

A Pluriversal Framework for Environmental Impact Assessment and Project-Level Decision-Making

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Abstract

The concept of sustainability emerged to address the socio-environmental challenges of a planet in crisis. While sustainability can be interpreted through numerous lenses, the definition prevailing in policies and programs remains predominantly market-driven, colonizing, oriented toward economic progress. This definition has shaped project development and decision-making processes with asymmetrical environmental and social outcomes. We argue that alternative understandings of sustainability - particularly those stemming from dissident and decolonial epistemologies - can ingrain the benefits and externalities of development. Drawing from Political Ecology and post-development theories, we propose a '*Pluriversal Framework*' to guide environmental decision-making in infrastructure projects. Our framework is based on four categories: I) Capital Non-Substitutability; II) Pluriversal Governance and the Right to Reject Projects; III) Pluriversal Knowledge; and IV) Biocultural indicators. As an environmental decision-making process, we discussed the institutions and epistemologies governing sustainability within Environmental Impact Assessment (EIA). It is evident that a market-oriented, economic growth-driven approach to sustainability dominates the Impact Assessment process. Conversely, emerging opportunities and experiences indicate the rise of dissident approaches in infrastructure projects decision-making. Our analysis suggests that while a purely decolonial approach is unlikely to manifest within EIA, discussing insights from Political Ecology is fundamental to contesting the epistemological arena of EIA and preventing the complete co-optation of the environmental project-level decision-making process by a purely market-based logic.

1 Introduction

Sustainability has emerged as a central pillar in contemporary discussions (Mensah 2019). Predominantly, practitioners and policymakers have adopted the term 'sustainability' in connotation with prosperity and balance among economic, social, and ecological systems to ensure human development (Milne and Gray 2013; Mensah and Enu-Kwesi 2018; Mensah 2019), further considering the generational aspect (Mensah and Enu-Kwesi 2018).

When coupled with the term 'development', the idea of sustainable development has firmly established itself as a long-term socioeconomic and environmental paradigm (Mensah 2019). Famously defined in the 1987 Brundtland Report ('Our Common Future') as development that 'meets the needs of the present without compromising the ability of future generations to meet their own needs' (World Commission on Environment and Development 1987, p. 43), the concept of sustainable development has guided numerous national and international analytical frameworks for the assessments of policies, plans and programs. For example, it is the central conceptual basis behind the United Nations' Sustainable Development Goals (SDGs), a universal call to action for economic growth, social equity, and environmental protection for all by 2030.

Despite the three-pillar model - a historically contingent discursive arrangement, that emerges from the attempt to reconcile social and ecological critiques of economic growth popularity and recognition - the hegemonic rhetoric surrounding the terms 'sustainability' and 'sustainable development' proves to be

permeated with contradictions and gaps (Vogt and Weber 2019). Its conceptual ambiguity, far from being an accidental limitation, is precisely what allows its wide diffusion and institutional acceptance, at the cost of obscuring fundamental conflicts and underlying power relations.

This sustainability 'indefiniteness' creates repercussions for project-level design and decision-making, particularly for development projects - such as ports, roads, mining and dams. Especially in the Global South, where the prevailing logic dictates that energy and infrastructure projects must advance national progress (Moretto et al. 2012), the sustainability discourse guides damage reduction efforts, seldom challenging the feasibility and actual necessity of the undertaking itself.

Tools for environmental planning and management that operate at the project level - notably the Environmental Impact Assessment (EIA) and Environmental Permitting and Approval Systems - exist to attest to the socio-environmental feasibility of projects (Sánchez 2020). However, these tools paradoxically incorporate the discursive elements of dominant sustainability and sustainable development approaches, instead of questioning the socioenvironmental gaps underlying the development model (Bond et al. 2020). In other words, beyond its technical function, EIA operates as a key mechanism through which dominant understandings of sustainability are translated into project-level decision-making.

Drawing from this context, this manuscript aims to critically analyze the approach to sustainability in theory and practice of development project decision-making, using the conceptual framework and implementation background of Environmental Impact Assessment (EIA) process as the focus of analysis. We used a Political Ecology lens - moving from a systemic worldview to the project level - to debate the sustainability paradigm that orientates EIA. Navigating through multiple worldviews and alternatives to development, we argue that there is a pluriverse of opportunities (Demaria et al. 2023) within the EIA field to improve different sustainability narratives in decision-making arenas.

The paper is structured in four sections, beginning with this (1) introduction. The next section (2) characterizes the predominant sustainability Environmental Impact Assessment practice and introduces different perspectives on sustainability, built upon post-development theories and political ecology. In the (3) third section, we propose the "Pluriversal Framework" to discuss project-level environmental decision-making processes, considering aspects such as capital non-substitutability, governance, traditional knowledge and biocultural indicators. Finally, in the (4) concluding remarks, we present challenges, reflections, and future perspectives for environmental management and EIA based on discussions throughout the manuscript.

