should distinguish between two groups-(i) those whose wealth came about in unjust ways, and (ii) those whose wealth did not come about in unjust ways-and we should apportion greater responsibility to (i) than to (ii)*". (Caney, 2010b, p.218) This approach is hybrid as it combines

3 Caney uses the term "the Remainder" to refer to harmful climate changes stemming from (a) the emissions of earlier generations, (b) non-human-induced climate change, and (c) the (legitimate) emissions of disadvantaged groups. See: (Caney, 2010b, p. 213).

the two principles separately. Those who possess the resources are obligated to invest in measures for mitigating and adapting to climate change.

Caney distinguishes between those who acquired their wealth unjustly (for instance, through benefiting from slavery), and those who acquired it justly. He argues that both groups have responsibilities to contribute, but those who gained their wealth unjustly bear a heavier burden under the HSAPP (Caney, 2010b, p. 218). To justify why those with the ability to pay have a duty to do so, even if they have *not* contributed to the harm, Caney (2010b, p. 216) draws on arguments about the duty of aid (similar to those of Singer), suggesting that there are both negative duties not to harm and positive duties on those with the ability to pay. He argues that one should pay to the point where the duties are not too demanding. This approach promotes fairness by integrating the PPP with the APP, thereby addressing concerns of justice. It also underscores the human right to avoid suffering from the adverse effects of anthropogenic global climate change.

However, to effectively address climate change, we need to rethink the scope of justice to include duties toward the natural world. This entails advocating for an additional principle that places greater emphasis on the responsibility to protect biodiversity. Any position based on the Polluter Pays Principle (PPP), the Beneficiary Pays Principle (BPP), the Ability to Pay Principle (APP), or a hybrid approach must respect the Principle of Biodiversity Protection. This hybrid responsibility model should also complement the principles of justice and equity outlined in Article 4 of the Declaration of Ethical Principles in Relation to Climate Change (UNESCO, 2017).

The most relevant passage appears in Article 4 (Equity and Justice), paragraph 2: "It is important for all to take measures to safeguard and protect Earth's terrestrial and marine ecosystems, for present and future generations. The interaction of people and ecosystems is particularly important given the high dependence of one upon the other." While this provision underscores the importance of ecosystem protection and the interdependence between humans and nature, the declaration does not explicitly recognize biodiversity protection as an autonomous principle, nor does it refer to "biodiversity" in a direct or recurring way. Nonetheless, the preservation of biodiversity may be understood as implicitly supported within its broader call to safeguard ecosystems for present and future generations—particularly given biodiversity's essential role in maintaining ecosystem resilience, promoting human health, and advancing intergenerational justice.

4.5 Principle of biodiversity protection and interconnected health

Biodiversity refers to the variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part. This diversity, within species, between species, and among ecosystems, is indispensable for the health and well-being of all life forms. In the context of climate change and global health, the protection of biodiversity acquires heightened ethical urgency. As the World Health Organization notes,

> Biodiversity provides many goods and services essential to life on earth. The management of natural resources can determine the baseline health status of a community. (...) Biodiversity supports human and societal needs, including food and nutrition security, energy, development of medicines and pharmaceuticals and freshwater, which together underpin good health. It also supports economic opportunities, and leisure activities that contribute to overall wellbeing" (World Health Organization, n.d.).

There are several compelling arguments for preserving biodiversity. First, it is critical for safeguarding the well-being of sentient animals: habitat destruction, pollution, and climate change cause not only

extinction but also widespread suffering. Second, biodiversity possesses *intrinsic value* and deserves protection regardless of its utility to humans.

However, this section focuses primarily on the normative claim that preserving biodiversity is essential for securing the basic rights of people and for enabling both human and nonhuman flourishing. As noted by the UN Special Rapporteur on Human Rights and the Environment, "the full enjoyment of human rights... depends on biodiversity," and its degradation directly undermines these rights (Knox, 2017, p. 3). Forest ecosystems, in particular, play a vital role in regulating the climate, storing carbon, and maintaining conditions for disease resilience. According to the World Health Organization, "land use change through deforestation is the leading driver of disease emergence in humans" (World Health Organization, n.d.). In Brazil, ongoing deforestation in the Amazon significantly contributes to greenhouse gas emissions while simultaneously increasing the risk of zoonotic disease spillovers, an alarming connection underscored by the IPCC in 2023. These dual threats highlight the convergence between environmental protection and public health imperatives.

