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BEYOND COMMODITIES: the role of sociobiodiversity in Brazil's bioeconomy

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ANA CAROLINA MENDES DOS SANTOS

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To my daughter

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RESUMO

O Brasil abriga uma das maiores diversidades biológicas e culturais do mundo, representada por mais de 15% da biodiversidade global e centenas de Povos Indígenas e Comunidades Locais (IP&LC) cujos modos de vida são profundamente conectados à natureza. Apesar disso, essa diversidade permanece amplamente invisibilizada nas estatísticas oficiais e, consequentemente, é pouco considerada no planejamento do desenvolvimento rural do país. Embora a bioeconomia seja frequentemente apresentada como uma oportunidade de redefinir a relação entre economia, sociedade e natureza, ainda existem lacunas que dificultam sua tradução em estratégias capazes de incorporar efetivamente a diversidade biológica e cultural no planejamento territorial e de desenvolvimento rural. Esta tese argumenta que a construção de uma bioeconomia baseada na sociobiodiversidade exige mais do que o uso sustentável dos recursos naturais: requer uma transformação sistêmica que redefina o conceito de valor e reconheça quem o produz. Para investigar essa transição, a tese integra análises quantitativas e qualitativas em quatro estudos complementares. O primeiro capítulo apresenta um mapeamento nacional das cadeias da sociobiodiversidade, identificando 152 produtos nativos comercializados, dos quais apenas 36 aparecem nas estatísticas oficiais. Isso evidencia a invisibilidade estrutural que limita políticas baseadas em evidências e mostra que a maioria das organizações comunitárias opera em mercados informais, depende de compras públicas e agrega pouco valor além da produção primária. O segundo capítulo analisa a evolução institucional do ecossistema de apoio à sociobiodiversidade entre 1995 e 2025, examinando 1.286 iniciativas. Os resultados mostram que organizações intermediárias têm sido fundamentais para conectar iniciativas de base a financiamento, infraestrutura e mercados, mas sua atuação de curto prazo e baseada em projetos tem limitado a coordenação duradoura e o aprendizado coletivo. O terceiro capítulo examina como mecanismos de reconhecimento – legais, culturais, de governança e econômicos – fortalecem os IP&LC. Com base em 38 casos globais e 384 projetos nacionais, desenvolve-se uma tipologia empírica de reconhecimento e aplica-se a escada da participação cidadã de Arnstein para avaliar empoderamento. As iniciativas mais transformadoras são as que garantem voz, poder de decisão e autoridade de cogestão, posicionando o reconhecimento como elemento estrutural da criação de valor. O quarto capítulo adota a Teoria da Perspectiva Multinível para comparar duas trajetórias distintas de bioeconomia: a bioeconomia holandesa baseada nos princípios da circularidade, coordenada pelo Estado e orientada por tecnologia, e bioeconomia brasileira baseada nos princípios da sociobiodiversidade, descentralizada e impulsionada por iniciativas de base local. Argumenta-se que transições sustentáveis exigem arquiteturas híbridas que combinem coordenação centralizada com legitimidade territorial, e que a Perspectiva Multinível deve incorporar dimensões culturais, territoriais e relacionais típicas do Sul Global. De forma integrada, os resultados mostram que consolidar uma bioeconomia baseada na sociobiodiversidade depende da convergência de quatro condições interdependentes: informacional (dados e visibilidade), institucional (coordenação e governança), normativa (reconhecimento e valoração) e relacional (empoderamento e apoio em rede). A tese conclui que essa consolidação depende de como o conceito de sociobiodiversidade é compreendido: em sua complexidade que integra pessoas, recursos, identidades e territórios. Reconhecer essa complexidade é essencial para avançar além das commodities rumo a uma bioeconomia verdadeiramente justa.

Palavras-chave: biodiversidade; povos indígenas e comunidades locais; produtos florestais não-madeireiros; atores intermediários; cadeias de valor.

ABSTRACT

Brazil harbors one of the world's richest biological and cultural diversities, encompassing over 15% of global biodiversity and hundreds of Indigenous Peoples and Local Communities (IP&LC) whose livelihoods are deeply intertwined with nature. Despite this, such diversity remains largely invisible in official statistics and, consequently, is poorly considered in the country's rural development planning. Although the bioeconomy is often presented as an opportunity to redefine the relationship between economy, society, and nature, significant gaps remain that hinder its translation into strategies capable of effectively incorporating biological and cultural diversity into territorial planning and rural development processes. This thesis argues that building a sociobiodiversity-based bioeconomy requires going beyond the mere sustainable use of natural resources. It demands a systemic transformation that redefines what counts as value and who is recognized as a value creator. To investigate how such a transformation could unfold, the thesis integrates quantitative and qualitative analyses across four complementary studies. The first chapter provides a national-scale mapping of sociobiodiversity value chains, identifying 152 native products that are traded, of which only 36 are captured by official statistics. This shows the structural invisibility that constrains evidence-based policymaking on sociobiodiversity. It shows that most community-based organizations operate in informal markets, depend on public procurement, and rarely add value beyond primary production. The second chapter examines the institutional evolution of Brazil's sociobiodiversity support ecosystem over three decades (1995–2025), analyzing 1,286 initiatives to understand how intermediary organizations, public funds, and networks of cooperation have shaped the country's bioeconomy architecture. The results demonstrate that although intermediary organizations have been essential in connecting grassroots initiatives with finance, infrastructure, and markets, their short-term and project-based nature has limited long-term coordination and learning. The third chapter expands the analytical lens by examining how recognition mechanisms – legal, cultural, governance-based, and economic – contribute to empowering IP&LC. Drawing on a systematic review of 38 global cases and a national dataset of 384 projects, it develops an empirical typology of recognition and applies Arnstein's ladder of participation to assess degrees of empowerment. The analysis reveals that the most transformative initiatives are those that grant voice, decision-making power, and co-management authority, reframing recognition as a structural element of value creation. The fourth chapter offers a comparative perspective between Brazil and the Netherlands, contrasting the top-down, state-coordinated Dutch circular bioeconomy with Brazil's bottom-up, sociobiodiversity-centered trajectory. It argues that sustainable bioeconomy transitions require hybrid architectures that combine centralized coordination with decentralized legitimacy, and that the Multi-Level Perspective must evolve to account for cultural, territorial, and relational dimensions typical of Global South contexts. Collectively, the findings demonstrate that the consolidation of a sociobiodiversity-based bioeconomy depends on the convergence of four interdependent conditions: informational (data and visibility), institutional (policy coordination and governance), normative (recognition and valuation), and relational (empowerment and networked support). The thesis concludes that the consolidation of a sociobiodiversity-based bioeconomy ultimately depends on how the very concept of sociobiodiversity is understood: in its inherent complexity that integrates people, resources, identities, and territories. Recognizing this complexity is key to moving beyond commodities toward a truly just bioeconomy.

Keywords: biodiversity; indigenous peoples and local communities; non-timber forest products; intermediary actors; value chains.

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1 INTRODUCTION

1.1 Concepts & key research topics

1.1.1 Bioeconomy as a global sustainability

Bioeconomy [Box 1], understood as the set of economic activities based on the renewable and sustainable use of biological resources, has been widely promoted as a strategic response to the systemic challenges of the 21st century, such as climate change, biodiversity loss, and dependence on fossil fuels [1–5]. It represents an attempt to reconcile economic growth with environmental limits, often presented as a “win–win” solution, capable of generating economic growth, innovation, and environmental sustainability [3,6,7] and, therefore, also portrayed as a potential pathway for the transition to sustainability.

Box 1 – Concept of bioeconomy

The first appearance of the term dates back to the early twentieth century, when the Russian biologist Baranoff [8] used the term bioeconomics to discuss fisheries economics. This focus was consolidated in the 1950s with the Gordon–Schaeffer model [9], expanding to the economics of renewable resources and the pursuit of the ‘maximum sustainable yield,’ a central concept in ecological economics [10]. In the 1970s, Nicholas Georgescu-Roegen gave the term a new dimension, linked to the debate on the limits to growth [11], by integrating the principles of thermodynamics (especially the entropy law) as a critique of the conventional economic paradigm and advocating for an economic theory that recognized the limits of natural resources and the exhaustion of raw materials [12]. His approach represented a radical break from orthodox economics, which considered the economic system as independent from nature and infinitely expandable. Today, the term is often used to describe an economy based on biological resources, such as bioenergy and renewable chemicals, in substitution for fossil and non-renewable resources.

In theoretical terms, the transition to sustainability involves structural transformations across socio-technical and institutional systems, changes in how societies produce, govern, and attribute value to nature [13,14]. Yet these transitions are not purely technological processes; they are deeply political and value-laden, shaped by conflicting visions of what sustainability

means and who benefits from it [15,16]. Within this broader framework, the bioeconomy can be understood as both a site and a driver of such transformations, by reorganizing production systems, energy use, and value creation around renewable biological resources [17,18].

Since the mid-2000s, when the debate on bioeconomy first gained momentum in the Global North [5,8], national government bioeconomy-related policies or strategies have been adopted in more than 50 countries [7,19,20]. Yet, the bioeconomy is far from being a unified concept: each country interprets and operationalizes it according to its priorities, institutions, and resources. The European Union (EU) has positioned itself as a frontrunner through the Knowledge-Based Bioeconomy (KBBE) framework [21] and subsequent strategies that integrate sustainability, circular economy and societal transformation goals [2,3,5]. The United States followed with its National Bioeconomy Blueprint, emphasizing biotechnology and innovation-led growth [22]. Emerging economies have also advanced distinct approaches: China with large-scale biomass utilization, the BRICS¹ with strategies combining energy and agricultural innovation [6], and Nordic countries such as Finland and Sweden with comprehensive national policies that integrate biorefineries, forest-based industries and renewable energy [19,23–25]. G20 member states² begun to integrate bioeconomy strategies into broader agendas of climate action, decarbonization, and sustainable growth [26] and Latin American and African countries have more recently introduced pathways centered on rural development and agro-biodiversity, showing that bioeconomy discourses are not limited to industrialized regions but are adapted to diverse socio-ecological contexts [7,27–30].

Across these regions, the bioeconomy has been framed as both a sustainability narrative and an innovation policy. Nonetheless, in general it remains largely technological and industrial in orientation. Its core logic often lies in converting biomass into new commodities and fuels, privileging efficiency and scale as indicators of progress. Critics argue that this industrial framing risks reproducing “business as usual” models under a “green” narrative, by reducing biological resources to feedstocks rather than acknowledging them as components of living, social–ecological systems [12,31]. In this sense, the bioeconomy can act either as a vehicle for sustainability transitions, when linked to biodiversity conservation and social justice, or as a continuation of the same unsustainable economic development under a green guise.

¹ An acronym derived from the initials of the names of the founding countries of the group – Brazil, Russia, India, China and South Africa

² An international forum of major economies. The G20 comprises 19 countries (Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Türkiye, the United Kingdom, and the United States), the European Union, and since 2023, the African Union.

1.1.2 Competing bioeconomy trajectories in Brazil

In Brazil, the bioeconomy has also entered both policy and academic debates but without a shared definition or coherent strategy. Instead, two contrasting visions coexist, reflecting distinct views on development, governance, and the role of biodiversity in the national economy [32].

The first and dominant trajectory is associated with agribusiness and the biofuel industry. Rooted in the state-led Proálcool Program of the 1970s, this bioeconomy is supported by advanced research institutions such as EMBRAPA and by consolidated value chains in sugarcane, soy, and cellulose [33,34]. Its advocates see it as an engine for renewable energy, productivity, and global competitiveness. This bioindustrial bioeconomy belongs to the dominant development model in Brazil, grounded in the intensive use of natural resources for the production and export of commodities. But despite its economic relevance, agribusiness has been strongly associated with deforestation, greenhouse gas emissions [33,35,36], and long-term negative externalities such as soil and water contamination due to the widespread use of agrochemicals, impacting both biodiversity and human health [37,38]. Although agribusiness accounted for 27.6% of Brazil's GDP in 2021 [39], its benefits have been unevenly distributed. Studies show that the model has deepened income concentration and contributed to the dispossession of Indigenous Peoples and Local Communities (IP&LC) [40] (Box 2). In the MATOPIBA region (an expansion frontier encompassing the states of Maranhão, Tocantins, Piauí, and Bahia), just 0.41% of the wealthiest rural establishments account for 60% of agricultural GDP, while 80% of family farmers generate only 5% [41].

Alongside this dominant model, an alternative trajectory has been gaining ground, based on sociobiodiversity and traditional ecological knowledge (TEK) systems. This approach sees biodiversity not as raw material for industrial conversion but as the foundation of territorial and cultural economies capable of combining conservation, income generation, and social inclusion [42,43]. It is supported by a growing network of communities, cooperatives, NGOs, and public programs that link the sustainable use of native species to the livelihoods of IP&LC. Scholars argue that this perspective carries a distinctive transformative potential, since it embeds TEK, local governance, and cooperation into the heart of economic systems [44-46].

These two distinct bioeconomy trajectories – the agro-industrial bioeconomy and the sociobiodiversity-based bioeconomy – reflect deeper historical tensions in Brazil's development trajectory that coexist and interact in complex and often uncoordinated ways. They are grounded in profoundly different logics: while the plantation-based economy is

homogeneous, intensive, and oriented toward exchange value, the sociobiodiversity economy is diverse, cooperative, and oriented toward use value. Because of this structural contrast, some scholars argue that the very notion of bioeconomy should be reconsidered – or even abandoned – when applied to systems rooted in sociobiodiversity, as it tends to mask existing inequalities and legitimize new forms of extractivism [47].

Box 2 – Indigenous peoples, traditional communities, and smallholder family farmers

Various terms are used to designate traditional communities. The Convention on Biological Diversity (1992) adopts the concept of Indigenous Peoples and Local Communities (IP&LC). Decree No. 6.040/2007 introduced the concept of Traditional Peoples and Communities (PCT) as culturally distinct groups that self-identify as such, possess their own forms of social organization, and occupy and use territories and natural resources as a condition for their cultural, social, religious, ancestral, and economic reproduction, employing knowledge, innovations, and practices generated and transmitted through tradition. Law No. 13.123/2015 recognized family farmers as holders of traditional knowledge as well. Since then, the term PICTAFs (Indigenous Peoples, Traditional Peoples and Communities, and Family Farmers) has been adopted. More recently, there has been a growing preference for the term “Guardians of Biodiversity” (Guardiões e Guardiãs da Biodiversidade), as stated in CGEN Resolution No. 34 of May 24, 2023. In this Thesis, we use the term IP&LC, as it is more widely recognized internationally, while understanding that it encompasses the full diversity of traditional peoples, including family farmers.

Just as there is growing concern in the global debate about bioeconomy not being sustainable, the same risk applies to Brazil. There is the risk that the dominant agribusiness and industrial sectors appropriate the discourse of a so-called “sociobiodiversity bioeconomy” merely to legitimize their own activities, reproducing extractive and exclusionary dynamics under the guise of sustainability. Such co-optation could result in the dilution of sociobiodiversity’s political and cultural meanings, turning a historically grounded agenda of rights, territories, and stewardship into another extension of resource commodification.

1.1.3 The legacy of non-timber forest product chains

Despite the dominant agribusiness and extractive trajectory, at least since the 1990s, segments of civil society, academia, and local governments have been experimenting with alternative models of rural development grounded in the sustainable use of native biodiversity. The development of non-timber forest product (NTFP) chains—supported by social movements, cooperatives, and research institutions—marked early efforts to integrate forest conservation with local economies. Pioneering initiatives (Box 3) such as the Chico Mendes Extractive Reserve movement and the establishment of extractive reserves (RESEX) in the Amazon sought to reconcile environmental protection with social justice by granting communities collective rights over forest territories and encouraging sustainable harvests of products such as rubber, Brazil nuts, and açaí [48,49].

Box 3 - The meaning of “initiative” in this thesis

We use the term “initiative” to refer to any organized collective effort designed to promote sociobiodiversity-based production, conservation, or valuation practices. An initiative may take the form of a project, program, enterprise, cooperative endeavor, or multi-actor partnership that mobilizes resources, people, and institutions in the context of sociobiodiversity value chains or community-based bioeconomy arrangements. It is also used as the unit of analysis for mapping, classifying, and comparing actions. The concept is intentionally broader than that of project or organization, as it captures the dynamic and process-oriented nature of actions that connect communities, markets, and support ecosystems.

Throughout the 1990s and 2000s, these experiences expanded through federal and international cooperation programs, including the ProManejo and ProVarzea projects (IBAMA/World Bank), which linked biodiversity conservation to income generation, as well as through the emergence of community enterprises and cooperatives supported by NGOs and development agencies. Researchers emphasize that NTFP systems play a crucial role in rural well-being, not only as sources of income but also as safety nets, cultural resources, and elements of identity and autonomy [45,50]. In the Brazilian context, studies show that agroextractivism – the combination of low-impact extraction and small-scale cultivation – enabled communities to maintain biodiversity while diversifying livelihoods, especially in the

Cerrado and Amazon biomes [41,51]. As a result, the NTFP experience of the 1990s and 2000s can be seen as the conceptual and institutional foundation of what is today called the sociobiodiversity-based bioeconomy.

Within this historical trajectory, a key but often underexplored role has been played by intermediary actors [161, 190, 206]. As NTFP chains emerged in contexts marked by weak state presence, limited market access, and structural asymmetries of power [51, 91, 124], a diverse set of intermediary organizations, including NGOs, foundations, development agencies and research institutions, became central in connecting local initiatives to external resources, policies, and markets. These actors have operated at the interface between grassroots practices and broader institutional and economic systems, translating funding, technical knowledge, regulatory requirements, and market demands into locally embedded processes of organization and value creation [46]. Rather than acting as producers themselves, intermediaries have contributed to shaping the conditions under which sociobiodiversity-based activities could emerge, persist, and, in some cases, scale [198].