2 Sustainability trends in project-level decision-making and Environmental Impact Assessment: from critique to alternative ontologies

2.1 Conceptual aspects

Environmental Impact Assessment (EIA) emerged as a tool for environmental protection in the United States (NEPA 1969) in the context of the National Environmental Policy Act (NEPA). This regulation defined EIA as a process of identifying and predicting future impacts of proposed development projects on human health, well-being, society, economy, and environment (Glasson et al. 2013; Sánchez 2020).

Since EIA's first regulation in the US (NEPA 1969; Sánchez 2020), the concept and practice have expanded to more than one hundred countries over approximately thirty years (Petts 1999). As the EIA practice spread worldwide, not all countries incorporated environmental planning and management tools into their legislation. The World Bank filled this gap by instituting a policy that mandated impact assessment procedures for financing large-scale projects in developing countries. Other financial institutions were encouraged to adopt similar policies. This trend resulted in the Equator Principles, which required EIA for financial institutions' decision-making regarding project financing (Morgan 2012).

As financial institutions act on defining environmental standards and management processes for project development, the understanding of sustainability oriented to balance economic growth and socio-environmental concerns came to be a central part in environmental studies and mitigation measures (Silvius and Schipper 2014). So that, EIA began to operate as a tool for guiding project-level decision-making based on a sustainable development understanding which advocates for economic growth aligned with 'green' technological advancements to reduce environmental impacts (van Staden and Retief 2022; Glasson et al. 2013; Oliveira et al. 2009). From this perspective, projects convey sustainability through energy efficiency, adaptation, and the reduction of carbon emissions (International Finance Corporation 2012).

Usually, the sustainability of such projects is certified through a systematic and pre-established decision-making process and emission of an environmental permit (Sánchez 2020). In the common sense, the acquisition of an environmental permission indicates the project is environmentally feasible and contributes to sustainable development (Fent 2020) because the decision-makers impose a series of socio environmental mitigation and compensation requirements to guarantee the environmental, social and economic quality (Fonseca and Gibson 2021; Collard et al. 2020; Sánchez 2020). Consequently, EIA became widely recognized as a means of promoting sustainable development, mainly because it addresses the social, environmental, and economic aspects of development projects (Glasson et al. 2013), informs decision-making (Rozema et al. 2012), and proposes mitigation measures to reduce or compensate significant impacts (Bond et al. 2020).

This sustainability conceptual approach, frequently addressed to EIA, allows us to classify projects that ensure economic growth as 'sustainable', provided they incorporate technical solutions to address risks and impacts (Heryadi and Hartono 2016), i. e. it gives the impression that it is possible to couple economic growth with environmental protection by articulating the environmentally damaging development trade-offs among different types of capital (social, economic, and natural) (Bond et al. 2020; Tulloch and Neilson 2014). However, Hickel (2015) and Oliveira et al. (2009) indicate that substituting natural capital with human-made capital is limited or unfeasible, particularly due to the irreplaceable role of natural resources in sustaining life-support systems. Furthermore, the current replacement of natural

resources with renewable or artificial alternatives often entails lasting negative impacts, compromising intergenerational justice (Hickel 2015).

From this conceptual divergence, Fent (2020) attests that in this sustainability approach, EIA rhetorically and discursively adopts economic, capitalist, and liberal perspectives to evaluate and commodify nature (Wanner 2015). Additionally, Bond et al. (2020) criticize this epistemology, arguing that, in this view, EIA represents much more a support mechanism for a neoliberal economic agenda and a policy that facilitates economic growth, than a tool for assessing the socio-economic and environmental impacts of a project to support the analysis of alternatives and fair socio-environmental decision-making.

To address the contradictions of sustainability in this manuscript, we frame EIA as a contested epistemological arena. On the one hand, we suggest the hegemony of the traditional sustainability concept, grounded in 'green technologies' and the principle of capital substitutability (Oliveira et al. 2009). This perspective remains strong in EIA as it reconciles large-scale development projects with nature conservation, primarily in the impact mitigation and compensation stages. On the other hand, this approach reveals significant asymmetries within the contested arena: traditional communities and affected populations, whose socio-cultural dynamics are often deeply intertwined with biophysical cycles, find their notions of sustainability systematically invisibilized in deliberative processes.