The *convergence thesis* holds that what is good for human beings in the long term generally aligns with what is beneficial for the nonhuman world. Preserving forests and ecosystems not only supports biodiversity but also serves as a preventive strategy against emerging infectious diseases, water scarcity, and food insecurity, threats exacerbated by climate change. From an ethical standpoint, the duty to protect biodiversity entails a responsibility to avoid irreparable harm to critical components of the natural world. This includes preserving forests essential for carbon sequestration and disease buffering, as well as promoting sustainable land-use practices that protect soils, freshwater systems, marine habitats, and air quality. The urgency of such measures is especially pronounced in Brazil, where environmental degradation intersects with global responsibilities in addressing climate change.

The insights of the convergence thesis find institutional expression in the One Health approach, which underscores the systemic interdependencies between human, animal, and environmental health. While the convergence thesis offers an ethical rationale for aligning human and ecological well-being, the *One Health* framework operationalizes this alignment through coordinated, multisectoral strategies. According to the definition developed by the One Health High-Level Expert Panel – OHHLEP (WHO, 2021), *One Health* is "an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals, and ecosystems." To guide this approach, OHHLEP has articulated five key principles:

> 1. equity between sectors and disciplines;
>
> 2. socio-political and multicultural parity (the doctrine that all people are equal and deserve equal rights and opportunities) and inclusion and engagement of communities and marginalized voices;
>
> 3. socioecological equilibrium that seeks a harmonious balance between human–animal–environment interaction and acknowledging the importance of biodiversity, access to sufficient natural space and resources, and the intrinsic value of all living things within the ecosystem;
>
> 4. stewardship and the responsibility of humans to change behavior and adopt sustainable solutions that recognize the importance of animal welfare and the integrity of the whole ecosystem, thus securing the well-being of current and future generations; and
>
> 5. transdisciplinary and multisectoral collaboration, which includes all relevant disciplines, both modern and traditional forms of knowledge and a broad representative array of perspectives. (WHO, 2023)

As these principles make clear, the *One Health* framework reinforces the centrality of biodiversity, equitable access to natural resources, and recognition of the intrinsic value of all living beings. It calls for a socioecological equilibrium that respects ecosystem integrity and acknowledges the deep interdependencies that define life on Earth.

Embracing the *One Health* approach not only strengthens the ethical imperative to protect biodiversity (principle 3) but also provides a pragmatic and inclusive model for situating climate action within a broader ecological context, one that prioritizes the prevention of environmental degradation (principle 4), including deforestation. From this perspective, preserving biodiversity and halting deforestation in Brazil is not merely a national responsibility, but a matter of shared global concern. As climate change accelerates, Brazil's dual role as both a significant emitter and a vital ecological steward necessitates policies that are both ecologically informed and ethically grounded. This ethical and ecological framing sets the stage for a deeper examination of Brazil's deforestation crisis, its global implications, and the responsibilities it entails.

5 Assessing Brazil's ongoing deforestation crisis

Under the Paris Agreement (2015), Brazil pledged to reduce its greenhouse gas (GHG) emissions by 37% below 2005 levels by 2025 and by 43% by 2030, alongside the restoration of 12 million hectares of forest. These pledges, outlined in its Nationally Determined Contribution (NDC), were subsequently strengthened. Following the 26th Conference of the Parties (COP26) in Glasgow (October 2021), Brazil updated its NDC to aim for a 50% reduction in emissions by 2030 and to reach net-zero emissions by 2050, partly through forest restoration and biome recovery (Brasil, 2022). At COP29 in Baku, Azerbaijan (November 2024), Brazil announced a further revision, aiming for a 59–67% reduction in net GHG emissions by 2035 (Brasil, 2024). Despite these increasingly ambitious targets, deforestation and forest fires remain persistent and serious challenges.

During the Bolsonaro administration (2019–2022), deforestation surged due to weakened enforcement by IBAMA**4** and ICMBio**5**, coupled with diminished political support for environmental protection (Rajão *et al.,* 2020). Recent reports from the DETER-B and PRODES systems indicate a decrease in deforestation in the Amazon and the Cerrado as of July 2024 (INPE, 2024). According to the Climate Observatory, this reduction contributed to a 12% drop in Brazil's greenhouse gas emissions in 2023, even as global emissions rose by 1.3% (Pivetta, 2025).

Understanding the persistence of deforestation in Brazil requires addressing the structural drivers behind it. According to the 2024 Annual Deforestation Report (RAD, 2025, p. 76), over 97% of native vegetation loss in the past six years has been linked to agribusiness-related pressures. Chief among these are cattle ranching and large-scale soybean cultivation, which have severe impacts on biodiversity, land rights, and social equity. These activities drive extensive land-use change, threaten endemic species, undermine ecosystem resilience, and fuel socio-environmental conflicts.