However, the use of biodiversity and the structuring of value chains are controversial in the literature. On one hand, numerous studies demonstrate that the sustainable use of native species, when grounded in local governance and TEK systems, can simultaneously enhance biodiversity conservation and improve community livelihoods [44,52-54]. On the other hand, evidence also shows that market demand for high-value natural products can drive overexploitation, loss of ecological integrity, and species extinction, particularly when governance is weak or when communities have limited control over resource management [55-57]. Both perspectives are likely correct, as the outcomes of biodiversity use depend less on whether markets are involved and more on how such bioeconomic systems are organized. A biodiversity-based economy is not inherently sustainable; it becomes so only when value chains are structured around principles of ecological integrity, equity, and collective governance. This is why, unlike conventional productive chains (see Box 4), a sociobiodiversity value chain is defined as an integrated system composed of interdependent actors and a succession of processes involving education, research, management, production, processing, distribution, commercialization, and consumption of sociobiodiversity-based goods and services. These processes are marked by cultural identity, the incorporation of local knowledge and values, and the fair and equitable distribution of benefits [58].

The challenge, therefore, lies in designing value chains that internalize social and environmental limits, rather than reproducing the extractivist logic of commodification under a new label. In other words, the transition toward a sociobiodiversity-based bioeconomy is not

about using nature at any cost or in any form, but about redefining what counts as value and ensuring that economic activities reinforce, rather than undermine, the conditions that sustain life.

1.1.4 Brazilian sociobiodiversity – a neglected wealth

Brazil's dependence on monocultures of exotic species, particularly soybeans, contrasts sharply with its extraordinary biological and cultural diversity. The country hosts between 15% and 20% of global biodiversity, has the largest tropical forest (the Amazon), and includes two of the world's nineteen biodiversity hotspots: the Atlantic Forest and the Cerrado [59]. Estimates suggest that approximately 207,000 known species and nearly 1.8 million estimated species occur in Brazilian territory [60], including more than 46,000 native plants, algae, and fungi [61]. This makes Brazil the world's most megadiverse nation, with a strategic role in providing ecosystem services essential for planetary life [62].

Box 4 – Productive chains versus value chains.

While often used interchangeably, the concepts of productive chain and value chain emphasize different analytical dimensions. A productive chain focuses on the linear and technical flow of material transformation—from production to commercialization—prioritizing efficiency, infrastructure, and technological processes [63]. In contrast, a value chain encompasses the broader network of actors, institutions, and governance arrangements that shape how economic, social, and environmental value is created and distributed [64,65]. In the case of NTFPs, this distinction is crucial: productive chains describe the flow of goods, whereas value chains reveal the flow of value, including intangible aspects such as knowledge, identity, certification, and stewardship [65-67]. Adopting a value chain perspective thus allows a more comprehensive understanding of how conservation, equity, and development intersect within forest-based bioeconomies.

Brazilian sociobiodiversity encompasses a wealth of yet-unknown potentialities, which could become a cornerstone of a new sustainable development paradigm [68]. The structuring of value chains based on sociobiodiversity products has been identified by scientists as one of the key pathways for implementing a bioeconomy [42,46,69,70]. Such chains also create opportunities for adding value to sociobiodiversity products produced by IP&LC [71]. And at

the same time, TEK systems can lead to savings in time and financial resources for biotechnological research and the development of high value-added commercial products, such as pharmaceuticals, cosmetics, and others [72].

A study conducted by the Brazilian Association of Bioinnovation (ABBI) estimated that the bioeconomy could add up to US\$284 billion to Brazil's industry by 2050 [73]. In other words, the country has the potential to generate significant gains for both environmental conservation and the economy by promoting job creation, increasing income, and fostering development through the valorization of biodiversity and the maintenance of standing forests.

Much is already known about the potential of biodiversity resources to generate various products across different economic sectors, or in other words, the potential for bioeconomy, both high-technology sectors – such as pharmaceuticals, cosmetics, and green chemistry – and extractive activities involving NTFP, including oils, fruits, seeds, and resins. For instance, under the coordination of the Ministry of the Environment, a series of publications has been produced since 2011 under the “Plants for the Future Initiative” Project³, highlighting the present and future economic value of several native Brazilian species across all regions of the country. To date, within the scope of this Project, 639 species have been described, detailing available literature information regarding botanical characteristics, geographic distribution, economic value, and parts used, as well as ecological, agronomic, and silvicultural aspects, in addition to relevant experiences with the species, conservation status, and perspectives and recommendations [74].

Despite this potential, only a small fraction of the country's biodiversity is currently known, harvested, or commercialized [75,76]. And much of the sociobiodiversity products that are used, produced and commercialized is unknown. To date, sociobiodiversity value chains in Brazil remain largely invisible, informal and weakly structured, with limited value addition and low economic returns for communities that collect and trade those products [51,77]. It is estimated that only a small fraction of native biodiversity has been effectively integrated into markets [51,77]. Even products of great cultural and economic importance for local communities, such as pequi (*Caryocar brasiliense*) and babaçu (*Attalea speciosa*), face low prices, and a lack of targeted public policies [78,79].

³ <https://antigo.mma.gov.br/publicacoes/biodiversidade/category/54-agrobiodiversidade.html>

1.1.5 Biodiversity as a social and cultural construct

The first step to the transition toward a sociobiodiversity-based bioeconomy is to understand that biodiversity is not merely a biological reality; it is also a social, cultural, and economic construct. In this sense, sociobiodiversity products, such as açai (*Euterpe oleracea/precatoria*), Brazil nuts (*Bertholletia excelsa*), pequi, babaçu, and stingless bee honey, cannot be understood merely in terms of production volumes or market prices. They embody intangible values – including territorial identity, stewardship practices, intergenerationally transmitted knowledge, and cultural meanings – that distinguish them from the commodity logic [80,81]. In this sense, a bioeconomy grounded in sociobiodiversity is not limited to the incorporation of new inputs into industrial value chains or the substitution of fossil-based energy sources. It provides a transformative framework for reconfiguring the forest sector's role in addressing major global challenges, particularly the need to halt biodiversity loss and eradicate poverty [82].

Box 5 – Stewardship practices.

Stewardship practices refer to active efforts by individuals, groups, or networks to protect, care for, or sustainably manage natural resources in pursuit of environmental and social benefits [98]. They take diverse forms, shaped by local contexts, environmental challenges, and community goals. Several countries have introduced market-based instruments such as subsidized agri-environmental or payment-for-environmental services schemes and voluntary conservation programs to stimulate environmental stewardship actions [344]. Rewarding these practices is a relevant way to combine conservation and development goals, especially in rural areas of developing countries, where inequalities in access to rights, resources and services may affect people's sovereignty [345].

Species are objects of knowledge, domestication, and use, serving as inspiration for myths, rituals, and collective identities [83]. IP&LC play a decisive role in conserving biodiversity through low-intensity management practices that minimize genetic erosion and maximize ecosystem integrity [84-86]. These populations are intrinsically linked to their territories, maintaining knowledge systems and sustainable management practices that constitute a living repository of genetic and cultural heritage.

This recognition of the interdependence between biodiversity and society has been progressively incorporated into international and national policy frameworks. The Convention on Biological Diversity (CBD) [87] was a milestone in affirming that the sustainable use and fair sharing of benefits derived from genetic resources must include IP&LC as rights-holders. The Nagoya Protocol (2010) advanced this agenda by establishing access and benefit-sharing (ABS) mechanisms grounded in prior informed consent and equitable governance [88]. By formalizing the social and cultural dimension of biodiversity use in international law, the Protocol reinforces the valuable TEK associated with the use of biological resources carried out by IP&LC [89].

More recently, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services – IPBES [90] has consolidated the recognition of the multiple values of nature (instrumental, intrinsic, and relational) highlighting that biodiversity embodies cultural identities, spiritual practices, and knowledge systems essential to sustainability. Its Values Assessment Report [90] makes it explicit that biodiversity holds not only instrumental, but also intrinsic and relational meanings, which are expressed through cultural identities, spiritual practices, and ways of life. Recognizing these multiple values, as well as the diversity of knowledge systems, is considered essential to guide public policies for conservation and sustainable use.

In Brazil, these international principles resonate across various legal and institutional frameworks. Law No. 13.123/2015 (Biodiversity Law) regulated access to genetic resources and associated TEK, establishing mechanisms for benefit-sharing. Public policies such as the National Policy for the Sustainable Development of Traditional Peoples and Communities (Decree No. 6.040/2007) and the National Plan for the Promotion of Sociobiodiversity Product Chains (2009) have also reinforced the idea that biodiversity is not merely a natural resource, but a constitutive element of local territories, cultures, and economies.

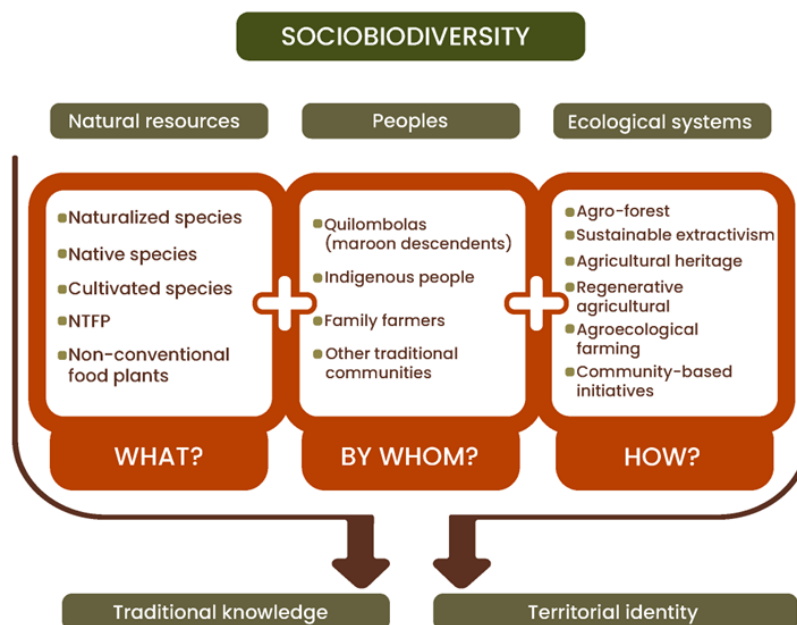
In this context, since 2009 Brazil has begun to adopt the concept of sociobiodiversity, understood as the inseparable articulation between biological and cultural diversity (Figure 1). It refers to the “coexistence and interrelationship between biodiversity and the plurality of sociocultural systems, which considers peoples, territories and seascapes, TEK, and ways of life as central aspects for the sustainable development of regions, states, biomes, and countries”⁴.

⁴ <https://semanadasociobio.com.br/noticias/carta-da-semana-da-sociobiodiversidade/>

The concept of sociobiodiversity emerges from the interconnection among three fundamental dimensions: natural resources, people, and ecological systems. This interaction creates a web of relationships that goes beyond the mere economic use of biodiversity. It encompasses TEK and territorial identities, which ensure both the conservation of ecosystems and the cultural and social reproduction of these communities. In this sense, sociobiodiversity is a concept that integrates biological and sociocultural diversity, reflecting the inseparability between nature and society in the construction of sustainable development alternatives. More than a technical concept, sociobiodiversity constitutes a political category that repositions these social groups not merely as users of biodiversity, but as central agents in shaping economic and ecological alternatives.

Following from the above, a conceptual diagram was built exploring what, by whom and how Brazilian sociobiodiversity unfolds (Figure 1).

Figure 1: Conceptual diagram of sociobiodiversity, integrating its different components.



Source: Authors, 2025

What? Sociobiodiversity products are usually associated with NTFP. However, since sociobiodiversity is a broad concept linked to traditional ways of life, sociobiodiversity products encompass different types of biological resources and several related concepts, including native, naturalized, or cultivated species; agricultural crops, fisheries, and artisanal

products derived from natural fibers and other non-plant resources [77,92]. These resources form the material basis of production and are linked to immaterial and cultural practices that sustain traditional livelihoods.

By whom? Sociobiodiversity products are managed, conserved, and used by IP&LC, including quilombola communities, family farmers, and other local groups who hold knowledge transmitted across generations. The concept gives visibility to the role of IP&LC as protagonists in biodiversity conservation and the sustainable management of natural resources [58,96]. If sociobiodiversity products are dissociated from their cultural and social dimensions, they become mere commodities (Box 4).

How? Sociobiodiversity is expressed by stewardship practices, the set of actions undertaken by individuals, communities, or networks of actors to protect, care for, and responsibly use natural resources, aiming for positive social and environmental outcomes across diverse socio-ecological contexts [97-99]. These practices encompass both direct forms of management, such as sustainable extractivism⁵, agroecology, regenerative agriculture, agroforestry systems, the maintenance of agricultural and forest diversity, and ecosystem restoration, as well as institutional and collective dimensions, including community rules, governance systems, and processes of intergenerational knowledge transmission. If a productive system is not ecologically sustainable, the sociobiodiversity product loses its defining character and becomes a commodity.

1.1.6 Sociobiodiversity-based bioeconomy as a transition to sustainability

We argue that the bioeconomy wave represents a new window of opportunity [100] for shedding light on the sociobiodiversity concept, to learn from the past experiences with NTFP chains and to build a more sustainable development in Brazil. The convergence of multiple streams – problem, policy, and politics – has created a favorable moment for rethinking the country’s development trajectory (Box 6). On the one hand, the growing recognition of climate and biodiversity crises exposes the structural limits of the agribusiness-export model and reinforces the urgency of aligning production systems with ecological integrity. On the other hand, bioeconomy has become part of the national government’s agenda, marked by the launch

⁵ In Brazil, extractivism of NTFP often refers to small-scale, community-based resource use practiced by IP&LC, commonly associated with traditional knowledge, low environmental impact and long-term stewardship. But because internationally it is commonly associated to environmental degradation, here we add the adjective “sustainable” to make it clear.

of the National Bioeconomy Strategy (Decree No. 12.044/2024), the creation of a National Secretariat for Bioeconomy within the Ministry of the Environment, and the proliferation of programs dedicated to promoting bioeconomic activities across multiple ministries and funding agencies. Simultaneously, there has been a strengthening of grassroots movements and community networks that articulate the sociobiodiversity agenda from below (Observatory of Sociobiodiversity Economies, Network of Traditional Peoples and Communities of Brazil, Interstate Movement of Babassu Coconut Breakers, among others), as well as the growing political protagonism of IP&LC, evident in the establishment of ministries specifically focused on their agenda, and in their direct participation in policy design, such as the National Plan for Sociobiodiversity currently under construction.

Box 6 – Public policies, agenda setting and windows of opportunity.

Public policies result from government decisions and actions aimed at addressing collective problems through a cyclical process that includes agenda setting, formulation, implementation, and evaluation. Among these stages, agenda setting is often considered the most challenging, since only issues perceived as relevant by decision-makers gain entry into the policy cycle. Political, social, and ideological factors influence which problems reach the governmental agenda—particularly when they are framed as crises, championed by interest groups, or supported by bureaucratic actors. According to Kingdon's Multiple Streams Framework (1984), policies emerge when problems, solutions, and politics—normally evolving separately—converge at specific moments, creating policy windows that enable the coupling of ideas with decision-making. During these fleeting opportunities, policy entrepreneurs—individuals such as civil servants, academics, or advocates—play a crucial role by mobilizing resources, promoting ideas, and linking issues to political momentum. Thus, windows of opportunity represent the critical junctures through which new issues gain visibility and enter the government's agenda.

However, as described before, these advances are not emerging from a vacuum. Brazil already holds over three decades of accumulated experience in structuring NTFP/sociobiodiversity chains through programs, projects, and cooperative arrangements that have generated a wealth of practical lessons (both successes and failures) regarding what it takes to align biodiversity use, community empowerment, and market access. This historical

legacy, combined with renewed political will and institutional coordination, creates a unique policy window for transforming the sociobiodiversity-based bioeconomy from a fragmented field of initiatives into a coherent national strategy for sustainability transitions.

1.2 Hypothesis and research questions

Following from the above, this thesis argues that, in their current form, sociobiodiversity chains should not be referred to as value chains, as there is little value added to raw materials or intermediate goods at each stage of production, and no recognition of the intangible assets that confer identity and distinguish them from commodity chains. In this sense, the central hypothesis of this study is that the sociobiodiversity-based bioeconomy in Brazil only materializes as something different to the conventional bioeconomy if sociobiodiversity is not treated merely as a source of biomass or products and instead structures how its value (in its social, environmental and economic dimensions) is defined, recognized, and institutionalized. Therefore, there is a need to overcome its invisibility and strengthen institutional and governance arrangements.

Building on this hypothesis and given the limited understanding of how sociobiodiversity can underpin a more inclusive bioeconomy, this thesis: a) analyzes the informational, institutional, normative, and relational conditions required for consolidating a sociobiodiversity-based bioeconomy in Brazil; and maps existing initiatives, networks, and governance arrangements that might reveal pathways and constraints for scaling up a sociobiodiversity-based bioeconomy. To investigate these points, the following questions are addressed in each chapter:

- 1) How visible are sociobiodiversity value chains in Brazil, and what do existing data reveal about their structure, territorial distribution, and market dynamics?
- 2) How have intermediary organizations and support networks contributed to connecting local initiatives with policies, markets, and financial mechanisms?
- 3) How can material and non-material contributions, such as stewardship practices, traditional knowledge, and cultural values, be effectively recognized and valued within bioeconomy frameworks?
- 4) What lessons and complementarities can be drawn from distinct bioeconomy strategies to foster a more just and sustainable bioeconomy?