2.2 Implementation issues

The dominance of the 'mainstream' sustainability approach has direct implications for EIA practice and implementation, particularly regarding how the mitigation hierarchy premises are addressed. Ideally, the mitigation hierarchy is a fundamental guiding principle for EIA (Wood 2002; Lawrence 2003). The mitigation hierarchy is structured around four main criteria, ordered as follows: avoidance, followed by minimization, restoration, and lastly, compensation, with the additional possibility of enhancing positive impacts (Council on Environmental Quality 1997). In the practical sphere of project development, the 'avoidance' step is frequently subverted (Wood 2002; Jacob et al. 2016; Larsen et al. 2018; Phalan et al. 2018). For instance, the discussion of technical and locational alternatives - which should be the core of the process - rarely addresses genuinely feasible possibilities, serving primarily to legitimize and validate the proponent's predetermined alternative (Benson, 2003). This methodological drift pushes impact management toward the final stages of the mitigation hierarchy (Moretto et al. 2021). Consequently, these gaps culminate in an overemphasis on the compensation process. Considering this inverted mitigation hierarchy, compensation solidifies the commodification of nature, as it treats the loss of ecosystems and their associated social-ecological values as quantifiable and exchangeable assets (Kiesecker et al. 2010). Reinert (2018) contends that compensation processes facilitate socio-environmental sacrifice under the promise of gains in another form - a 'gift' or 'payment', usually financial - thereby perpetuating colonial models of extractivism and territorial injustice.

Additionally, a set of several cases demonstrates that the EIA implementation doesn't mean sustainability is achieved for all stakeholders or the effective implementation of mitigation and compensation measures (Fearnside 2014; Mayer et al. 2022). For example, in Pará (Brazil), although EIA and

environmental permit approval for Belo Monte hydropower dam, Indigenous populations reported experiencing and feeling impacts in different ways and multiple scales, as the EIA did not incorporate the communities' understandings and their biocultural relationships with the territory (Utsunomiya et al. 2024). In Jirau and Santo Antônio hydropower dams (Rondônia, Brazil), the EIA process only considered fishermen registered with the fishermen's association for financial compensation, which means that many fishers that regularly practiced professional fishing were not registered with the association, facing conflicts to access the compensation (Doria et al. 2018).

In political and institutional terms, the Brazil's General Environmental Permitting and Approval System (Federal Law No. 15,190/2025), enacted in 2025 (Brazil 2025), demonstrates how the decision-making arena is heavily co-opted by vague interpretations of sustainability, creating loopholes that allow economic interests to prevail even within legislation intended for socio-environmental protection. In Brazil, EIA was implemented alongside the Environmental Permitting and Approval System starting in the 1980s. Despite numerous procedural criticisms (Zhourri 2011; Fearnside 2014, 2015; Sánchez 2020; Alves et al. 2020; Fonseca and Gibson 2021; Moretto et al. 2021; Athayde et al. 2022), this set of instruments was responsible for overcoming the tragic legacies of large-scale polluting projects within the national territory and ensuring compensation for affected populations (ABAI 2025). However, since the 2000s, a new legislative path has been debated in the Brazilian Congress regarding EIA and Environmental Permitting, under the premise of streamlining decision-making. In 2025, under heavy pressure from the Parliamentary Agricultural Front and the National Confederation of Industry, the General Environmental Permitting and Approval System (2,159/2021) - popularly dubbed the 'Devastation Law' - was enacted, significantly simplifying the institutions that guide EIA and Environmental Permitting and Approval System. Notably, new permitting modalities replaced prior detailed analysis with self-declarations and flexible rites for issuing environmental permits. While this manuscript does not intend to provide an exhaustive critical analysis of the 'Devastation Law', we point out that the new legislation infringes upon the rights of Indigenous Peoples, Quilombolas, and traditional communities potentially affected by major infrastructure projects. Furthermore, it represents a setback in the protection of biomes and livelihoods, favoring the interests of a conservative economic elite that is retrogressive from a socio-environmental perspective; it means the complete co-optation of the EIA arena by the dominant sustainability epistemology - a certain environmental concern coupled with the guarantee of economic gains (Oliveira et al. 2009).

From theory to practice, the colonial and neoliberal institutions that affect governance, participation and sustainability on EIA (Castillo and Silva 2020; García-Lopez and McCormick-Rivera 2024) has strongly tensioned the decision-making arena and led to many gaps on the process, such as poor quality environmental studies, underestimation of impacts (Enríquez-de-Salamanca 2024), inefficient and ineffective participatory events (Alves et al. 2020; Morrison-Saunders and Early 2008), contradictory environmental compensations (Walker 2010), and the increase of socio-environmental conflicts (Kakonge 1998). Given this context, we argue that resisting the dominant sustainability within the EIA arena requires generating tensions that prevent the complete co-optation of the instrument and its institutions by the colonizing, discretionary logic of economic progress. We propose that contesting the epistemological

definition of sustainability - which predominantly guides both EIA process and environmental decision-making - is a vital way to exert this pressure.

2.3 Alternative pathways

Overcoming the dominant rhetoric requires developing alternative epistemological paths. We believe that Political Ecology and Post-Development Theories provide a great foundation for these paths.