Brazil's agribusiness sector, while economically significant, faces reputational and economic risks due to ongoing illegal deforestation. Since 2020, experts have warned that Brazil's inability to effectively address illegal deforestation endangers the future of its agribusiness sector (Rajão *et al.* 2020). This failure, combined with the continued importation and consumption of agricultural products linked to deforestation by international economic partners worsens GHG emissions. Foreign countries and

4 Brazilian Institute of Environment and Renewable Natural Resources (IBAMA).

5 Chico Mendes Institute for Biodiversity Conservation (ICMBio). This is an independent public body in Brazil, linked to the Ministry of Environment. Along with the IBAMA, it oversees the National Environmental System.

companies that purchase Brazilian goods such as soy and beef indirectly contribute to deforestation by failing to enforce stricter sustainability standards. By accepting products linked to deforestation, these international partners share responsibility for the environmental harm caused, making it a global issue rather than solely a Brazilian problem.

In September 2024, President Lula da Silva reaffirmed Brazil's commitment to halting deforestation during his speech at the United Nations. In his address, he made clear that Brazil is not only confronting the climate crisis but is also fighting against those who profit from environmental degradation. He emphasized, "We will not make compromises in our fight against environmental crimes, illegal mining, and organized crime" (Lula da Silva, 2024). This renewed commitment marks a significant shift from previous policies and offers hope for the future of Brazil's role in addressing the global climate crisis.

Reinforcing this shift in environmental governance, Brazil's Supreme Federal Court issued a landmark ruling in March 2025 (ADPF 743), mandating the expropriation of lands subject to illegal deforestation when the owner's responsibility is established (Supremo Tribunal Federal, 2025). The decision also obligates coordinated action from federal and state authorities to prevent the legal regularization of degraded lands. These legal and political developments indicate a growing alignment between executive and judicial efforts to enforce environmental protection and uphold Brazil's international climate commitments.

In this context, both the Polluter Pays Principle (PPP) and the Ability to Pay Principle (APP) are highly relevant when considered alongside the Principle of Biodiversity Protection. The PPP holds that those responsible for environmental harm—such as deforestation and the resulting greenhouse gas emissions—should bear the costs of mitigation or remediation. In this case, Brazilian agribusinesses involved in land clearing and forest burning would be accountable for the environmental consequences of their actions, including their contribution to global climate change.

In contrast, the APP maintains that those with greater financial capacity should assume a larger share of the costs of mitigation and adaptation, regardless of their historical or direct responsibility. This is particularly pertinent to wealthier nations and multinational corporations that, although not directly engaged in deforestation, profit from related trade and investments and possess the economic means to support remedial efforts. Under the APP, international trade partners and investors would have a duty to provide financial and technological assistance to promote sustainable development and halt deforestation in countries like Brazil.

Meanwhile, the Principle of Biodiversity Protection emphasizes the global ethical responsibility to preserve ecosystems and safeguard biodiversity. Given the Amazon rainforest's status as one of the world's most critical biodiversity hotspots, deforestation not only threatens local species and communities but also poses a significant risk to global ecological stability. Upholding this principle would require Brazil and its economic partners to prioritize conservation-oriented practices, including sustainable agriculture and the establishment of deforestation-free supply chains.

A hybrid approach that integrates the Principle of Biodiversity Protection with both the PPP and APP offers a more comprehensive framework for addressing deforestation. This approach ensures that those responsible for environmental degradation, those with the financial capacity to mitigate it, and those with a moral duty to protect biodiversity are all actively engaged in reducing deforestation and associated emissions. It reflects the interconnected nature of global environmental challenges and reinforces the notion of shared responsibility for protecting both the climate and ecosystems.

The Amazon rainforest, which spans Brazil, Colombia, Peru, and other South American countries, plays a critical role in regulating the planet's climate and supporting local livelihoods. As a major carbon sink and a vital buffer against climate change, its continued degradation could push the region toward a tipping point, triggering abrupt and potentially irreversible ecological shifts. As Lenton *et al.* (2019) warn: "Deforestation and climate change are destabilizing the Amazon. Estimates of where an Amazon tipping point could lie range from 40% deforestation to just 20% forest-cover loss." With approximately 17% of the forest already lost since 1970, urgent action is needed to reduce emissions and halt deforestation. Such efforts must also uphold the rights and territories of Indigenous peoples and ensure sustainable livelihoods for forest-dependent communities.