1.3 Research goals

1.3.1 General goal

The overall goal of this thesis is to understand how informational, institutional, normative, and relational conditions interact to shape a sociobiodiversity-based bioeconomy capable of promoting more just, inclusive, and sustainable development pathways in Brazil.

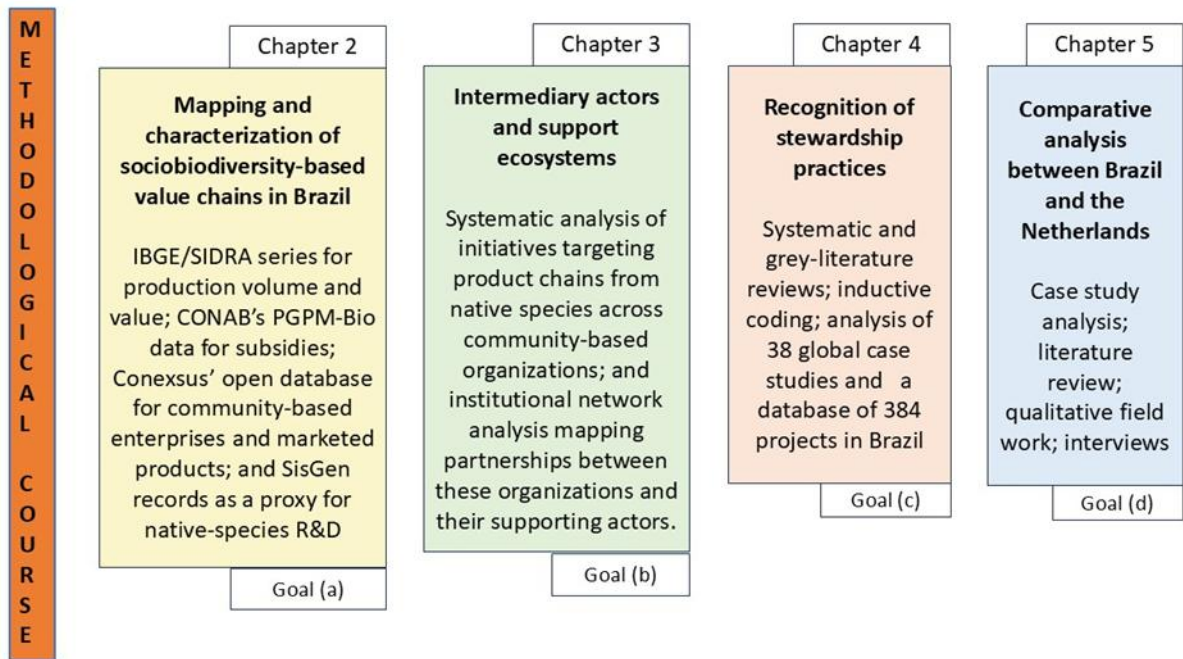
1.3.2 Specific goals

- a) Map and characterize the main sociobiodiversity value chains in Brazil to assess their visibility, structure, and data gaps as a basis for evidence-based planning;
- b) Analyze how intermediary organizations and support networks have contributed to the structuring and consolidation of sociobiodiversity value chains and community-based bioeconomy initiatives;
- c) Identify mechanisms through which immaterial and relational contributions (stewardship practices, TEK, and cultural values) can be recognized and valued within bioeconomy frameworks;
- d) Compare and synthesize lessons and complementarities between distinct bioeconomy strategies (e.g., Brazil and the Netherlands) to identify opportunities for fostering fairer and more sustainable transitions.

1.4 Methodological course

This thesis followed a multi-phase methodological course to answer the overarching research question and the chapter-specific questions derived from the working hypotheses. The sequence integrates comparative qualitative research, systematic reviews, secondary data analysis, and mixed methods on institutional initiatives and networks that structure sociobiodiversity value chains in Brazil (Figure 2).

Figure 2: Flowchart of the phases involved in the methodological course



Source: Authors, 2025

Phase I – National mapping and characterization of sociobiodiversity value chains (Chapter 1)

We compiled and analyzed secondary data to identify major products, characterize production (supply), market presence (demand), and organizational participation at national scale. Sources include: (i) a literature review (Scopus, ScienceDirect) and federal publications to identify chains and priorities; (ii) Brazilian Institute of Geography and Statistics (IBGE/SIDRA) series for production volume and value; (iii) National Supply Company (CONAB)'s Minimum Price Guarantee Policy for Sociobiodiversity Products (PGPM-Bio) data for subsidies; (iv) Conexsus Institute's open database for community-based enterprises and marketed products; and (v) National System for the Management of Genetic Heritage and Associated Traditional Knowledge (SisGen) records as a proxy for native-species R&D "in the making." This phase situates the portfolio of chains and organizations across Brazil and informs subsequent institutional analyses.

Phase II – Intermediary actors and support ecosystems (Chapter 2)

Adopting a mixed-methods design, we first performed web scraping and data mining of initiatives supporting native-species chains, identifying 1,286 records with temporal and investment attributes and a refined sample of 384 projects with detailed intervention

descriptions. Projects were classified into three support modalities: (1) capacity building & institutional strengthening, (2) financial support & infrastructure, and (3) market access, via curated dictionaries and regex coding to detect presence and co-occurrence. In the second stage, we mapped institutional networks that connect community-based organizations with meso-institutions and funders, analyzing how combinations of support modalities and actor coalitions evolved over time.

Phase III – Recognition of stewardship practices: global evidence and Brazil’s project landscape (Chapter 3).

We conducted a systematic review (2014–2024) on recognition of stewardship practices by IP&LC (Scopus, EBSCOHost), following explicit inclusion/exclusion criteria, de-duplicating, screening by multiple reviewers, and selecting 38 concrete cases for deep analysis. In parallel, we assembled a curated Brazilian dataset of 384 projects (2000–2023) drawn from Small Eco-Social Projects Program (PPP-ECOS/ISPN) and the Amazon Fund/BNDES to examine how support to value chains also acts as material, legal-institutional, participatory/governance, and cultural recognition of stewardship. An inductive coding (open coding → conceptual clustering → cross-validation) generated a typology of recognition forms and, using the Arnstein’s Ladder of citizen participation, we assessed the degree of community empowerment embedded in each mechanism.

Phase IV – Comparative analysis between Brazil and the Netherlands

To contrast how bioeconomy transitions unfold in different contexts, we combined a structured literature review with qualitative fieldwork in the Netherlands (Noord-Brabant) and Brazil (Northern Minas Gerais). The review searched Scopus, Web of Science, and Google Scholar for “bioeconomy” + country terms, screened 697 records and retained 139 for in-depth analysis. We then conducted 20 semi-structured interviews (10 NL; 10 BR), complemented by field visits, and coded all materials with a theory-informed scheme based on the Multi-Level Perspective theory (MLP) plus elements from grassroots innovation (landscape, regime, niche/intra-niche; governance structures; actor coalitions). This phase provides the comparative lens and the first set of insights on complementarities and learning across trajectories.

1.5 Thesis structure

This thesis is organized into four empirical chapters, preceded by the introductory section (Chapter 1) and followed by the discussion and concluding section (Chapter 6). Each chapter was developed as a manuscript submitted to peer-reviewed journals – therefore presenting some repetition in context – but together they are arranged to reflect a progressive analytical movement. It starts from the national mapping of value chains, through the organizational and institutional dimensions of support, to the recognition of immaterial and relational contributions, culminating in a comparative perspective that links Brazil's sociobiodiversity-based bioeconomy to international experiences.

Table 1 - Overview of Thesis's structure with goals, concepts and methods

Chapter	Concepts	Goal	Methods
Chapter 2: Bioeconomy of sociobiodiversity in Brazil: supply, demand and actors	Bioeconomy, sociobiodiversity, market dynamics, value chains, community-based organization	Map and characterize the main sociobiodiversity value chains in Brazil to assess their visibility, structure, and data gaps as a basis for evidence-based planning	Literature review (scientific and gray); official datasets (IBGE, Conab, SisGen), and Conexsus Institute's mapping of community-based organizations
Chapter 3: Intermediary organizations and the structuring of sociobiodiversity product chains in Brazil	Bioeconomy, sociobiodiversity, intermediary organizations, initiative, experimentalist governance	Analyze how intermediary organizations and support networks have contributed to the structuring and consolidation of sociobiodiversity value chains and community-based bioeconomy initiatives	Mixed methods combining web scraping and data mining of 1,286 initiatives (1995–2025); text mining and classification of support modalities (capacity building, financial/infrastructural, market access); network analysis of institutional linkages.
Chapter 4: Beyond commodities: valuing the contributions of stewardship practices in sociobiodiversity-based bioeconomy	Bioeconomy, sociobiodiversity, stewardship practices; Indigenous Peoples, Local Communities, and Smallholder Farmers (IP&LC), recognition mechanisms, Arnstein's Ladder of Participation	Identify mechanisms through which immaterial and relational contributions (stewardship practices, traditional knowledge, and cultural values) can be recognized and valued within bioeconomy frameworks	Systematic literature review (2014–2024, Scopus and EBSCOHost); content analysis of 384 Brazilian projects (PPP-ECOS/ISPN, Amazon Fund/BNDES); inductive coding and typology building

Chapter 5: Identifying opportunities for mutual learning across different bioeconomy transition processes: case studies in The Netherlands and Brazil	Transition to sustainability, multi-level perspective (MLP), grassroots innovation, deep root systems	Compare and synthesize lessons and complementarities between distinct bioeconomy strategies (e.g., Brazil and the Netherlands) to identify opportunities for fostering fairer and more sustainable transitions.	Structured research of academic publications and official reports; case studies; semi-structured interviews; qualitative coding
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Source: Authors, 2025

The second Chapter – “*Bioeconomy of sociobiodiversity in Brazil: supply, demand and actors*” provides a national-scale mapping and characterization of Brazil’s sociobiodiversity-based economy. The chapter identifies the main native products, production systems, market dynamics, and social organizations involved in these value chains, combining data from multiple sources — including official statistics (IBGE/SIDRA, CONAB/PGPM-Bio), institutional databases (Conexsus), research registries (SisGen), and scientific and grey literature. It describes the characteristics of production systems (supply) and market structures (demand), assessing how many of these products integrate consolidated value chains and how cooperatives and local associations participate in their commercialization. The study also identifies products currently under research and development, which could strengthen future bioeconomy chains. Using the criteria proposed by Costa [101], products are classified according to their market dynamics (dynamic, promising, stationary, or declining). Finally, a case study in the North Minas Gerais highlights the invisibility of cerrado product chains in official statistics. This chapter establishes the empirical and analytical basis for understanding how sociobiodiversity products are positioned within Brazil’s broader bioeconomy agenda.

The third Chapter – “*Intermediary organizations and the structuring of sociobiodiversity product chains in Brazil*” analyzes how intermediary actors and support networks have contributed to shaping Brazil’s sociobiodiversity-based bioeconomy over the past three decades. The chapter adopts a mixed-methods design that combines large-scale data mining, institutional network analysis, and qualitative document review. It compiles and systematizes information on 7,298 initiatives implemented between 1995 and 2024, selecting 1,286 projects directly related to sociobiodiversity product chains and examining a detailed subset of 384 initiatives that explicitly describe their type of support. Using a coding framework based on three categories (organizational strengthening, financial and infrastructural investment, and market access), the study investigates how different forms of support were

combined over time. The analysis further integrates data from 1,044 community-based organizations mapped by Conexsus to reconstruct the institutional network connecting grassroots producers with intermediary organizations, donors, and government programs. Finally, qualitative content analysis of reports from key meso-institutions—such as ISPN, IEB, FAS, IDESAM, and FUNBIO—was conducted to identify recurrent institutional lessons and recommendations. Together, these methods provide a longitudinal and relational view of how the support ecosystem for sociobiodiversity value chains has evolved, identifying key actors, funding mechanisms, and governance patterns.

The fourth Chapter – *“Beyond commodities: valuing the contributions of stewardship practices in sociobiodiversity-based bioeconomy”* examines how stewardship practices carried out by IP&LC are recognized and valued within both global and Brazilian bioeconomy frameworks. Using a comparative and inductive approach, the chapter combines a systematic literature review of 38 international case studies with the analysis of 384 projects implemented in Brazil between 2000 and 2024, encompassing initiatives funded by the Amazon Fund and the PPP-ECOS Program (GEF/UNDP/ISPN). The study develops an inductive typology of recognition mechanisms—encompassing material (monetary and non-monetary) and non-material (legal, participatory, cultural) forms—and applies Arnstein’s Ladder of Citizen Participation to assess the degree of community empowerment embedded in each case. Through grounded qualitative coding and cross-validation, the chapter identifies how different recognition forms reflect distinct governance arrangements and degrees of participation, ultimately proposing an analytical framework to integrate stewardship, recognition, and empowerment into the sociobiodiversity-based bioeconomy.

The fifth Chapter – *“Identifying opportunities for mutual learning across different bioeconomy transition processes: case studies in The Netherlands and Brazil”* develops a comparative analysis of two subnational cases – Noord-Brabant Province in the Netherlands and Northern Minas Gerais in Brazil – to understand how bioeconomy transitions unfold under contrasting institutional, ecological, and governance conditions. Anchored in the MLP framework and complemented by insights from Grassroots Innovation (GI) theory, the chapter explores how niche innovations, regime dynamics, and landscape pressures interact differently across Global North and South contexts. Empirically, the study combines a structured review of academic and grey literature with semi-structured interviews, complemented by field visits to both territories. Six analytical dimensions guided the comparison: landscape pressures, characteristics, niche innovations, strategic visions, governance structures, operational instruments, and actor coalitions. The chapter proposes an expansion of the MLP framework to

include infra-niches and deep root systems, capturing territorialized and culturally embedded grassroots dynamics often overlooked by classical transition theory. This analytical lens enables a nuanced comparison between top-down, state-coordinated transitions in the Netherlands and bottom-up, sociobiodiversity-driven pathways in Brazil, identifying opportunities for mutual learning and theoretical refinement.

The final Chapter brings together the analytical, empirical, and theoretical contributions developed throughout the thesis to provide an integrated interpretation of the findings. It revisits the central hypothesis that the consolidation of a sociobiodiversity-based bioeconomy depends on the convergence of informational, institutional, normative, and relational conditions, and examines how these dimensions interact across scales and actors. Finally, it reflects on the broader significance of Brazil's sociobiodiversity experience for global sustainability transitions, proposing future research pathways and lessons for building more inclusive and sustainable bioeconomies.

2 BIOECONOMY OF SOCIOBIODIVERSITY IN BRAZIL: SUPPLY, DEMAND AND ACTORS⁶

2.1 Abstract

Brazil harbors exceptional biodiversity, yet its integration into markets remains limited and uneven. The bioeconomy of sociobiodiversity, which combines biodiversity with traditional knowledge, holds great potential but lacks systematic data on production, markets, and organizational structures. This study compiles information from scientific and gray literature, official datasets (IBGE, Conab, SisGen), and Conexsus Institute's mapping of community-based organizations. Reliable data exist for only 36 species across multiple biomes. Cassava, açaí, cocoa, Brazil nut, rubber, and honey dominate national markets, while culturally important species such as babassu, pequi, and umbu remain regionally restricted and highly informal. Only 5% of organizations report value-added processing, reflecting challenges of low producer prices, seasonal dependence, and fragile markets. Meanwhile, thousands of native species show research interest but remain disconnected from policy and market agendas. Strengthening sociobiodiversity value chains requires better integration of science, public policy, and local economies.

Keywords: Biological resources, sustainable development, rural farmers, non-timber forest products, community-based organizations.

2.2 Introduction

Brazil is recognized as one of the most biodiverse countries in the world, encompassing five major biomes that collectively harbour between 15% and 20% of global biodiversity [102,103]. The country holds the largest number of endemic species, the world's largest tropical forest (the Amazon), and two of the nineteen global biodiversity hotspots: the Atlantic Forest and the Cerrado [59,104]. Despite this exceptional biological wealth, its potential economic benefits have been insufficiently integrated into the national economy and have contributed only marginally to the livelihoods of traditional peoples and local communities [105–109]. Instead, Brazil's development model remains largely driven by large-scale agribusiness,

⁶ Manuscript submitted to Ambiente & Sociedade Journal

particularly the monoculture of exotic species such as soy, whose expansion has often occurred at the expense of native ecosystems [102,110]. Although agribusiness plays a central role in the Brazilian economy, accounting for approximately 27.6% of the GDP in 2021, it has not consistently translated into tangible improvements in the living conditions of rural populations. In many cases, it has been associated with land concentration and the displacement of traditional communities [32,42,106,111].

In recent years, the concept of a bioeconomy has emerged as a potentially transformative framework for reconciling economic development with environmental conservation [32,42,47,105,106,111,112]. Brazil's National Bioeconomy Strategy, launched in 2024, outlines five strategic sectors for development: (i) sociobiodiversity value chains, (ii) ecosystem regeneration and restoration, (iii) industrial biomanufacturing and biotechnology, (iv) agri-food systems and agriculture, and (v) bioenergy and biofuels. While industrial biomanufacturing, agri-food systems, and bioenergy sectors are progressing, the advancement of a sociobiodiversity-based bioeconomy, centered on the sustainable use of native species and the TEK associated with them, remains limited [47,105,106,113].

Sociobiodiversity refers to the intersection of biological diversity with the cultural and social practices of traditional peoples and local communities [77,114]. It encompasses a broad array of goods, including NTFPs, agricultural crops, fisheries, and artisanal products derived from natural fibers and other non-plant resources [77,92]. The recognition and valorization of sociobiodiversity hold the potential to generate both environmental and socioeconomic benefits, ranging from the preservation of cultural heritage to the acceleration of high value-added product development in sectors such as food, cosmetics, and pharmaceuticals [68,110,115].