Political Ecology emerges in response to the environmental crisis. Born at the intersection of human geography, cultural ecology, and ethnobiology, it became a new field of inquiry in the 1960s and 1970s (Leff 2021). The discipline challenges the dichotomy between nature and society, the universality of reason, and the neutrality of Western science (Paulson 2017, 2024). By doing so, it exposes how environmental governance is shaped by power relations and unequal control over resources (Paulson 2024; Acosta 2016).

Post-development theories emerge as an economic critique of the 'cult of growth for growth's sake' and the relentless pursuit of profit (Azam 2019, p. 70). Post-development is not a single approach, but a political-epistemological project that translates the ecological critique into a search for alternatives, including practices from ecovillages, traditional communities, Indigenous Peoples, and local communities that offer alternative understanding of sustainability. Degrowth, Decoloniality and Buen Vivir are key approaches to post-development theory, which converge by calling for a radical shift away from Western-centric modernization, and seek for diverse, locally defined ideas of well-being and social-ecological justice over economic metrics (Hickel 2015; Acosta 2016).

Degrowth brings together various actors, including activists, scientists, and practitioners, around a diversity of strategies, ranging from oppositional activism to the development of alternatives and policy proposals. Rather than simply reducing economic activity, Degrowth strategies include proposals for limits and alternative models for private property, a globally decreasing cap on carbon emissions, discussions about restrictions on the extraction of natural resources, and suggestions for the redistribution of work and the institution of a basic income not tied to paid labor (Healy et al. 2015).

Decoloniality considers historical and ongoing effects of colonial power in structuring development, questioning Western epistemologies and universal concepts of progress. Inspired by Latin American thinkers such as Aníbal Quijano, Arturo Escobar, Catherine Walsh, and Walter Dignolo, decolonial ecology works to deconstruct the power, knowledge, and being inherited from colonial modernity (Ferdinand 2022). Santos (2007) reinforces this perspective by arguing that the necessary change to achieve an 'other globalization' would necessarily come from underdeveloped countries, as they realize they have become 'increasingly fragile partners in this unequal game' (Santos 2007, p. 172), making cooperation for these nations a factor that increases and reinforces their dependence on the system. In this way, decoloniality looks to the Global South for solutions. Silva (2024) points out that some 'progressive' ideas in these countries are based on the existence of 'communitarian social and cultural traits' (Silva 2024, p. 39) that survived the colonial process. These ideas do not represent a passive return to the past, but rather an active search for elements from it to build an alternative future (Silva 2024).

Buen Vivir is rooted in indigenous knowledge, being a ‘task of (re)construction’ (Acosta 2016, p. 81) that offers a more complex and diverse vision. Its essence lies in overcoming the traditional concept of development and deconstructing the notion of progress as a single, linear path (Acosta 2016), but dialogue also with various other global voices and movements, such as ecologists, feminists, marxists, cooperativists, and humanists, who also question the logic of unlimited growth. It emerges as one of the most prominent alternatives for sustainability and expresses a set of ideas and practices from Andean peoples which, despite the pressure of contemporary developmentalism, continue to resist (Solón 2019).

One of the driving forces of Buen Vivir is its continuous struggle for decolonization, promoting self-management and self-determination. In this *pacha* centric worldview, the goal is not to control nature but to care for it, with the understanding that everything is interconnected. Time and space are seen as cyclical and nonlinear, which makes the notion of infinite progress incompatible, and the pursuit of balance is the central objective. Buen Vivir is also based on multipolarity, which recognizes the duality in all things and understands that ‘the individual and the community are poles of the same unit, and a person only exists by acting for the common good of the community to which they belong’ (Solón 2019, p. 26). The path, therefore, is the complementarity of diversity, where multiple alternatives combine instead of competing with each other, which would otherwise imbalance the whole.

We understand that these theories and approaches provide a pluriverse of opportunities to transform EIA, by 1) challenging the expected economic-growth-oriented outcomes, 2) valuing human-nature relationships from non-economic metrics, and 3) evidencing power imbalances between the stakeholders in infrastructure development. To explore the opportunities and challenges of a pluriversal approach, below we discuss aspects from political ecology and post-development theories that can transform traditional sustainability frameworks applied to EIA.