The health consequences of continued deforestation in the Amazon extend far beyond national borders. Habitat fragmentation and increased human-wildlife contact significantly raise the risk of zoonotic disease spillovers, as mentioned before, a concern recognized by the IPCC (2023) and central to the *One Health* approach. Outbreaks of diseases such as Zika, yellow fever, and potentially novel pathogens have been linked to changes in land use and ecosystem disruption in tropical regions. In Brazil, deforestation-driven encroachment into previously undisturbed areas accelerates these risks, particularly affecting forest-dependent communities and vulnerable populations. Moreover, forest fires release pollutants that degrade air quality and contribute to respiratory and cardiovascular illness. These public health impacts underscore the ethical imperative to protect biodiversity not only as a climate and ecological priority, but also as a vital dimension of global health security**.**

As the world's most biodiverse country, Brazil along with its regional neighbors, has a *prima facie* duty to pursue low-emission development pathways. Several studies and initiatives show that agricultural productivity can be maintained or even enhanced without further deforestation. One notable example is the Amazônia 4.0 Project, which aims to develop a sustainable bioeconomy in the Amazon by combining scientific and traditional knowledge to create value chains based on biodiversity (Nobre & Nobre, 2019). Nobre advocates for a "standing-forest, flowing-river" model that supports sustainable agriculture, forest products, and biotechnology, offering a viable alternative to environmentally destructive practices.

Another key strategy involves transitioning from intensive, high-emissions agriculture to more sustainable land-use models. This requires adopting practices that protect and restore forest ecosystems while promoting social and economic resilience. In this context, approaches such as agroforestry and regenerative agriculture**6** offer promising solutions. These methods help restore soil health, enhance biodiversity, and increase carbon sequestration, providing ecologically sound and socially equitable alternatives to conventional agriculture.

These examples demonstrate the feasibility of sustainable development without deforestation and point to practical pathways for reducing land-use emissions as Brazil moves toward a net-zero future. If countries like Brazil can achieve economic development without relying on high levels of fossil fuel use or forest loss, then pursuing environmentally harmful trajectories becomes ethically indefensible. However, realizing this potential will depend on strong political will, effective governance, and robust international cooperation.

6 While agroforestry and regenerative agriculture share certain principles, they also differ in important ways. Due to space limitations, these distinctions are not addressed here. For a critical discussion, see: (Tittonell *et al.*, 2022).

6 Conclusions

This article began by arguing that anthropogenic climate change threatens the enjoyment of fundamental human rights, most notably, the rights to life, health, and subsistence. It examined the principle of Common but Differentiated Responsibilities and Respective Capabilities (CBDR-RC), advocating for a more robust and inclusive interpretation—one that incorporates not only historical responsibility and current capacity to act but also an ethical obligation to halt biodiversity loss. This third dimension is crucial: biodiversity loss reduces ecosystem resilience and increases the risk of severe health impacts due to rising epidemics, particularly vector-borne diseases, as recognized by the IPCC in its 2023 report.

Building on this analysis, the article proposed a hybrid ethical model for assigning climate responsibilities, grounded in three pillars: the polluter pays principle (historical emissions), the ability to pay principle (present capacity), and a biodiversity protection principle, based on the need to reduce health risks linked to ecosystem degradation and deforestation. This model aims to support fairer and more effective responses to the climate crisis, particularly in countries like Brazil, where land-use change is the leading source of emissions.

This framework also reflects the convergence thesis, which emphasizes the normative alignment between human rights and environmental protection. It further aligns with the One Health approach, which underscores the interdependence of human, animal, and environmental health. From this perspective, halting deforestation is not only a measure for climate mitigation and biodiversity preservation. It is also a public health strategy essential to preventing future epidemics and pandemics.

By placing biodiversity protection at the heart of climate ethics and governance, this paper advances a more integrated vision of justice in a climate-constrained world. In the Brazilian context, this means acknowledging the country's dual role as both a major emitter due to deforestation and a vital steward of global biodiversity. A hybrid ethical model offers a coherent and practical framework for guiding national and international responsibilities in transforming agricultural, industrial, and land-use practices, not only to meet climate goals, but also to safeguard health and resilience for generations to come.

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Declaração de Disponibilidade de Dados:

Todo o conjunto de dados que dá suporte aos resultados deste estudo foi publicado no próprio artigo.

Submetido em 10 de junho de 2025.

Aceito em 03 de março de 2026.