Nevertheless, the formal knowledge base regarding the production, commercialization, and market dynamics of sociobiodiversity products remains scarce [76,93,105,115]. Existing research is frequently limited to one or two products [78,116-119] or geographically confined to the Amazon region [42,106,120-122], leaving significant knowledge gaps at the national scale. Moreover, the integration of sociobiodiversity into Brazil's bioeconomy policies is still in its early stages, with most products marketed informally, characterized by low added value and limited economic returns for the communities that depend on them [47,106,123,124]. Overcoming these challenges will require targeted public policies, private investment, and a robust understanding of supply chains, market structures, and the actors involved [105,107,114].

This study starts by addressing these gaps by providing a comprehensive analysis of sociobiodiversity products at the national scale. We begin by defining sociobiodiversity within the framework of Brazil's bioeconomy agenda, followed by an examination of supply, markets, and organizational actors involved in these value chains across the country's biomes. Specifically, the study addresses the following research questions: a) What are the main sociobiodiversity products in Brazil? b) What are the characteristics of their production systems (supply) and market dynamics (demand), and how many integrate consolidated value chains? c) How many cooperatives and local organizations participate in these supply chains? d) Which products are the focus of research and development (R&D) efforts with potential to strengthen a sociobiodiversity-based bioeconomy? E) How well do the national statistics data from IBGE and CONAB in Cerrado correspond to data reported by the local cooperative? By answering these questions, the study aims to inform strategies for integrating sociobiodiversity into Brazil's bioeconomy, thereby contributing to the improvement of rural livelihoods and the sustainable use of biodiversity.

2.3 Methods

2.3.1 Literature review and secondary data collection

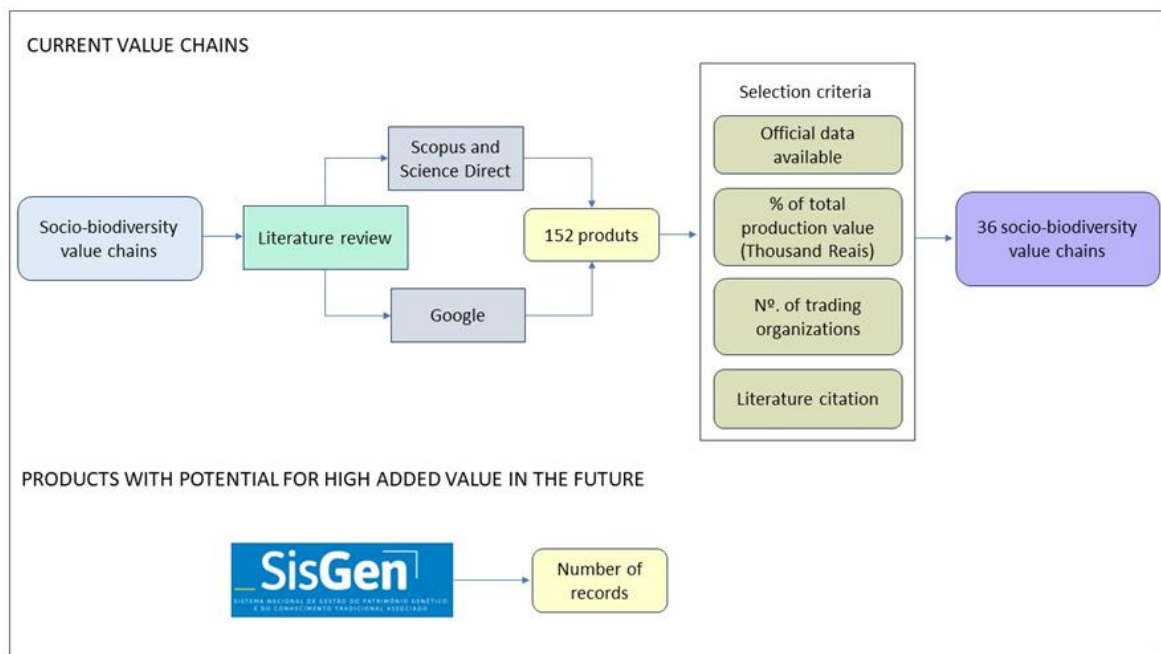
To compile a list of sociobiodiversity products and characterize their supply, demand, and associated actors, we conducted a literature review complemented by secondary data analysis. Searches were performed in two specialized databases – Scopus and Science Direct – up to October 2022. In addition, we reviewed publications from Brazilian federal government websites, identifying three key documents produced by relevant national agencies that referred to sociobiodiversity value chains [125–127]. Although no official list of priority sociobiodiversity products exists, these publications were treated as indicative of governmental priorities.

Given the limited availability of systematized information on buyers or intermediaries, our analysis focused on the upstream segments of the value chains, specifically production volume and producer organizations (processing). This focus is justified by the sociobiodiversity bioeconomy's intrinsic emphasis on social and cultural values, which includes safeguarding the well-being of traditional peoples, local communities, and family farmers reliant on native natural resources.

To quantify production, we used official historical data on production volume (tonnes) and value (thousand Brazilian reais) from the Automatic Recovery System (SIDRA) of the Brazilian Institute of Geography and Statistics (IBGE) (<https://sidra.ibge.gov.br/home/cnt/brasil>) (accessed July 2025), as well as subsidy data from the National Supply Company (Conab) (<https://sisdep.conab.gov.br/consultasisbio/>) (accessed July 2025).

To map products currently present in formal or informal markets, we used the Conexsus Institute's open-access database of community-based enterprises (<https://desafioconexsus.org/mapa-desafio-conexsus/>) (accessed July 2025). This dataset compiles self-reported information from associations or cooperatives of family farmers and agroextractive communities that participated in the 2018 Conexsus Challenge. Although not up to date, it is the most comprehensive database publicly available so far. Organizations that did not report marketed products, or that traded goods outside the scope of Brazilian sociobiodiversity, were excluded. The full process of product identification and classification is summarized in Figure 1.

Figure 1: Flowchart of the process of identifying the main sociobiodiversity value chains.



Source: Authors, 2025

To identify biodiversity products “in the making” – considered in this study as those not yet commercially available but under active R&D, we used the number of access records in the SisGen (<https://sisgen.gov.br/>) (accessed July 2025) as a proxy. SisGen is a mandatory

declaratory electronic platform established under Decree No. 8.772/2016 to ensure transparency and traceability of activities involving genetic heritage and associated traditional knowledge, as mandated by Brazil's Biodiversity Law (No. 13.123/2015). Since this legislation applies only to native species and SisGen records are indexed by scientific rather than common names, we used both homotypic and heterotypic names for searches, as provided by the Re flora database (<https://reflora.jbrj.gov.br/consulta/>) (accessed July 2025).

Finally, in order to address data gaps between official national statistics and local data from cooperatives, we conducted a fieldwork study in the Northern of Minas Gerais State in December 2023. In this field work, we visited cooperatives and asked for their local data on some traded products in the Cerrado Norte Mineiro. This study compares production data from IBGE's PEVS (2023) with local datasets produced by cooperatives and associations across selected municipalities in the Cerrado biome. By analyzing divergences in the number of species and associated products and production volumes, this study aims to investigate the structural causes of information gaps and discuss pathways toward a more integrated and community-grounded system of monitoring the use of wild species in Brazil.

2.3.2 Data Analysis

From the list of marketed sociobiodiversity products, we identified those which could be classified as consolidated value chains using the criteria proposed by [37]: a) existence of consistent and regular production (supply); b) existence of consistent and regular buyers (demand); c) support from institutional partners, public policies, and organized governance structures (e.g., associations or cooperatives).

We combined literature review findings with secondary data and adapted the typology of [38], originally developed for the state of Pará, to the national scale. Market dynamics were evaluated using IBGE's historical series (2006–2023). We calculated the Compound Annual Growth Rate (CAGR), whose formula is:

$$CAGR = \left(\frac{V_t}{V_0} \right)^{\frac{1}{n}} - 1$$

Where V_t is the final production (2021), V_0 is the initial production (2006) and n the number of years in the historical series (15).

We then classified products into four categories:

1. Dynamic – high production value and positive growth (>1%);

2. Promising – currently low production value but positive growth;
3. Stationary – relevant with growth rate between -1% and 1% ;
4. Declining – relevant with negative growth ($< -1\%$).

We added a fifth category: Products with R&D and potential for future added value, based on SisGen records.

2.4 Results

2.4.1 Sociobiodiversity products and value chains in Brazil

The review of articles on sociobiodiversity products highlights that biodiversity in Brazil is not simply a concept restricted to the natural world, biological resources or native species. It is also a cultural, social, and economic construct. For this reason, we adopt the concept of sociobiodiversity, a term that combines the biological component (biodiversity) with cultural and social values [128,129]. As such, we used a definition of sociobiodiversity products that include not only NTFPs but also agricultural products, fisheries and handicrafts made from natural fibers and other non-plant resources relevant to the traditional communities that depend on them. Sociobiodiversity value chains are here defined as integrated systems composed of interdependent actors engaged in a sequence of activities (including education, research, management, production, processing, distribution, marketing, and consumption) related to sociobiodiversity products and services. Production systems within these chains may encompass extractivism (often characterized by seasonal resource availability), managed harvesting, agroforestry systems, and intensive cultivation (with or without irrigation), provided they respect the ecological requirements of the species, safeguard cultural identity, and incorporate local values and knowledge. Unlike the interpretation proposed by [47], our definition emphasizes that the two predominant land use-based economic models – the plantation economy and the sociobiodiverse economy – are not mutually exclusive. Instead, they can be strategically integrated within broader approaches to advancing the bioeconomy agenda.

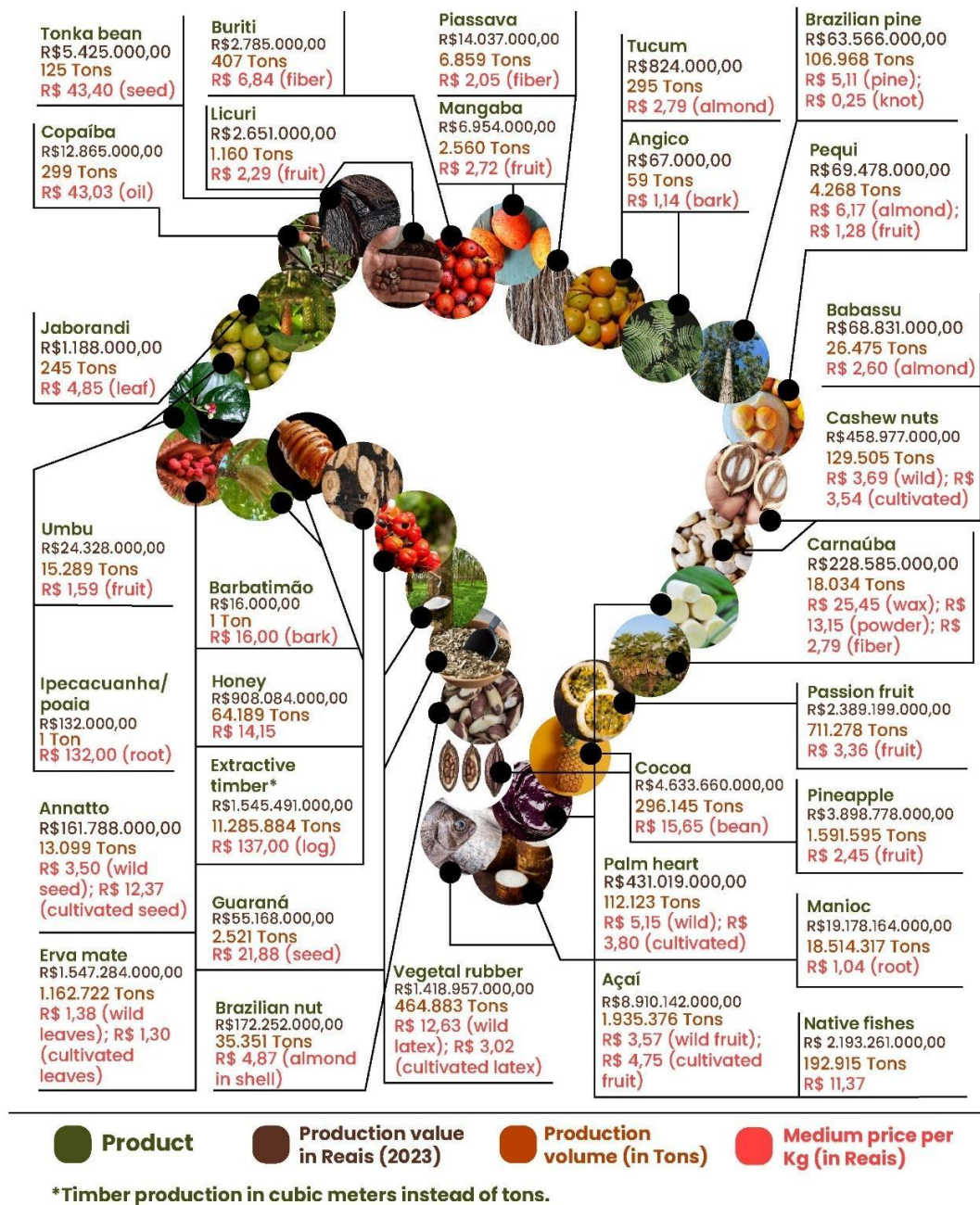
Based on the definition above, a total of 152 sociobiodiversity products were identified from both peer-reviewed and grey literature sources (Supplementary Material - SM), although the vast majority (80%) focuses on only a few of them, confirming other studies [130]. The most cited were: Brazil nut (*Bertholletia excelsa*), açai (*Euterpe oleracea*), vegetal rubber

(*Hevea brasiliensis*), buriti (*Mauritia flexuosa*), pequi (*Caryocar brasiliense*) and babassu (*Attalea speciosa*). Of the total, official historical production data were available from IBGE for 36 products, which are therefore considered part of consolidated product chains and are the focus of this analysis.

IBGE does not explicitly distinguish between native and exotic biodiversity products, adopting instead the PEVS classification, which separates plant extractivism and silviculture from agricultural and livestock products. All products from plant extractivism are native or naturalized species, as they occur naturally in Brazil. IBGE groups these species into nine categories: food products; aromatic, medicinal, toxic, and dye products; fibers; non-elastic gums; woods; oilseeds; and tanning agents. Certain species contribute to multiple product categories. For example, açaí yields both fruit and heart of palm; carnauba (*Copernicia prunifera*) produces wax, powder, and fiber; and pequi provides both fruit and kernel. Conversely, in some cases, only a single product per species is recorded, as with buriti, where only fiber is listed despite the extraction of pulp and oil. Some species, such as balata (*Manilkara bidentata*), maçaranduba (*Manilkara huberi*), sorva (*Sorbus domestica*), and oiticica (*Licania rigida*), remain on the IBGE list despite the absence of current production records.

Among agricultural products listed in SIDRA/IBGE, only five are from native Brazilian species: pineapple (*Ananas comosus*), cocoa (*Theobroma cacao*), passion fruit (*Passiflora edulis*), cassava (*Manihot esculenta*), and guarana (*Paullinia cupana*). In total, historical production data are available for only 31 native species: açaí, cashew nut (*Anacardium occidentale*), Brazil nut, yerba mate (*Ilex paraguariensis*), mangaba (*Hancornia speciosa*), heart of palm, pequi, Brazilian pine (*Araucaria angustifolia*), umbu (*Spondias tuberosa*), ipecacuanha (*Carapichea ipecacuanha*), jaborandi (*Pilocarpus microphyllus*), annatto (*Bixa Orellana*), vegetal rubber, carnauba, buriti, piassava (*Attalea funifera*), wood from native species, babassu, copaiba (*Copaifera sp.*), tonka bean (*Dipteryx odorata*), licuri (*Syagrus coronata*), tucum (*Astrocaryum aculeatum*), angico (*Anadenanthera colubrina*), barbatimão (*Stryphnodendron adstringens*), pineapple, cocoa, passion fruit, cassava, guaraná, native fishes, and honey. Together, these markets were valued at approximately R\$ 50 billion in 2023. Figure 2 shows the products, its production value in 2023, production volume and mean price.

Figure 2: Sociobiodiversity products, its production value, production volume and mean price in 2023.