3 Thinking about practical applications: a Pluriversal Framework to Environmental Impact Assessment and Project-Level Decision-Making

Drawing from Political Ecology (Escobar, 2005) and post-development theories (Acosta 2016; Solón 2019; Ferdinand 2022; Hickel 2015), we believe that the idea of progress and the paradigm of unlimited growth imbricated in environmental decision-making and EIA concept and practice can be replaced by a guiding principle linked to natural metabolic cycles and rhythms. This new perspective incorporates concepts, methodologies, and epistemologies derived from decolonial post-developmental approaches, which elucidates different relational forms between human beings and nature, shifting the focus from the Global North to the experiences, knowledge systems, and cosmologies of the Global South (Acosta 2016; Krenak 2022). By integrating the voices of peoples and traditional communities - who directly resist the ‘sustainable’ extractivist model (Mandai et al. 2025) - it becomes possible to build (not-so) new sustainability approaches based on environmental justice, knowledge plurality, and overcoming the modern separation between nature and society. In this view, sustainability represents a safeguard for the social, ecological, and economic stability of spaces for human life (Vogt and Weber 2019). Consequently,

this sustainability approach exerts strategic tensions within environmental decision-making arenas, thereby challenging the hegemony of dominant perspectives and actively contesting their epistemological space.

Building on the critiques discussed above and alternative perspectives from latin american political ecology and post-development theories, we will henceforth refer to the set of ideas, when applied to EIA, as our *Pluriversal Framework*. First, we adopted this term because, from a decolonial perspective, it seeks voices and worldviews from the Global South to deconstruct the Western-based system of infinite growth, and incorporate ideas from multiple knowledge systems and livelihoods that are not fully based on capital accumulation. The approaches of Degrowth, Decoloniality, and Buen Vivir, stemming from Political Ecology and Post-Development Theories, reunite important frameworks, and offer a radical critique of the traditional development model. At the same time, they also point to practical paths for change.

Second, we decided to avoid using the term 'sustainability' in our framework, because the concept inevitably links to the maintenance of something which is the core of our critique. The 'Pluriverse' reference (Escobar 2005; Kothari et al. 2019) implicates in the multiple possibilities and transformations that can emerge from new perspectives and worldviews.

Third, we recognize that incorporating such perspectives into the management and planning of infrastructure projects presents a complex challenge, as 1) the prevailing socioeconomic paradigm is rooted in the pursuit of infinite growth and wealth accumulation (Nowlin 2017); and 2) infrastructure projects are deeply embedded in this growth-oriented narrative (Palei 2015; Moran 2016). However, as Santos (2007) suggests, the seeds of the new can impose themselves almost imperceptibly, even when the 'old' is still dominant. Transformation, therefore, does not require the total overcoming of capitalism as a prerequisite. Instead, the emphasis is on building production and cooperation relationships based on sufficiency and solidarity, in opposition to the mere efficiency of the traditional system (Acosta 2016). In this sense, we envision new perspectives for the tools that attest to (or reject) the socio-environmental feasibility of infrastructure projects - the EIA and Environmental Permitting and Approval Systems.

While acknowledging this challenge, we seek to present opportunities and insights to project development that can guide environmental decision-making at the project level. We believe that the Pluriversal Framework introduces premises that exert a necessary tension within environmental decision-making. This tension is fundamental to ensuring that disputes are not entirely co-opted by a technocratic and reductionist sustainability approach, dominated by the interests of political and economic elites. Despite the practical limitations highlighted in the scientific literature, we believe that post-development theories provide the theoretical foundations and perspectives for constructing methodologies that adopt social and environmental justice approaches, which can be widely applied to the planning and management of infrastructure projects. Thus, to ensure a Pluriversal Framework, we propose the following categories that challenge the dominant conception of sustainability in environmental decision-making, particularly within EIA processes (Table 1). We contend that by reflecting on these categories within decision-making processes, project development, and EIA itself, different outcomes can be

achieved in terms of socio-environmental justice, governance, and the preservation of social-ecological systems.

Table 1
Pluriversal Framework to Environmental Impact Assessment and project-level decision-making.

Category	Why?	References
Capital Non-Substitutability	Traditionally, there is a belief that technology can address the world's environmental degradation and resource scarcity by enabling the substitution of natural capital with human-made capital. Stemming from Decolonial Ecology and Degrowth ideas, the natural capital can't be fully replaced by human-made capital. In this perspective, Nature addresses complex social-ecological supporting processes and deeply embedded cultural values that technology hardly can replace.	Lawn (2004); Oliveira et al. (2009); Roquetti; et al. (2016); Hickel (2015); Ferdinand (2022).
Pluriversal Governance and the Right to Reject Projects	Decision-making regarding large projects of national interest is typically centralized in State, often influenced by political and economic interests. Political Ecology addresses that decision-making power must be equitably distributed, which means that the role of the State and entrepreneurs must be revised, and affected communities, particularly those directly impacted by such infrastructure projects, must exercise greater agency and self-determination over decision-making processes. This means to ensure that those territories and livelihoods can effectively shape the trajectories of regional development.	Moretto et al. (2021); Chaffin et al. (2014); Oliveira et al. (2009); Hanna & Vanclay (2013).
Pluriversal Knowledge	Impact assessment requires knowledge from different sources. Although combining scientific and traditional knowledge is a challenge, this integration provides tools to address social-ecological complexity, and present an inclusive approach for environmental management. Additionally, projects, technologies and solutions must be context-appropriate, autonomous, and strengthen community resilience, rather than relying on external high-tech fixes; they must recognize and respect non-Western cosmologies and traditional knowledge systems.	Mantyka-Pringle et al. (2017); Brook & McLachlan (2008); Stevenson (1996)
Biocultural Indicators	Project development must be oriented toward fulfilling fundamental human needs, rather than serving the demands of capital. In this sense, impact significance, thresholds, and follow-up criteria should consider alternative indicators, centered on local autonomy, social security, distributive justice, and the maintenance of traditional livelihoods.	Hickel (2015); Kallis et al. (2020); Acosta (2016); Sterling et al. (2017); De Roy et al. (2019); Utsunomiya et al. (2025)