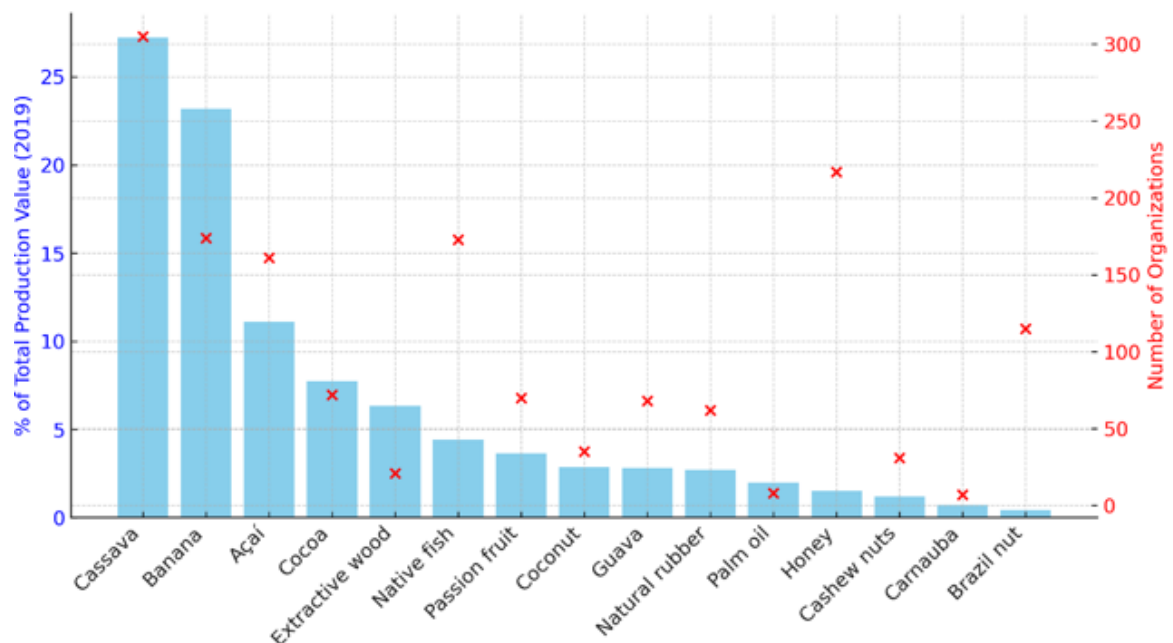


Source: Authors using data from SIDRA/IBGE, 2025

Prices paid to producers vary a lot but are generally low, especially if they are consumed only as food, as are the case for umbu (R\$ 1,59/kg), cassava (R\$ 1,04/Kg), pineapple (R\$ 2,45/Kg), pequi fruit (R\$ 1,28/Kg), while tonka bean (R\$ 43,40/kg), copaiba oil (R\$ 43,03/kg) and ipecacuanha (R\$ 132,00/kg), sold mainly as raw material to cosmetic and pharmaceutical products, can reach higher values (Figure 2). For several products traded by community-based enterprises, including cupuaçu (*Theobroma grandiflorum*), acerola (*Malpighia emarginata*),

andiroba (*Carapa guianensis*), guava (*Psidium guajava*), and extractive wood, price data were unavailable. Low prices in general for almost all sociobiodiversity products is mainly explained because processing is minimal, with most products sold fresh, frozen, or as basic raw materials. Only 5% of organizations report producing value-added goods. Processing typically consists of cleaning, selection, and quality grading. Sales occur mainly in local markets or through intermediaries. In 2019, products with the largest share of total production value were cassava (27.23%), bananas (23.20%), açaí (11.13%), cocoa (7.73%), extractive wood (6.33%), native fish (4.42%), passion fruit (3.63%), coconut (2.88%), guava (2.84%), natural rubber (2.71%), honey (1.52%), and cashew nuts (1.20%). All other products accounted for less than 1% of total value (Figure 3). When considering extractivism alone, five products – extractive wood (64%), açaí (18%), carnauba (7%), Brazil nut (4%), and babassu (3%) – account for 96% of total production value.

Figure 3: Product distribution by production value and number of organizations.



Source: Authors, 2025

According to IBGE data, in 2023, the native product with the highest volume and production value was cassava, the main product of Brazilian biodiversity. It accounted for 50% of the value and 40% of the volume of all native products analyzed here. It is also the main product traded by community-based organizations in all regions of Brazil. A total of 316 organizations reported selling cassava flour or the fresh product, focusing mainly on the local

market (86%). Açaí is the second native product with the highest share of production value in 2023, accounting for 18% (almost R\$ 9 billion) when combining wild-harvested and cultivated production, followed by cocoa (10%). Currently, only 12% of açaí production comes from extractivism. Brazil nut, despite being one of the main extractive products with a consolidated chain [43], represents only 0.42% of total production value.

In terms of the number of associations or cooperatives marketing these products, the leaders are cassava (305), honey (217), bananas (174), native fish (173), açaí (161), Brazil nut (115), cocoa (72), passion fruit (70), guava (68), and natural rubber (62). Most other products involve fewer than 50 organizations (Figure 3).

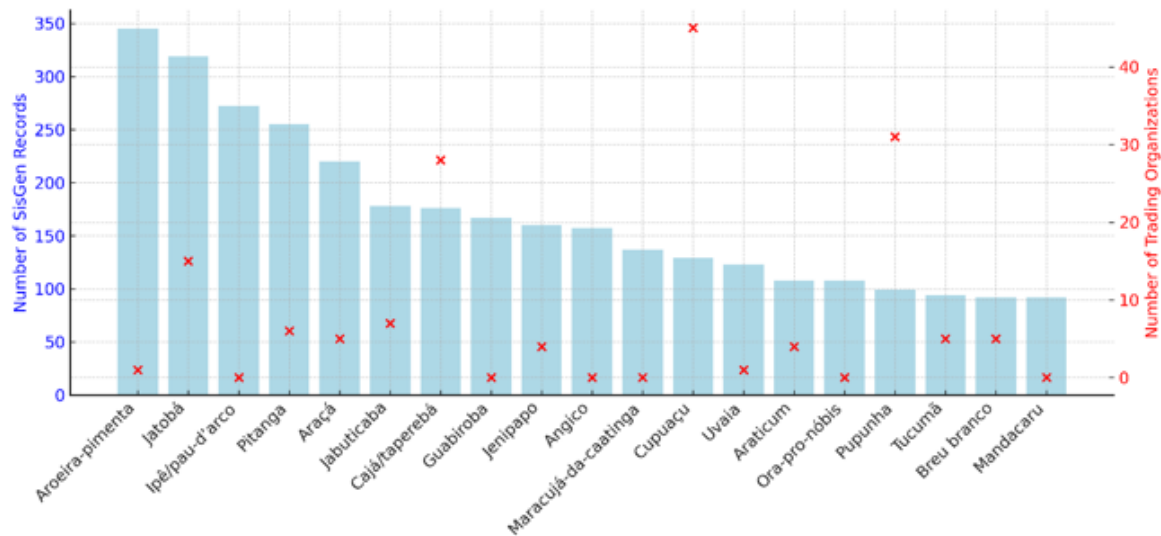
2.4.2 Research and development (R&D) potential

We identified almost 17.000 different vegetal species with ongoing R&D activities registered in the SisGen, although 46% of them (7.807 species) had only one record. 1.953 vegetal species have more than 10 access records, showing the potential of Brazilian native flora. Species like pitanga (*Eugenia uniflora*), aroeira-pimenteira (*Schinus terebinthifolius*), jatobá (*Hymenaea courbaril*), macaúba, araçá (*Psidium cattleianum*/*Psidium guineense*), andiroba, cajá (*Spondias mombin*), urundeúva (*Myracrodruon urundeuva*), baru (*Dipteryx alata*), capim-santo (*Cymbopogon citratus*), jenipapo (*Genipa americana*), copaiba, pupunha (*Bactris gasipaes*), araticum (*Annona crassiflora*), bacuri (*Platonia insignis*), guabiroba (*Campomanesia xanthocarpa*) and jabuticaba (*Plinia cauliflora*) are among the 50 most accessed. That is a good signal that they are of great interest to the market for the development of new product.

95 species among the most accessed are already marketed by community-based enterprises (SM), although for most of them there is no official information about their production. Figure 4 lists the species with the highest number of SisGen records, alongside the number of marketing organizations.

Products with both high R&D activity and established marketing channels have the greatest potential to develop consolidated value chains. These include aroeira-pimenteira, jatobá, pitanga, araçá, jabuticaba, among others (Figure 4).

Figure 4: Products with R&D: number of SisGen records vs. number of trading community-based organizations.



Source: Authors, 2025

2.4.3 Market Dynamics of Sociobiodiversity Products

Of the 152 sociobiodiversity products identified, only 23% (36 products) could have their chains classified in terms of market dynamics according to established criteria. Analysis of production trends over 2006–2023 revealed that 14 products exhibited positive growth rates (açaí, natural rubber, cocoa, palm oil, guava, honey, palm heart, pequi, Brazil nut, Brazilian pine, mangaba, umbu, yerba mate, and tonka bean) while 12 exhibited negative growth rates (babassu, cashew nut, copaíba, cassava, tucum, extractive woods, licuri, barbatimão, piassava, ipecacuanha, angico and carnauba). The most relevant products (based on both production value share or number of marketing organizations) include cassava, honey, banana, açaí, cocoa, extractive wood, native fish, passion fruit, coconut, guava, natural rubber, cashew nuts, babassu, buriti, carnauba, Brazil nuts, and palm hearts. Palm oil is the only product with high production value but a limited organizational base (eight cooperatives/associations). Based on IBGE's historical production data:

- Eight products were classified as dynamics: açaí, natural rubber, cocoa, palm oil, guava, honey, Brazil nut, and yerba mate.
- Nine products were classified as stationary: pineapple, banana, native fishes, passion fruit, coconut, annatto, guarana, buriti, and jaborandi.

- Twelve products were classified as declining: barbatimão, tucum, piassava, ipecacuanha, angico, cassava, extractive wood, cashew nut, babaçu, carnaúba, copaíba, and licuri.
- Six products were classified as promising: palm heart, mangaba, Brazilian pine nuts, umbu, tonka beans, and pequi.

Figure 5 summarizes production value, growth rates and market dynamics classification for each product.

Figure 5: Market dynamics for sociobiodiversity products.



Source: Authors, 2025

2.4.4 Actors and Organizational Landscape

We identified 822 community-based organizations marketing the 36 analyzed products. All operate within the family farming framework, and most (77.5%) market more than one product. Sociobiodiversity product marketing generally complements household income, with limited reliance on a single commodity.

A large share of organizations (80%) use multiple sales channels, while 60% sell to intermediaries. Half of the organizations access public procurement programs such as the Programa de Aquisição de Alimentos (PAA), Programa Nacional de Alimentação Escolar (PNAE), or Política de Garantia de Preços Mínimos para Produtos da Sociobiodiversidade (PGPM-Bio). Nevertheless, of the 64 products eligible for these programs (Brasil, 2016), only 17 receive PGPM-Bio subsidies. Furthermore, 21 had no associated producer organizations.

In 2018, when data was collected, only 47% of organizations hold a valid Declaração de Aptidão ao PRONAF – DAP (replaced, as of November 2022, by the National Registry of Family Farming – CAF, in accordance with the regulations of the Ministry of Agrarian Development and Family Farming). The document is the primary instrument granting access to public policies for family farming. This reflects a high level of informality, as 53% either lack or have expired DAP registration.

On average, each organization has five institutional supporters, including government agencies, universities, research institutions, NGOs, and private companies. Notably, 22% sell directly to large corporations, with Natura identified as the most engaged buyer.

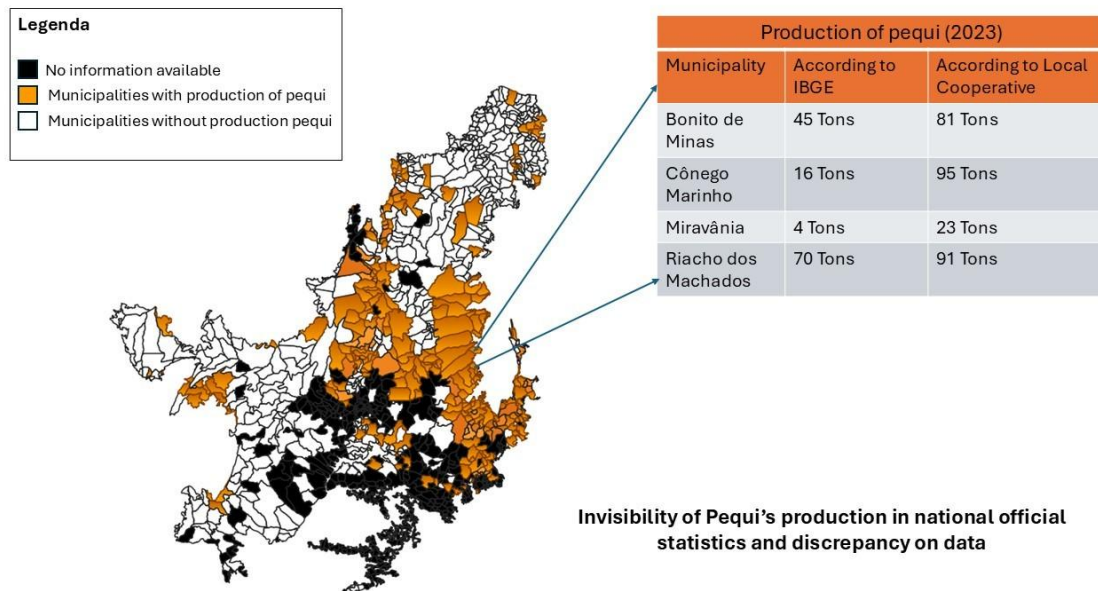
Well-structured value chains tend to be linked to large-scale agricultural production (e.g., cocoa, bananas, coconuts, passion fruit, honey, guava, cassava) or to extractive products that have transitioned to cultivation (e.g., açaí, natural rubber). These cultivated forms often surpass extractivist production volumes and have shifted geographically beyond their original range [105]. For instance, São Paulo State nowadays accounts for 60% of the country's natural rubber production while 93% of the community-based organizations that market this product remain located in the Amazon.

By contrast, value chains restricted to extractivism, such as pequi, baru, babaçu, carnauba, licuri, mangaba, copaíba, umbu, piaçava, barbatimão, macaúba, and pine nuts, are generally poorly consolidated, highly seasonal, and dependent on government purchases. Some of them are relevant only at the local or regional scale. For example, babassu is vital for generating income for low-income families of traditional people, especially for women known as "babassu coconut breakers", who are heads of households dependent on the fruit for their livelihoods [78]. Similarly, pequi is very important for agro-extractivist populations and local economies, where some "collectors" and traders obtain up to 80% of their annual income from selling the fruit [79].

2.4.5 Gaps and discrepancies in data⁷

The comparison between production data from IBGE with figures provided by a leading local cooperative revealed two main trends. First, that value chains of native species are largely absent from systematic monitoring of their use, production, or market flows, corroborating previous studies [78,131]. Of the 18 native species collected and commercialized by agroextractivists locally, only four (umbu, mangaba, pequi, and buriti) are tracked in official datasets. Only five species, including macaúba, are recognized under public procurement programs, despite their socio-economic relevance. Even for pequi, the most consolidated product, official data is incomplete (Fig. 6). Among the 1,434 municipalities in the Cerrado, its natural distribution area, only 292 (20%) appear in IBGE statistics, as the institute only records volumes above one ton. This implies that in 42% of municipalities, pequi production exists but remains unregistered, while in 38% there is no data at all. Such undervaluation further amplifies the lack of knowledge about real production levels.

Fig. 6: Map with data on pequi production (IBGE) in municipalities of the Cerrado biome. Yellow refers to municipalities producing pequi; white indicates those with no production; and black represents municipalities with no data available. The table compares IBGE data with figures from the local Cooperative for the four largest producing municipalities.



Source: Author, 2025

⁷ Extended abstract presented at the Living Data 2025 in Bogotá, Colômbia, and submitted to Biodiversity Information Science and Standards (BISS) Journal.

Another finding was the marked discrepancy between official statistics and actual production reported by cooperatives. In four leading pequi-producing municipalities, official records diverged substantially from local data. In Cônego Marinho, for instance, just 30 agroextractivists collected six times more pequi than IBGE registered for the entire municipality in 2023, and in Miravânia two collectors harvested more than five times the official figure.

2.5 Discussion

This study started by analyzing secondary data on the supply, demand, and actors associated with sociobiodiversity products, with the aim of exploring their potential role in fostering a sociobiodiversity bioeconomy in Brazil. The results reveal a highly heterogeneous landscape among the main products, underscoring the need for differentiated strategies tailored to the characteristics of each value chain. Only 5% (8 of 152) of the mapped products can currently be considered both relevant and dynamic, and even these occupy a small niche in the global market [93]. More than half (58%, or 21 of the 36 analysed) are stationary or declining, and although 6 are classified as promising and 14 as having high potential for future added value, most of Brazil's sociobiodiversity remains understudied, despite decades of recognition of its potential [76,105].

Tendencies like the commodification of açaí through monoculture expansion (referred to as “açaization”) or the displacement of traditional extractive production from original biomes to cultivation systems in other regions (the case of natural rubber) illustrates how sociobiodiversity products, once transformed into commodities under intensive production regimes, can undergo profound structural changes in their market and production dynamics [132]. These processes bring not only environmental concerns but also raise questions about the future of local communities traditionally associated to them with the risk of disconnecting the cultural and territorial identity aspects associated with sociobiodiversity products. The findings reinforce arguments that sociobiodiversity products should not be viewed solely as raw materials or assessed only in terms of production volumes or GDP contribution [77,133]. Instead, they embody ecological, cultural, and social dimensions that extend far beyond economic metrics.

A major limitation highlighted by this study is the scarcity of systematic data, despite the widely acknowledged potential of these products for developing innovative goods and services if Brazil is really considering implementing sociobiodiversity-based bioeconomy [93,115]. Our results underscore the sharp narrowing from the vast biodiversity potential,

represented by approximately 17,000 species registered in SisGen, to the very limited subset of only 36 with sufficient official data to allow for an analysis of supply, demand, and actors, highlighting the structural bottlenecks that constrain the transformation of biological richness into consolidated value chains and measurable socioeconomic outcomes.

Other studies have shown that there are more than 2000 NTFP only in the Amazon region [76] and at least 636 native plants with current or potential economic value in Brazil have already been identified as priorities for application in different sectors of society [105]. The absence of comprehensive statistical data, particularly for products obtained through extractivism, reflects the high level of informality in the sector and constitutes a significant barrier to assessing the feasibility of a sociobiodiversity-based bioeconomy [105,115].

To effectively plan production, marketing, and conservation strategies, there is the need for official data for at least the species currently in use and traded identified in this present study. Similarly, even though this study employed the most comprehensive mapping of community-based organizations available (Conexsus Institute), the actual number of cooperatives and associations marketing sociobiodiversity products is likely underreported. This lack of statistical coverage constrains the design of targeted public policies, limits opportunities for private investment, and contributes to the marginalization of these markets. Informal and under-documented value chains remain invisible in policy debates, perpetuating a cycle in which the absence of data leads to the absence of investment and institutional support.

There is substantial scope for market expansion, but structural challenges must be addressed, particularly for chains dependent exclusively on extractivism [93,105,139]. These include informality, market fragility, low levels of social and productive organization, high perishability, elevated transaction costs, and limited technical capacity for processing, resource management, and sustainable harvesting [120,135]. Low producer prices for minimally processed goods further undermine the economic viability of these chains, limiting their potential as sustainable income sources for traditional communities and family farmers [116,133]. Low added value and high informality also impede benefit-sharing arrangements, a key objective of the Convention on Biological Diversity (CBD), the Nagoya Protocol, and the principles of the bioeconomy [77].

In this sense, considering their current configuration – marked by low levels of value addition, informality, and the predominant recognition of products merely in terms of physical volume rather than the diversity of social and ecological values they embody – these sociobiodiversity systems can hardly be described as value chains. In our view, they should instead be regarded as production chains, since the processes that truly generate and distribute

value, both materially and immaterially, remain largely absent or invisible within the current bioeconomic framework.

Our results reinforce the need for more effective integration between science, public policy, and local economy agendas in order to align the development of new products and technologies with strategies for territorial valorization, cultural recognition, and fair benefit-sharing [107]. Products with high innovation potential, but still economically invisible, should be prioritized in strategies to foster value chain structuring, value addition, and origin valorization, especially in contexts where traditional knowledge and community-based management are central. Strengthening sociobiodiversity value chains requires coordinated action on several fronts: namely on a) policy and investment: design and implementation of specific public policies to attract private investment and encourage processing industries [112,136]; b) Value recognition: adding intangible value to products through origin-based certification linked to producing territories and traditions [131]; c) Territorial intelligence: development of traceability systems and spatial data to guide decision-making [137].

Support from institutional partners (governmental, private, or non-profit) already plays a critical role in strengthening associations and cooperatives, as evidenced by Conexsus mapping data. Such support fosters cooperative governance, facilitates market access, promotes product diversification and vertical integration, and ultimately improves income generation [115]. Nevertheless, market prices for these products rarely reflect their ecological, cultural, and social significance [138]. In many cases, native species are traded as undifferentiated commodities (akin to soy, rice, or iron ore) despite their embedded cultural heritage and contributions to ecosystem services [139]. Conventional markets largely ignore the non-monetary values of nature, such as its cultural significance, subsistence role, and ecological functions [93,113,136]. Recognizing these values is essential for embedding sociobiodiversity within a sustainable bioeconomy that aligns economic development with traditional livelihoods and biodiversity conservation.

Regarding the results showing the gap between official production data of pequi from IBGE and the data reported from the local cooperative, the discrepancies may arise from multiple factors, including the informal or subsistence character of many extractive activities. If this is the case, the national statistics may fail to capture the full economic, ecological, and cultural importance of native species to rural and traditional communities. Understanding these data mismatches is essential for improving the accuracy and inclusiveness of biodiversity and bioeconomy indicators. Our results highlight the need to strengthen local monitoring capacities and create integrated data systems that combine national official records with community-based

knowledge to unlock the transformative potential of Brazil's sociobiodiversity. Investments in territorialized data governance are essential to ensure more accurate representation of sociobiodiversity value chains, enabling place-based policies that align biodiversity conservation with inclusive economic development. Strengthening the visibility of native species in data systems is needed not only to improve accuracy but also to ensure informed decision-making, equitable benefit-sharing, and resilience in the face of environmental and social challenges. Making sociobiodiversity visible in data is a prerequisite for building a sustainable and just bioeconomy.

2.6 Conclusion

Brazil holds an exceptionally rich and diverse sociobiodiversity, which represents a strategic asset for building a more sustainable development model. A bioeconomy grounded in sociobiodiversity products offers an opportunity to combine economic growth, environmental conservation, and cultural preservation. However, for this strategy to succeed, it is essential to formalize and strengthen sociobiodiversity value chains, which in most cases remain informal and fragmented.

This study identified products that are either already relevant in the market or hold significant potential for future development and can therefore be prioritized in policy and investment agendas. For the majority of the 152 products referenced in the literature, substantial gaps in research and statistical data still hinder the integration and visibility of their supply, demand, and actors. For the 36 products with available official data, we provide a recent overview of market performance and production trends. Products showing stagnation or decline require targeted interventions to address the underlying causes of reduced production. Their future trajectories will depend largely on proactive public policies and the engagement of private investment.

Our findings also reveal a misalignment between the resources prioritized in research and technological development and those targeted by public policies or most relevant to agroextractivist producers. Bridging this gap is critical. Above all, the development of policies to structure sociobiodiversity chains, particularly within the bioeconomy framework, might adopt a holistic and strategic perspective, integrating ecological, economic, social, and cultural dimensions.

3 INTERMEDIARY ORGANIZATIONS AND THE STRUCTURING OF SOCIOBIODIVERSITY-BASED PRODUCT CHAINS IN BRAZIL⁸

3.1 Abstract

Megabiodiverse countries with a multiplicity of traditional livelihoods have been putting forward policies and funding mechanisms for including the use of native species, often through the development of product chains, as mainstream strategies for conservation. Yet, how these initiatives have emerged, evolved, and how actors have interacted remains poorly understood. Here, we summarize data on projects and initiatives implemented between 1995 and 2024 in Brazil. A data mining process documented 7,298 initiatives and projects across Brazilian Municipalities. A detailed analysis of 1,286 projects reveals a complex but uneven support ecosystem. Intermediary organizations, strongly centered around the Amazon Fund, act as network integrators, connecting local communities to public policies and funding through capacity-building, infrastructure, and access to markets. Although this ecosystem has evolved, it still faces challenges from limited private-sector engagement, recurrent short-term funding cycles, and scarce value addition across sociobiodiversity value chains. Lessons from over thirty years of sociobiodiversity investment can guide public policies toward integrated, long-term strategies. Reinforcing territorial governance, private-sector participation, and adaptive learning would allow these product chains to generate ecological and social co-benefits across Brazil's biomes and beyond.

Keywords: community-based organizations; non timber forest products; governance; meso-institutions

3.2 Introduction

In megabiodiverse countries, where traditional livelihoods have long depended on natural resources, conservation strategies increasingly incorporate the development of productive chains based on biodiversity products with the aim of creating economic incentives to maintain standing native vegetation while improving the living conditions of traditional communities [65,140–145].

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In Brazil, the idea of linking biodiversity use with local economies is not new. Since the early 1990s, Brazil has promoted the sustainable extraction and commercialization of non-timber forest products (NTFP) as a way to generate income while maintaining forest cover [146–148]. Early programs such as the Pilot Program to Conserve the Brazilian Rain Forest (PPG7) and the Small Projects Program (PD/A) introduced participatory approaches and direct funding to civil society organizations (CSO) [11]. Following, several policies were implemented: Amazon Fund (2008), the National Plan for the Promotion of Sociobiodiversity Value Chains (PNPSB) (2009), and National Policy on Agroecology and Organic Production (PLANAPO) (2012) (see Supplementary Material - SM1 for a detailed analysis of programs and funding initiatives). Together, these instruments sought to align environmental conservation with income generation and social inclusion, in contrast to Brazil's dominant agro-industrial model based on large-scale commodity production and land concentration [33,35,149,150].

Over time, in Brazil the concept of NTFP has evolved into what is now referred to as sociobiodiversity products [46,101,151–155]. This broader framework encompasses not only forest products but also goods derived from agriculture and agroforestry managed by traditional communities and smallholder farmers (included in the concept of IP&LC). The shift from the NTFP focus to the sociobiodiversity approach reflects a growing recognition of cultural and territorial dimensions of biodiversity use [114], as well as the need for integrated strategies that connect conservation, livelihoods, and local economies [99,156,157]. In this context, the recent debate around Brazil's sociobiodiversity-based bioeconomy agenda [42,106,107,158] and the development of the National Plan for the Sociobiodiversity-Based Bioeconomy (PNSB) opens a window of opportunity [100] to transform decades of project-based experimentation into long-term institutional ecosystems capable of effectively structuring sociobiodiversity chains [106,159].

From the promotion of NTFPs in the 1990s to the rise of sociobiodiversity-based bioeconomy agendas after 2010, the principle of “conservation through use” gradually gained prominence in conservation policies [139]. However, community-based cooperatives and associations, formed by smallholder farmers, agroextractivists, and traditional communities who represent the grassroots level of sociobiodiversity productive chains, still face persistent structural barriers, including limited organizational capacity and restricted market access [51,160]. In parallel, meso-institutions, also called intermediary organizations –actors or networks that act as facilitators, connectors, and articulators in sociobiodiversity chains – play an important role in translating demands and opportunities between local and national levels,

supporting productive arrangements, and ensuring the inclusion of traditionally marginalized actors [46,161].

While the literature on transition intermediaries highlights the role of meso-institutions in connecting actors and coordinating multi-level processes [162,163], the framework of experimentalist governance offers a complementary perspective to understand how such coordination unfolds through iterative, learning-based processes [164]. Rather than relying on fixed, top-down regulations, experimentalist governance operates through provisional goal-setting, decentralized implementation, and continuous feedback between local experimentation and higher-level rulemaking [164]. This recursive and adaptive process aligns closely with the dynamics of the sociobiodiversity bioeconomy, where intermediary organizations foster learning loops between grassroots initiatives and policy frameworks, enabling innovation, coordination, and territorial adaptation across scales [165].

Understanding how intermediary organizations operate within this experimentalist architecture is crucial to explain the institutional trajectory of sociobiodiversity chains in Brazil. Over the past three decades, a wide array of programs, networks, and funding mechanisms has emerged to support community-based production systems [166,167], yet their coordination, learning dynamics, and long-term integration remain uneven. Examining these institutional arrangements through the lens of experimentalist governance allows us to identify how different actors interact across scales, how lessons circulate between local practices and national frameworks, and why systemic consolidation has proven difficult despite persistent policy and financial efforts.

Here we analyze the institutional evolution of Brazil's sociobiodiversity support initiatives (1995–2025), asking: (i) how these initiatives have evolved; (ii) which actors and networks foster this agenda; and (iii) what institutional factors limit the consolidation of these value chains despite decades of investment.

3.3 Methodological approach and empirical scope

This study adopted a mixed-methods approach, combining quantitative and qualitative analyses of secondary data. The methodological design followed two complementary stages: (i) a systematic analysis of initiatives targeting productive chains from native species across community-based organizations; and (ii) an institutional network analysis mapping partnerships between these organizations and their supporting actors. Together, these approaches provide an

integrated understanding of both the content of interventions (types of support provided) and the structure of the support ecosystem (who collaborates with whom).

In the first stage a web scraping approach and data mining was carried out to survey Brazilian initiatives that promote local community engagement through the use and commercialization of native species/NTFP. We collected data from websites of governmental, NGOs, foundations and funding entities that provide open access.

Following a detailed review of the data sources, we identified 1,286 initiatives that are directly related to sociobiodiversity chains and had additional information regarding the year of intervention and the amount of investment, which allowed us a temporal analysis. All of these 1,286 initiatives are projects financed by the main funds in the field of sociobiodiversity in Brazil. The selection went down to 384 initiatives (projects) that explicitly provided information about the type of intervention. Based on the typology proposed by Rosenfeld [167], the projects were classified according to three main types of support/intervention:

- Capacity building and institutional strengthening. It involves developing community skills and organizational capacities for sustainable resource management, collective governance, and market engagement through technical assistance, training, and advisory support.
- Financial support and infrastructure improvements. It encompasses investments in productive and logistical assets—such as equipment, agro-industries, and transport—through grants or hybrid financing, aiming to remove value chain bottlenecks and expand community participation in value creation.
- Market access. It includes actions to expand commercialization and income opportunities by connecting producers and consumers, reducing intermediaries, and enabling entry into regional, national, or international markets through certifications, collective brands, and value-added niches.

We constructed curated keyword dictionaries for each modality and applied regular-expression matching (Python) to project abstracts and activities carried out to flag modalities present in each record. Keyword-based coding identified each support type and their overlaps, allowing analysis of how projects combined one, two, or all three modalities to assess the integration and complexity of support arrangements (Supplementary Material - SM). Still on information regarding project abstracts/activities carried out, we also conducted a full-text reading and searched for keywords indicating value addition to the product ('beneficiation', 'value addition', 'processing', 'agroindustry', 'pulp machine', 'production diversification', 'quality improvement', 'certification', 'product valorization', 'industrialization').

Later, in the second stage, we cross-referenced our 384 projects database with the partners associated with 1,044 community-based organizations in the Conexsus Institute's open-access database of community-based enterprises that participated in the 2018 Conexsus Challenge (<https://desafioconexsus.org/mapa-desafio-conexsus/>) (accessed July 2025). This dataset compiles self-reported information from associations or cooperatives of family farmers and agroextractive communities that commercialize sociobiodiversity products and their main institutional partners. Although not up to date, it is the most comprehensive database publicly available so far. Each community organization is linked to one or more partners, classified according to their institutional function. We aggregated the partner categories associated with each of the 1,044 community organizations generating: (i) frequency ranks of partner categories, and (ii) co-occurrence matrices (which categories appear together supporting the same organization), and (iii) simplified two-mode projections to identify central categories and typical collaboration bundles (e.g., government + technical assistance + civil society organization).

Finally, to identify recurrent institutional lessons and recommendations and to trace institutional evolution trajectories, we conducted a qualitative document review of institutional reports, monitoring publications, and annual activity reports from key national intermediaries that play a structuring role in the field. These included: Instituto Sociedade, População e Natureza (ISPN), Instituto Internacional de Educação do Brasil (IIEB), Fundação Amazonas Sustentável (FAS), Instituto de Conservação e Desenvolvimento Sustentável da Amazônia (IDESAM), Instituto Conexsus, Fundo Casa Socioambiental, Banco do Brasil Foundation, Fundo Socioambiental da Caixa and the Partnerships for the Amazon Platform (PPA). Each report was systematically analyzed, and information on lessons learned and recommendations was extracted and synthesized into a comparative table. For each entry, we recorded the organization, report title and year, a concise synthesis of lessons and recommendations, thematic codes, and a short supporting quotation (SM). Thematic codes were used to classify each finding according to its institutional focus: FUND (funding continuity and long-term financial mechanisms), ADMIN (administrative simplification and reduction of transaction costs), TA (technical assistance and organizational strengthening), MARKET (market access, value addition, and commercialization strategies), MEL (monitoring, evaluation, and learning systems), GOV (multi-actor coordination and policy integration), and RIGHTS (land tenure, territorial governance, and local rights recognition). This approach allowed for cross-organizational comparison of recurring institutional challenges, trajectories of institutional change, and proposed solutions over time.

3.4 Results

3.4.1 Institutional evolution trajectories (1995–2025)

Brazil's sociobiodiversity economy has evolved through successive generations of programs linking biodiversity conservation with local livelihoods [166,167]. First initiatives were developed back to the 1990s [147,149]. In 1994, the Small Eco-Social Projects Program (PPP-ECOS) was created as the Brazilian branch of the Small Grants Programme (GEF/UNDP) [168]. It is coordinated by ISPN and initially focused on the Cerrado biome and adjacent transition areas, supporting community initiatives that combined biodiversity conservation with sustainable livelihoods [169]. In 1995, under the PPG-7, the PD/A was designed to test innovative community-based models of sustainable natural resource use and local development across the Amazon and Atlantic Forest regions [149]. Both programs financed hundreds of micro-projects in rural and traditional communities (97 projects by PDA and 289 by PPP-ECOS), supporting a wide range of community-based organizations, including associations, cooperatives, unions, indigenous peoples, quilombola communities, and agrarian reform settlers as well as local NGOs. They prioritized small-scale proponents, often funding their first collective projects, through annual public calls offering grants of up to US\$50,000. Direct community participation was a defining feature of these initiatives [170].

The Amazon Fund (Fundo Amazônia) was established in 2008 as a pioneering national mechanism to finance actions aimed at preventing deforestation and promoting the sustainable use of forests in the Brazilian Amazon. Managed by the Brazilian Development Bank (BNDES), the Fund was created under the REDD+ framework and designed to channel results-based, non-reimbursable donations from international partners, primarily the Government of Norway, followed by Germany and Petrobras. Its governance model combines centralized financial management with participatory oversight through the Guidance Committee (COFA), which includes representatives from federal and state governments, CSO, and the private sector [171]. By integrating international environmental finance into domestic institutions, the Amazon Fund became a key driver for scaling up initiatives linking conservation, sustainable production, and territorial development.

These mechanisms – the early phases of the PPP-ECOS, the PD/A, and the initial structuring of the Amazon Fund – were characterized by international donor funding channeled directly to local organizations [149,169]. Support was typically targeted to specific needs, such as technical training or equipment acquisition, with limited integration among stakeholders

[171]. Overall, these interventions reflected a traditional project-based model centered on isolated beneficiaries and lacking territorial or systemic coordination.

A new phase emerged from 2009 with the creation and refinement of public funding instruments specifically tailored to sociobiodiversity and agroecology. The Ecoforte Program, linked to the PLANAPO, played a pivotal role in supporting networks of cooperatives and social movements, building on earlier experiences such as Cataforte, which had strengthened recyclable waste collectors' organizations [172]. Simultaneously, acknowledging the lack of technical and managerial capacity of many grassroots organizations in meeting administrative requirements to access funding, the Amazon Fund underwent a major revision in 2012 [171]. It started adopting the “aggregator” (aglutinadoras) model that enabled intermediary institutions such as FAS, ISA, ISPN, and Imaflora to launch public calls, manage subprojects, and provide technical assistance—thereby expanding access for grassroots actors [171]. The public calls for “Sustainable Productive Activities” (2012) and “Territorial and Environmental Management Plans (PGTAs) for Indigenous Lands” (2014) required multi-sectoral land-use plans and cross-chain articulation (e.g., Brazil nut + oils + tourism + seeds), representing the first ecosystemic public policy approach to sociobiodiversity. During this period, additional mechanisms such as the Caixa Socio-Environmental Fund [173], the PNPSB (2009), and the Minimum Price Guarantee Policy for Sociobiodiversity Products – PGPM-Bio (2009) were also consolidated. Together, these instruments marked the beginning of a transition toward network-based strategies that emphasized territorial approaches.