Drawing from practical examples - such as the development of consultation protocols (Hanna and Vanclay 2013), decision-making processes led by indigenous communities (Nishima-Miller and Hanna 2022), and the incorporation of traditional ecological knowledge into projects, plans, and programs (Bojórquez-Tapia et al. 2025) - we envision possible pathways for just and inclusive processes, with a particular emphasis on EIA.

The Pluriversal Framework challenges the dominant logic by offering distinct perspectives on the relationship between humans and nature. Practical experiences and theoretical debates within the EIA field show promising results in this regard, particularly by subverting the extractive logic of economic progress. These approaches propose procedures and institutions that prioritize self-determination, quality of life, and environmental preservation. Below, we discuss how each element of our framework manifests within EIA and how these elements can be further strengthened.

3.1 Capital Non-Substitutability

Regarding capital substitutability, Oliveira et al. (2009) points out that the prevailing sustainability logic in EIA often assumes that unavoidable and non-mitigable impacts will be offset by financial or compensatory measures. Since major projects subject to EIA cause irreparable damage to natural, symbolic, and cultural capital, subverting this logic of substitutability requires rearticulating or even blocking such projects to uphold territorial integrity and ecological limits. According to Roquetti et al. (2016), prevention is the primary mechanism regulating capital substitutability, as 'only prevention has the potential to really change a project's overall conception and so to influence the production function that generates projects impacts' (Roquetti et al., 2016, p. 35). Thus, one way to enhance a Pluriversal Framework in EIA is by prioritizing prevention mechanisms, such as the rigorous discussion of alternatives and risk management. In the case of alternative assessments, prevention can occur in the early stages of a project's planning process; specifically, comparative evaluations of project alternatives can lead to a significant reduction in negative impacts or even their total avoidance (Roquetti et al., 2016).

3.2 Pluriversal Governance and the Right to Reject Projects

Regarding governance, Chaffin et al. (2014) propose that hierarchical and monopolized decision-making over complex social-ecological challenges has been strongly criticized in favor of a non-linear and more participative governance. In this sense, Moretto et al. (2021) argue for expanding the polycentric scope of decision-making in EIA. This involves shifting decision-making from a state-centered axis toward a multilevel governance structure, increasing participatory spaces, and broadening the distribution of power among affected stakeholders. A multilevel governance framework challenges state-led centralized decision-making, which often ignores pre-existing social-ecological management systems, local knowledge systems, and established traditional livelihoods (Moretto et al. 2021). Consequently, we believe that developing polycentric structures in EIA can ensure participative and collective governance by validating affected stakeholders as legitimate decision-making bodies. This approach enhances the capacity of impact management mechanisms to address emerging complex environmental challenges, increases social-ecological resilience, and manage resource access conflicts.

To ensure decision-making capacity across multiple levels, Hanna and Vanclay (2013) emphasize the importance of the right to Free, Prior, and Informed Consent (FPIC) for potentially affected populations, particularly Indigenous Peoples. The authors recommend that project proponents and the State endorse and respect the right to self-determination - including the decision of not implementing the project - even when not mandated by national or local legislation. In this sense, Indigenous-led impact assessments

have proven to be an important tool for guaranteeing power and agency to Indigenous Peoples affected by infrastructure projects, as Indigenous Governing Bodies determine the assessed impacts and analyze them based on their own values, concerns, and priorities (Nishima-Miller and Hanna 2022).

3.3 Pluriversal Knowledge

When EIA practice relies on single-lens perspectives to understand and manage highly contested issues, it can easily spark or exacerbate conflicts, ultimately undermining the management of complex systems (Kløcker-Larsen and Nilsson 2017). From this perspective, we believe that combining traditional ecological knowledge (TEK) with scientific knowledge can contribute to efficient socio-environmental management systems.

We recognize that this link represents a challenge. However, bridging different knowledge systems to assess impacts can promote the understanding of social-ecological complexity and uncertainty. While scientific methods provide biological numerical models and projections, TEK incorporates local knowledge about species, climate, environmental characteristics, and shared life histories, acquired through livelihoods and passed down from generation to generation (Brook and McLachlan 2008). Institutions, codes, norms, rules, and local decision-making processes embed this knowledge is fundamental to building legitim regional development (Oviedo and Bursztyn 2016).