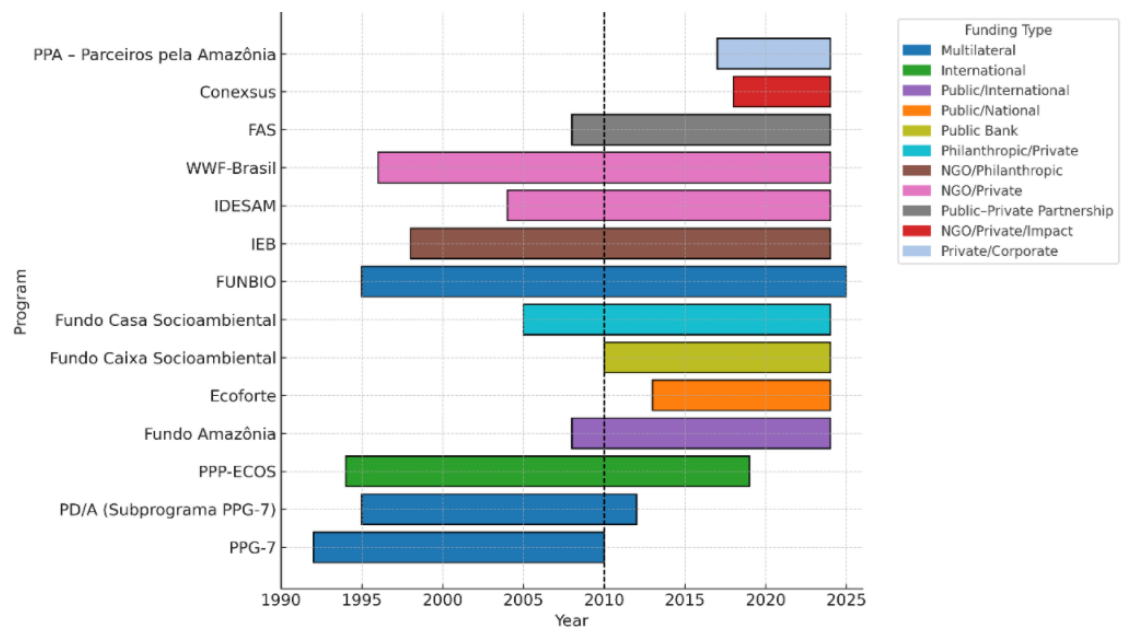
From 2018 onward, state mechanisms were complemented by hybrid public-philanthropic coalitions. Initiatives like Conexsus, Sitawi, and the PPA developed blended-finance instruments combining grants, revolving funds, guarantees, and market facilitation [174]. The FAS “Floresta em Pé” [175] and IDESAM programs connected sociobiodiversity production with carbon and restoration finance, emphasizing long-term territorial presence [176]. The PPP-ECOS Phase 2 (2018) expanded support for institutional strengthening and information systems, preparing community organizations for autonomous management. In 2024, Ecoforte was relaunched with R\$100 million, prioritizing agroecological networks, women, youth, and traditional peoples [177].

In 2025, Banco do Brasil launched the Amazon Financial Hub, with the aim of coordinating multiple capital sources (rural credit lines, investment funds, and international partnerships) to finance sustainable and structuring ventures in the region. Amazônia Viva, created by Natura in partnership with VERT Securitizadora and FUNBIO, operates through a hybrid model that combines Agribusiness Receivables Certificates (CRA) with a philanthropic

fund, providing advance financing and technical assistance to extractive cooperatives. The Amazon Food & Forest Financing Initiative, launched by Impact Bank and The Nature Conservancy (TNC), functions as an impact credit platform for agroforestry value chains, blending commercial capital with environmental risk mitigation tools. Finally, the Sitawi Collective Lending Platform enables individual and institutional investors to support sociobioeconomic organizations through low-interest revolving loans, generating moderate financial returns and high social–environmental impact. Together, these mechanisms exemplify a new generation of finance instruments tailored to the Amazonian context, proposing more permanent, scalable, and impact-oriented financial architectures [178].

Figure 1 presents the timeline of key programs and funding mechanisms that have shaped Brazil’s sociobiodiversity support ecosystem since the 1990s. It also illustrates the changing profile of funding types—from multilateral and international cooperation to national public funds and, more recently, hybrid arrangements involving public–private and philanthropic partnerships—showing how the institutional landscape has become more diverse and interconnected over time.

Figure 1: Institutional trajectories and funding profiles of sociobiodiversity support programs (1995–2025)

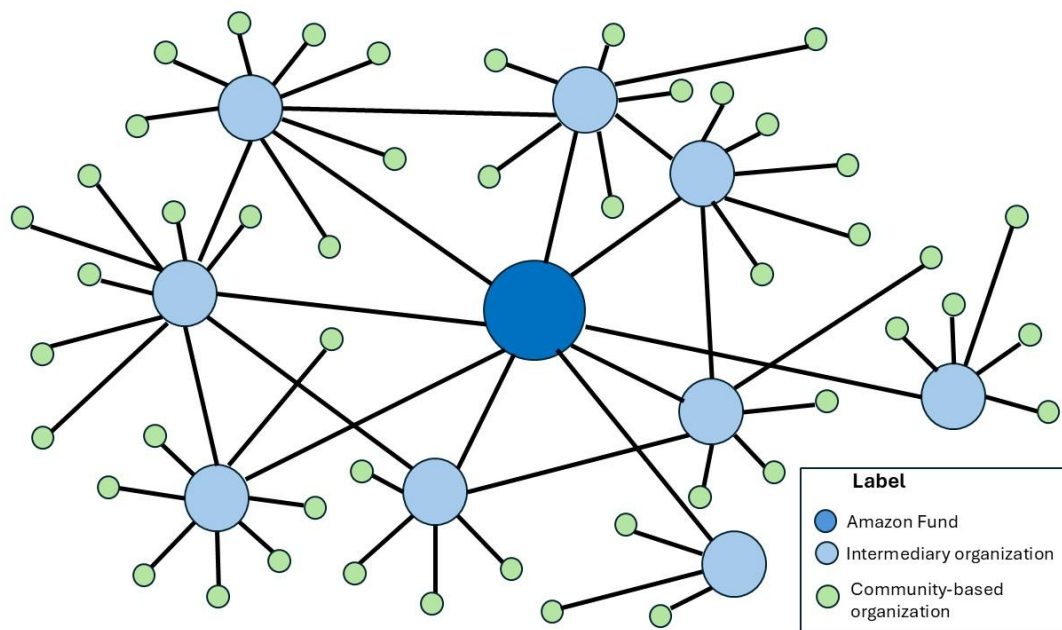


Source: Author, 2025

3.4.2 Intermediary-led governance: the architecture of sociobiodiversity networks

The consolidated corpus of 1,286 Brazilian initiatives reveals a dense institutional web of projects. The Amazon Fund stands as the structural backbone of this ecosystem, allocating over R\$3 billion to sociobiodiversity projects and functioning as both a financial super-hub and a data integrator linking nearly every major organization. Around this centralized core, other pivotal actors (intermediary organizations) serve as bridging nodes connecting multiple funding sources and territorial programs (Figure 2).

Figure 2: Multi-tier network architecture of the Amazon Fund linking intermediary and grassroots organizations. The Amazon Fund operates as a multi-level coordination hub linking intermediary organizations (light blue) to community-based organizations (green). Its network structure reveals a hierarchical pattern in which financial and technical flows are channeled from the Fund (dark blue) through intermediaries that, in turn, support numerous grassroots initiatives, illustrating the Fund's pivotal role in supporting Brazil's sociobiodiversity bioeconomy.



Source: Author, 2025

By mobilizing large volumes of resources (often above R\$100 million), intermediary organizations redistribute smaller grants (typically R\$50,000–150,000) to community-based organizations for localized activities such as training, diagnostic studies, and upgrading of small processing units. However, access remains asymmetric. Only nine community-based organizations were direct beneficiaries of the Amazon Fund, underscoring the administrative and legal barriers that still hinder smaller entities from accessing large-scale mechanisms. In this sense, intermediary organizations—including ISPN, IEB, FASE, Instituto Socioambiental,

and the Comissão Pró-Índio do Acre—play a crucial compensatory role. They not only manage multi-million-real portfolios but also perform multiple functions: executing projects, offering technical assistance, organizing calls for proposals, and coordinating territorial and thematic networks. For instance, ISPN, by channeling resources from GEF, Fundação Vale, and the Amazon Fund, financed over 90 grassroots organizations through PPP-ECOS. Similarly, FUNBIO manages contributions from over 60 donors, ensuring continuity and complementarity across initiatives [146].

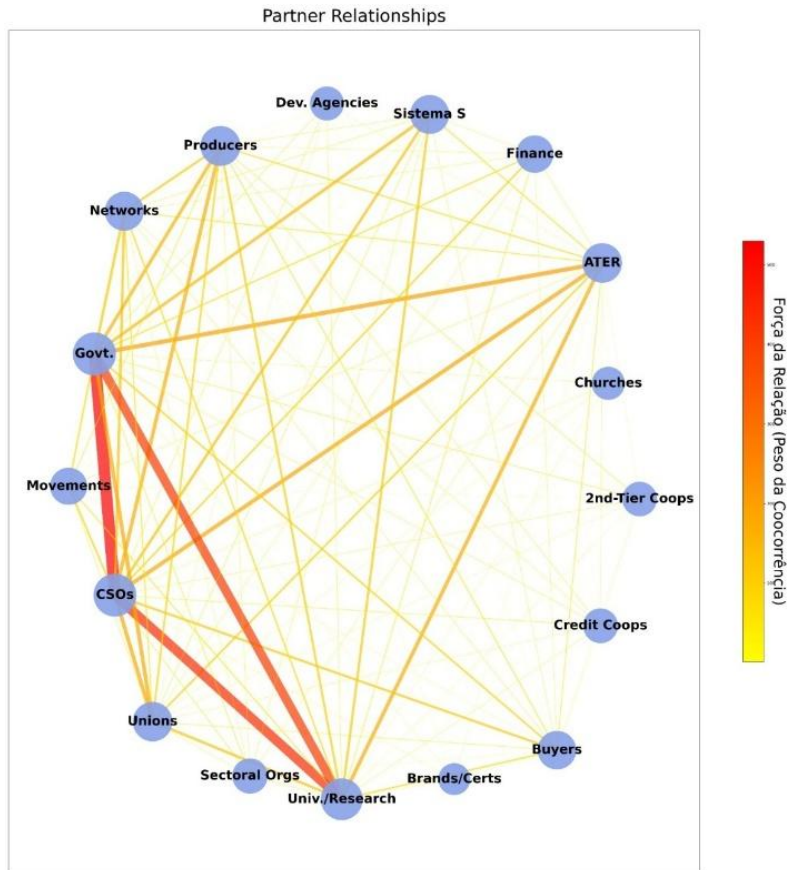
Our results show that the network of actors supporting sociobiodiversity value chains reflects a complex, multi-actor governance system spanning public, private, and civil society domains. Fifteen actor categories were identified (Table 1). Despite this diversity of actors, not all of them have the same prominence. Government institutions predominate as the main partner in sociobiodiversity value chains (2,347 mentions; 36%), followed by universities and research institutions (11%), rural extension agencies (10%), and CSO (9%). Together, they form the backbone of sociobiodiversity governance. The co-occurrence network (Figure 3) showing the most frequent combinations of partner types supporting the same community-based organizations corroborates that.

Municipal governments are the most frequent governmental partners of community-based organizations ($\approx 50\%$), and schools and municipal administrations are cited as key buyers, revealing the centrality of public procurement programs (Food Acquisition Program – PAA and National School Feeding Program – PNAE) for absorbing sociobiodiversity products [179–183]. As stated by one of the project's results, “even without the sanitary registration, the association is marketing fruit pulps to the city hall, via PAA”. In contrast, private buyers are marginal: companies account for only 2% of all partners reported by community-based enterprises.

Intermediary organizations, especially CSO, play a crucial role in fostering sociobiodiversity chains. They connect producers with public policies, funding mechanisms, and markets. The database reflects this multifunctional role, revealing how projects combine distinct forms of support to strengthen both organizational and productive capacities: 53% of the projects focused on capacity building and institutional strengthening, 40% included financial support or infrastructure investment, and 26% supported market access. On the other hand, many initiatives were multidimensional, combining multiple forms of support: 20% provided all three types; 18% combined capacity building with financial or infrastructural investment; 10% focused exclusively on capacity building; 102 projects (5%) combined capacity building with market access; 2% focused exclusively on financial or infrastructural

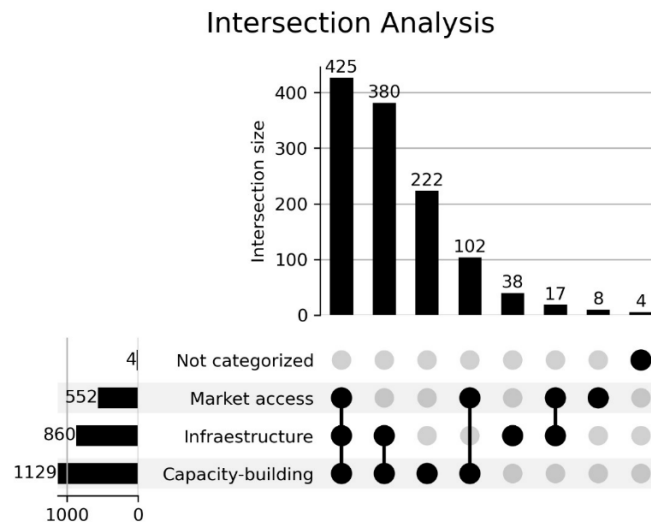
support; 0.8% combined market access and financial support; and only 0.4% focused exclusively on market access (Figure 4).

Figure 3: Co-occurrence network showing the most frequent combinations of partner types



Source: Author, 2025

Our results suggest that some entire sociobiodiversity chains exist today as the cumulative outcome of successive short-term projects, each typically lasting two years. In several cases, a single organization has consistently captured and implemented funds within a specific region. For instance, the Instituto Peabiru has led efforts in meliponiculture (stingless bee honey production) across southeastern Pará [184]. In other cases, such as the pirarucu fish chain in Amazonas State, a constellation of actors has contributed through successive initiatives: FAS (2010), WWF (2014), Operação Amazônia Nativa – OPAN (2015 and 2025), ASPROC – Associação dos Produtores Rurais de Carauari (2016 and 2018), IEB (2018), and Instituto de Desenvolvimento Sustentável Mamirauá (2025).

Figure 4: Types of support and different combinations observed in the project database

Source: Author, 2025

Another relevant finding is the progressive maturation observed in some grassroots organizations over time. Initially, as beneficiaries of projects, they began to expand their networks and assume intermediary roles. One example is the Cooperativa Grande Sertão, in the Northern region of Minas Gerais State, established in the late 1990s through partnerships with the CAA-NM and local family farmers. Through continuous partnerships with NGOs, research institutions, and public programs, it evolved from a local agroextractivist cooperative focused on pequi and buriti into a regional hub coordinating dozens of associations, managing a collective brand, and linking with public procurement programs and private companies such as Natura.

The Associação do Movimento Interestadual das Quebradeiras de Coco Babaçu (AMIQCB) is another example. Created in 1991, AMIQCB emerged from the collective mobilization of quebradeiras de coco babaçu (women extractivists from Maranhão, Piauí, Tocantins, and Pará States) seeking to defend their right to access palm groves and sustain their traditional livelihoods. Over three decades, the organization has expanded its scope from grassroots advocacy to territorial governance, articulating local associations and cooperatives while influencing national policy processes. Through broad institutional alliances with NGOs, public programs, and international cooperation agencies, AMIQCB played a decisive role in promoting and implementing the “Free Babassu Laws” (Leis do Babaçu Livre), which guarantee free access to babassu forests and protect extractivist practices from enclosure by private landowners. In recent years, AMIQCB has further consolidated its intermediary role by

managing the Fundo Babaçu, a financing mechanism that channels resources from the Amazon Fund (BNDES) and other partners to dozens of affiliated community organizations.

Another illustrative case of community empowerment leading to intermediary functions is the Uirapuru Fund, created by the Cooperativa Mista dos Produtores e Extrativistas do Rio Iratapuru (COMARU), in Amapá State. The fund was established with resources derived from benefit-sharing agreements between COMARU and the cosmetics company Natura, linked to the commercial use of Brazil nut and associated sociobiodiversity products. Over time, COMARU evolved from a producer cooperative to a territorial governance actor, managing projects on forest monitoring, education, and local infrastructure, and coordinating with government agencies and civil society partners.

One of the most cited examples in literature is “Rede Origens Brasil”, which represents a hybrid model of intermediation that connects IP&LC, and private companies through mechanisms of traceability, transparency, and fair trade in sociobiodiversity value chains [185]. Created in 2016 as a partnership between Imaflora and the Chico Mendes Institute for Biodiversity Conservation (ICMBio), the network operates multiple territories in the Brazilian Amazon, including the Xingu, Rio Negro, and Calha Norte regions. It is supported by a broad coalition of NGOs, research institutions, and public programs. They link community-based organizations directly with responsible companies through a verified traceability platform. Besides being responsible for the commercialization, the initiative strengthens local governance by building capacities for management, certification, and benefit-sharing.