Aligned with Mantyka-Pringle et al. (2017), we believe in the need to move away from the idea that scientific knowledge is inherently superior, overcoming the value of traditional knowledge. Stevenson (1996) highlights three main contributions of TEK to EIA and other socio-environmental management processes: I) TEK allows for documenting community concerns and the reasons for these concerns regarding the environmental, social, and economic impacts of a proposal; II) TEK guides mitigation measures to address the concerns of the communities in the affected region and seeks alignment with legal regulations; III) TEK promotes the inclusion of communities and incorporates their knowledge into ongoing impact monitoring and management efforts. For our Pluriversal Framework to assert its epistemological space within EIA, the instrument must recognize the plurality of knowledge as its intercultural differences - acknowledging the TEK is not homogenous. It must also subvert approaches that shape and condition TEK to the needs and interests of the dominant culture. In other words, EIA must move away from using TEK merely to fill gaps left by industry, government, and conventional scientific models (Stevenson 1996).

In summary, the growing shift from a hierarchical management of social-ecological systems to a more democratic adaptive co-management approach brings to EIA the need to consider different types of knowledge to foster collaborative innovation to deal with socio-environmental issues (Mantyka-Pringle et al. 2017).

3.4 Biocultural Metrics and Indicators

Biocultural metrics and indicators imply establishing criteria in EIA that addresses social-ecological sustainability in the long term, not solely focusing on wealth generation. Like DeRoy et al. (2019), we

argue that many landscapes - especially those where Indigenous Peoples assert sovereignty and governance over natural resources - cannot be assessed solely through functional ecology or economic metrics. These metrics fail to capture the fundamental values and relationships between the natural world and sociocultural construction. Therefore, aligned with DeRoy et al. (2019), we propose adopting biocultural indicators based on human-nature relationships to evaluate the success of monitoring and environmental management projects, particularly during the EIA follow-up phase (Moretto et al. 2021). Biocultural indicators can provide a foundation for understanding and communicating values and priorities that promote the ecological, cultural, economic, and social resilience of communities potentially affected by a project (Sterling et al. 2017).

Despite the complexity of methods for defining biocultural indicators (Sterling et al. 2017), DeRoy et al. (2019) propose six guiding criteria for their construction: culturally salient, supportive of place-based relationships, inclusive, sensitive to impacts, perceptible, and linked to human well-being. We argue that these criteria can help overcome the strictly technocratic perspective of EIA in addressing and managing impacts. A biocultural approach shifts the focus of monitoring and compensation mechanisms from a mere 'loss counting and reparation' exercise toward a robust social-ecological governance tool (Moretto et al. 2021). Consequently, impacts that are immeasurable from a marketing-oriented viewpoint - such as spirituality, social cohesion, and well-being - can be addressed, ensuring the integrity of social-ecological relationships and the resilience of social-ecological systems. Additionally, reframing the market-based view into a biocultural perspective on decision-making processes acknowledges that certain territories and communities are 'non-sacrificable'. Consequently, EIA process would ensure that ecological thresholds and the biocultural integrity of traditional populations are treated as absolute constraints rather than negotiable variables.

A significant case demonstrating the importance of adopting biocultural indicators to address impacts and subvert the logic of financial and ecological offsets in the EIA is the 'Piracema Hydrograph' (in Portuguese, 'Hidrograma de Piracema'), proposed by the Monitoramento Ambiental Territorial Independente da Volta Grande do Xingu (MATI-VGX) regarding the operation of the Belo Monte Hydropower Plan (Pará, Brazil). This initiative challenges conventional mitigation strategies (Utsunomiya et al. 2025). Belo Monte operates through a diversion canal that redirects the Xingu River's flow to an intermediate reservoir, imposing a reduced and controlled discharge on the river's original stretch, known as the Volta Grande do Xingu. During the Environmental Permitting and Approval process, a hydrological scheme of minimum monthly flows was established to supposedly ensure an 'ecological flow' and reconcile energy generation with the maintenance of ecological processes (MATI-VGX, 2025). However, severe impacts on local livelihoods and the environment revealed that these predefined hydrological values were insufficient to maintain social-ecological systems, prioritizing energy generation over ecosystem sustainability (Utsunomiya et al. 2025). In response, MATI-VGX (2025) and Utsunomiya et al. (2025) proposed practical biocultural metrics for impact monitoring and management. For instance, based on monitoring fish access to flooded forests (in Portuguese, 'igapós'), they suggest specific criteria for defining hydrological discharge in the Volta Grande do Xingu territory. If the water fails to reach certain areas during critical periods, fish life cycles and community food security are disrupted. From a

biocultural perspective, this indicator directly links hydrology to the traditional livelihoods in the Volta Grande do Xingu (Utsunomiya et al. 2025).

4 Concluding remarks

Our manuscript demonstrates that the prevailing vision of sustainability in EIA is primarily market-driven and oriented toward economic progress. In this context, projects are deemed viable through socioeconomic lens, and environmental impacts are typically offset based on the logic of capital substitutability. These contradictions are reflected in many sustainability practices. Instead of fostering deep structural changes in patterns of nature appropriation, consumption, and wealth distribution, they actually legitimize and perpetuate the dominant and colonial model of exploitation - North over South; Male over Female; Human over Nature. That is, 'mainstream' sustainability and sustainable development concepts fail to challenge contemporaneous paradigms, such as infinite economic growth, exacerbated accumulation, environmental injustices and the substitutability of capitals on a planet with finite resources. Instead, they rely excessively on technological innovation and 'green' production to address emergent social-ecological challenges. This paradigm is legitimized by a discourse of sociotechnological transition that obscures issues of power asymmetry and technocratization, while reinforcing unequal benefit distribution, typically privileging those who control decision-making over access to and gains from these innovations.

By applying a Pluriversal Framework to the theoretical and practical background of EIA, we identified opportunities to curb the advancement and total co-optation of the instrument by the logic of economic power. Generating tensions informed by our Pluriversal Framework within EIA implies shifting the axis of power from economic dominance over environmental decision-making toward the centrality of life and territories. Recognizing that economic progress is not an absolute end becomes a practical ideal for dissident epistemologies to occupy spaces within the Environmental Permitting and Approval areas.

Despite the opportunities offered by our Pluriversal Framework, we recognize the numerous practical and theoretical challenges to its adoption within EIA processes. First, we acknowledge that EIA, as a capitalist state-institutionalized tool, is unlikely to adopt a fully decolonial perspective. After all, it is intrinsically tied to a market-driven logic associated with facilitating infrastructure projects that inevitably impact the natural environment. At the same time, we argue that over the decades, civil society and affected groups have learned to 'play the game' of environmental permitting and approval systems. They have sought to internalize social-ecological elements and immaterial dimensions within decision-making - elements that originally find no place in the technocratic and discretionary spectrum of EIA. Thus, we believe that advancing the principles of Pluriversal Framework exerts vital pressure on the decision-making system. In other words, it tensions and politicizes the decision-making arena, transforming a strictly technical process into an epistemological dispute that challenges the dominance of capital and provides opportunities for recognizing alternative ways of coexisting and inhabiting the natural world.

Second, we acknowledge that the human need for energy and other utilities is unlikely to be abandoned. Thus, we propose a Pluriversal Framework that does not represent a negation or hindrance to 'progress'.

Rather, it is an approach that promotes a just energy and technological transition. Energy and technological planning, therefore, should favor decentralized, small-scale alternatives that promote self-sufficiency and local well-being ('Buen Vivir'), in contrast to mega-structures aimed at export or global market valuation. Consequently, we believe that the Pluriversal Framework can be applied at scales beyond the project level, such as in programs and policies. This offers potential for reflecting on alternatives to dominant sustainable development within instruments such as Strategic Environmental Assessment (SEA) and Cumulative Impact Assessment (CIA).

Third, we understand that sustainability involves diverse interpretations of the trade-off relationship. A 'win-win' situation is unlikely to materialize within the EIA arena. Therefore, we argue that a Pluriversal Framework in EIA represents a struggle for the epistemological space of decision-making. At the very least, it seeks a fair and equitable distribution of the costs and benefits of development, considering socio-historical contexts of marginalization and the colonial exploitation of both ecosystems and human groups.

Ultimately, the greatest provocation lies in the risk that this decolonial approach - much like the traditional sustainability framework - could be appropriated and redirected by the dominant system. This risk can only be addressed by understanding the non-negotiable connection between decolonial epistemology and practice, coupled with the concrete resistance and advocacy of social movements. We seek to defend a plural epistemology that prevents the co-optation, hollowing out, and creation of new market niches for this sustainability approach. To this end, we argue for a transformation of the social imaginary and contemporary human priorities; we believe in changing the 'collective dream'.

Declarations

Declaration of AI use

We applied Gemini 3.8 Live for translating the text to English and for language refinement. No generative AI was used to produce, conceptualize, or draft the intellectual content of this manuscript.

Author Contribution

G P A: Conceptualization; Methodology; Formal analysis and investigation; Writing - original draft preparation; Writing - review and editing; Supervision. T B C: Conceptualization; Methodology; Formal analysis and investigation; Writing - review and editing. R J B: Conceptualization; Methodology; Formal analysis and investigation; Writing - review and editing. T C: Writing - review and editing. E M M: Writing - review and editing.

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