These transformations illustrate a gradual institutional upgrading within Brazil’s sociobiodiversity economy. Intermediary organizations and, more recently, advanced grassroots cooperatives operate as meso-institutions that bridge local production systems with national policies and markets. Their presence has been important in converting fragmented initiatives into a more coordinated though still asymmetric ecosystem of support for a sociobiodiversity-based bioeconomy.

Table 1. Actor categories supporting sociobiodiversity value chains in Brazil

Actor category	Profile	Main functions in supporting sociobiodiversity value chains
Government institutions	Public entities at federal, state, and municipal levels	Design and implement public policies; provide funding, regulation, and coordination mechanisms; manage programs such as the Amazon Fund, PLANAPO, and PNPSB.

Actor category	Profile	Main functions in supporting sociobiodiversity value chains
Universities and research institutions	Public and private higher education and scientific organizations	Generate and disseminate technical and scientific knowledge; develop value-added processes; support monitoring and evaluation; and train human resources in specific fields of knowledge.
Technical assistance and rural extension (ATER)	Public or private rural advisory services	Offer training, technology transfer, and organizational strengthening for community-based enterprises.
Civil society organizations (CSOs)	NGOs and private foundations with socio-environmental mandates	Implement projects, provide technical and managerial assistance, and act as intermediaries between funders and local communities.
Workers' unions	Labor and rural unions representing producers or extractivists	Defend labor rights, negotiate prices, and strengthen the political representation of grassroots actors.
Professional training and industry support system (S-System)	Institutions such as SENAR, SENAI, and (S-SEBRAE)	Provide professional and entrepreneurial training; support business formalization and market access.
Networks and articulation platforms	Coalitions, alliances, and collective initiatives	Facilitate coordination, advocacy, and knowledge exchange among multiple actors and value chains.
Commercial and institutional buyers	Private companies, cooperatives, or public procurement programs (e.g., PNAE, PAA)	Create market demand; purchase products from community enterprises; foster value addition and commercialization.
Funders and financial institutions	Development banks, philanthropic funds, and impact investors	Provide grants, credit, and blended finance to strengthen production, infrastructure, and market integration.
Social movements	Grassroots and advocacy organizations (e.g., MIQCB, CNS, CONTAG)	Mobilize political support, defend territorial and cultural rights, and influence policy agendas.
Territorial or economic development agencies	Regional public agencies or consortia	Coordinate development strategies and territorial governance initiatives that integrate sociobiodiversity chains.

Actor category	Profile	Main functions in supporting sociobiodiversity value chains
Credit cooperatives	Member-owned financial organizations	Offer community-based credit and financial services adapted to local contexts and small producers.
Sectoral representation entities	Federations, councils, or associations of producers and industries	Represent and advocate for specific product sectors (e.g., nuts, honey, oils), promoting certification and quality standards.
Second-tier cooperatives	Cooperatives of cooperatives operating at regional or national levels	Aggregate production, coordinate logistics and sales, and negotiate collective contracts with buyers.
Churches and religious entities	Faith-based organizations with local presence	Promote social mobilization and solidarity-based economic practices.

Source: Author, 2025

3.4.3 Persistent fragilities and institutional dependencies

The database identifies 907 beneficiary organizations, of which 212 (23%) received funding from more than one project. Most of the beneficiaries (66%) were supported twice; 23 had between five and ten projects, although only two of these were grassroots entities (Associação Indígena Xakriabá - AIX and Associação Regional das Mulheres Trabalhadoras Rurais do Bico do Papagaio - ASMUBIP). This pattern reflects a core–periphery hierarchy, with intermediary organizations (already mentioned in the previous section) acting as central nodes connecting international donors, government programs, and community enterprises. What this pattern also reveals is a structural dependence on short-term project cycles for the consolidation of sociobiodiversity chains. Given that most projects last an average of two years and that each requires substantial time for proposal development, implementation, and reporting, the continuity of these entities often depends on securing new project rounds. As a result, institutional growth and learning processes are frequently interrupted or redefined by funding timelines rather than by endogenous organizational strategies.

Complementary evidence from intermediary organizations' annual and assessment reports reinforces this interpretation, where we find a strong recurrence of similar lessons and recommendations across programs and funding cycles (SM). Earlier initiatives (PPG-7, PD/A and PPP-Ecos) already emphasized the need for better coordination between projects and public policies, while more recent programs, such as the Amazon Fund, Ecoforte, Conexsus, and PPA,

continue to highlight the same operational constraints. The most frequent lessons concern the need of local governance arrangements, limited policy coordination, the absence of predictable, long-term financial mechanisms, limited access to markets and continuous technical assistance, and excessive administrative requirements. Recommendations commonly call for multi-year and flexible financing, simplified reporting procedures, stronger institutional coordination, and the creation of shared monitoring and learning mechanisms. Despite variations in focus, all organizations report difficulties in ensuring the continuity of community enterprises once funding ends, and note persistent challenges in integrating local initiatives with broader territorial and policy frameworks.

Across three decades of sociobiodiversity support, continuity has been the exception rather than the norm. When we look at the sociobiodiversity chains that are the object of the projects, of the 91 native species that received investments, only 20 were supported consistently every two years – roughly 15 times over the 30-year period – while the remaining 70 benefited from isolated or short-term interventions. Such discontinuity underscores the project-based nature of sociobiodiversity funding, in which most initiatives operate without the long-term horizon required to consolidate value chains. Since structuring a production system demands cumulative learning, organizational stability, and sustained market engagement, the lack of continuity raises fundamental questions about the effectiveness and legacy of past investments. This pattern of discontinuity is mirrored in the productive dimension of these chains, where value addition remains incipient. Only 32% of the 384 projects analyzed included any component of value addition, and just 5% of community-based organizations identified in the Conexsus mapping report produce value-added goods. Still, this level of value addition remains very low: most products are sold fresh, frozen, or as basic raw materials, and processing usually consists only of cleaning, sorting, and quality grading.

3.5 Discussion

Over the past three decades, thousands of initiatives have been implemented in Brazil by different government agencies, funds, CSO, and grassroots cooperatives [148,167]. Rather than emerging through a single national policy, this architecture evolved incrementally. Our results show that the sociobiodiversity bioeconomy is less a product of coordinated and deliberate planning [165] than of cumulative experimentation [186], shaped by successive generations of project-based interventions and intermediary coordination.

Intermediary organizations have played a decisive role in shaping Brazil's sociobiodiversity-based economy. Long before the term bioeconomy entered the national policy debate [42,158,187], these organizations invested in the idea that it is both possible and necessary to build an economy grounded in sociobiodiversity as a strategy for conservation and for improving the livelihoods of IP&LC [149,170].

Acting as connectors between public funds, donors, and grassroots initiatives, they have tried to translate external resources into locally embedded processes of organizational strengthening through capacity building, infrastructure, and market facilitation training [167]. Yet, these forms of support have not translated into sustained value addition. Most products continue to be sold fresh, frozen, or minimally processed, with limited use of technology and innovation to enhance product quality or differentiation [51,160]. This points to a systemic weakness in connecting production-oriented support to innovation and market dynamics [131], a gap that transition literature associates with incomplete actor coordination across levels and functions [105]. Besides, support has been dispersed, fragmented, and discontinuous, with resources historically allocated to dozens of native products in a scattered manner. These efforts have rarely converged into consolidated value chains, which require organized linkages among producers, traders, processors, and service providers that create synergies, reduce transaction costs, and generate collective gains through shared governance and innovation [188,189]. In summary, Brazil's sociobiodiversity system remains largely disconnected, with limited coordination mechanisms to integrate these actors into stable governance arrangements.

Besides, the concentration of administrative and financial capacities among a limited number of intermediaries tends to generate asymmetries in access and power. Only nine community-based organizations were direct beneficiaries of the Amazon Fund (the country's largest funding mechanism), demonstrating how regulatory and bureaucratic barriers constrain direct grassroots participation [171]. This outcome reveals a paradox typical of intermediary-led transitions: the same organizations that enable inclusion also reproduce dependency when long-term capability transfer and institutional embedding are absent [190,191]. Despite its fundamental role, intermediary organizations cannot substitute for the leadership and autonomy of community-based organizations [105,148]. Advancing the sociobiodiversity-based bioeconomy necessitates empowering local communities to derive economic benefits from biodiversity, not merely as resource users or project beneficiaries, but as protagonists capable of managing production, negotiating markets, and participating in decision-making processes that shape the future of the forest economy [192,193].

As demonstrated by the network analysis, the structuring of sociobiodiversity value chains depends on a diverse set of actors [46], each performing distinct but complementary functions, from funding and technical assistance to training, market access, and political advocacy [194]. However, these actors have not participated equally. Government institutions, particularly municipal administrations, universities, and CSO dominate the network, while the private sector remains almost absent, especially as a formal buyer [195]. This asymmetry reflects both the limited market insertion of sociobiodiversity products [43,196] and the persistent dependence on public programs such as PAA and PNAE for commercialization [179–183]. In this sense, Brazil's sociobiodiversity experience challenges the assumption that intermediary coordination alone can sustain systemic transformation [163,197]. Without mechanisms for recursive learning and co-decision, the sociobiodiversity ecosystem remains dependent on the operational capacities of intermediaries rather than embedded within public governance structures [165].

On the other side, this long trajectory of intermediary organizations and funding in supporting the structuration of sociobiodiversity chains has produced an important accumulation of experience, representing a rich legacy of institutional experimentation that should not be ignored [198]. Programs such as PPP-ECOS, Ecoforte, and the Amazon Fund have enabled thousands of localized experiments in sustainable production, territorial management, and bioeconomic innovation [169,172,177]. However, revisiting our findings through the lens of experimentalist governance helps clarify why decades of innovation have not resulted in systemic consolidation. While Brazil's sociobiodiversity agenda has been characterized by extensive local experimentation, it has lacked the core recursive features of experimentalist governance, particularly structured feedback loops between grassroots initiatives and higher-level rule-making. Rather than informing the design of new governance arrangements [107], the lessons of past initiatives seem to be frequently overlooked, leading to the repetition of similar models and mistakes. The pattern of project-based structuring still predominates, where each initiative operates within its own funding and administrative cycle, rather than as part of an articulated territorial strategy [199]. Each funding cycle reproduces the need for new calls, new intermediaries, and new micro-projects, rather than institutionalizing successful models. Each institutional report gives the impression that evaluation frameworks remain largely focused on donor compliance rather than peer learning and that lessons and innovations rarely circulate horizontally across territories or vertically into policy revision processes. Such fragmentation echoes what transition scholars describe as an experimental but non-recursive form of governance [165], where learning occurs locally but fails to accumulate

across scales [168]. The absence of such structured linkages might explain why successive investments have failed to consolidate durable value chains or achieve cumulative upgrading. The challenge now lies in converting this fragmented experience into a coherent governance system capable of fostering long-term coordination and collective learning across actors, products, and territories [50]. Unfortunately, the National Plan for the Sociobiodiversity-Based Bioeconomy (PNSB), currently under formulation, is apparently reproducing the same cycle. While aiming to coordinate public policies under a unified national strategy, it remains structurally organized around discrete, time-bound projects. Of the 137 initiatives listed under its Mission 1 – “To strengthen sustainable enterprises and community organizations of IP&LC”, 72 are defined as projects, suggesting a continuation of the project logic rather than a shift toward enduring institutional ecosystems.

Our results point that the consolidation of sociobiodiversity value chains requires a transition from a project-based support model to a systemic policy framework [200], with permanent enabling institutions that ensure long-term continuity, coordination, and feedback between local experimentation and national strategy, such as territorial development agencies, multi-actor governance councils, and hybrid financing facilities that integrate grants, credit, and performance-based incentives [201,202]. The federal government has a critical role in defining clear strategic priorities, aligning regulatory frameworks, and coordinating the multiple ministries involved in environment, development, science, and agriculture [61,203]. At the same time, policy instruments must go beyond financial transfer, embedding learning loops that capture and disseminate the lessons accumulated over thirty years of experimentation [164]. Without institutionalized mechanisms for knowledge exchange, evaluation, and adaptation, the sociobiodiversity bioeconomy will remain trapped in cycles of innovation without transformation [107,204].

Equally essential is the creation of conditions for institutionalized multi-actor platforms – a “fifth-helix” approach [205], where government agencies, private companies, academia, CSO, and community enterprises jointly design strategies, establish standards, and share responsibilities for scaling sustainable production [206]. Public policies should stimulate private-sector engagement [207] through fiscal incentives and innovation funds that reward companies sourcing from sociobiodiversity chains or investing in product differentiation, technology, and logistics [208]. Simultaneously, grassroots organizations need structured and constant access to technical assistance, credit, and training to move beyond dependence on intermediaries [130]. Incorporating these principles into the forthcoming PNSB would represent a decisive step toward transforming decades of isolated initiatives into an integrated,

reflexive, and market-connected sociobiodiversity economy, capable of generating well-being while maintaining the ecological foundations of Brazil's biomes [106,107].

Despite its breadth, this research presents some limitations. The analysis focused on projects with publicly available data, primarily derived from institutional reports and evaluation documents produced by intermediary organizations. As such, it may underrepresent initiatives or more recent programs whose records are not yet accessible. Future research should expand this scope by combining field-based assessments, longitudinal tracking of community enterprises, and comparative analyses across biomes and funding mechanisms. Such studies would help evaluate long-term outcomes, trace learning processes across scales, and identify the enabling conditions under which sociobiodiversity value chains can achieve economic viability and ecological resilience.

3.6 Conclusion

Over three decades, Brazil has built an extensive institutional ecosystem linking biodiversity conservation with local livelihoods. Through successive programs, funds, and intermediary organizations, thousands of community-based enterprises have emerged, demonstrating that sociobiodiversity can serve as both an economic and ecological strategy. Yet this architecture remains fragmented, short-term, and unevenly connected to markets, limiting its ability to consolidate lasting value chains.

Brazil's sociobiodiversity economy stands at an intermediate stage of transition: rich in innovation but lacking the recursive governance mechanisms needed for cumulative learning and coordination. Moving beyond project-based interventions requires long-term territorial planning that aligns finance, capacity building, and market access under adaptive and participatory frameworks, while also stimulating greater engagement from private actors.

The Brazilian case provides globally relevant insights for sustainability science. It shows that the critical bottleneck in transitioning toward inclusive bioeconomies lies not in the absence of innovation but in the absence of institutional mechanisms that learn from innovation. Building a sociobiodiversity-based economy at scale will require transforming the logic of project funding into one of collective, adaptive governance, where experimentation becomes part of how the system learns, evolves, and sustains itself.

4 BEYOND COMMODITIES: VALUING THE CONTRIBUTION OF STEWARDSHIP PRACTICES IN SOCIOBIODIVERSITY-BASED BIOECONOMY⁹

4.1 Abstract

Efforts to build a sociobiodiversity-based bioeconomy increasingly depend on recognizing and rewarding the stewardship practices carried out by Indigenous Peoples, Local Communities, and smallholder farmers. Yet, such practices, rooted in collective governance, traditional knowledge, and care for ecosystems, remain largely invisible in market and policy frameworks. This study compares recognition mechanisms for stewardship practices worldwide (38 case studies) and in Brazilian projects supporting sociobiodiversity chains (384 projects) using an inductive typology of material and non-material recognition and Arnstein's Ladder of Citizen Participation. Results show that 70% of the cases analyzed combine multiple recognition forms, but their distribution and empowerment outcomes diverge. Globally, recognition mechanisms are more balanced, often codified in laws, participatory councils, and payment-for-ecosystem-service (PES) schemes that place communities on the upper rungs of Arnstein's ladder, with co-management authority. In Brazilian projects, recognition remains predominantly material and focused on short-term interventions – capacity-building, equipment, and market access, corresponding to lower rungs of citizen participation. Overcoming this condition requires policies that couple economic incentives with institutionalized participation. Markets alone will not value the non-material elements that sustain sociobiodiversity. Implementing Brazil's National Bioeconomy Strategy will therefore depend on public policy that reward both the products and the collective stewardship behind them.

Keywords: sustainable use, non-timber forest products, traditional ecological knowledge, governance, recognition mechanisms

4.2 Introduction

Over the past decade, the concept of bioeconomy has gained increasing relevance in global sustainability agendas as countries seek to reconcile economic development with

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environmental protection [1–5,209]. The bioeconomy is commonly understood as the transition from a fossil-based to a biological resource-based economy, aiming to reduce greenhouse gas emissions, foster innovation, and promote more efficient resource use [210,211]. By replacing non-renewable resources with biomass and other biological materials, bioeconomy strategies are expected to decouple economic growth from environmental degradation while generating new jobs and income opportunities [212,213].

However, the bioeconomy is far from a uniform concept [2,20,214]. A growing body of literature highlights at least three distinct strands – biotechnology, bio-resource, and bio-ecology – that reflect different understandings of how biological resources, knowledge, and values are mobilized [17]. While the first two emphasize technological efficiency and market competitiveness, the bio-ecology perspective stresses ecological integrity, circularity, and social inclusion. In biodiverse countries such as Brazil, these debates increasingly intersect with urgent challenges of biodiversity conservation, social justice, and the recognition of the rights of Indigenous Peoples, Local Communities, and Smallholder Farmers (IP&LC) [215,216].

In Brazil, this convergence has given rise to the notion of a sociobiodiversity-based bioeconomy, which links the sustainable use of native species to territorial rights and traditional ecological knowledge (TEK) [42,158]. The recent National Bioeconomy Strategy, instituted in 2024 (Decree N° 12.044/24)[20], explicitly recognizes sociobiodiversity, understood as the dynamic interaction between biological diversity and the cultural, ecological, and territorial practices of IP&LC [19], as a central pillar of the country's development pathway. Rather than focusing solely on biomass or productivity, this approach seeks to strengthen community-driven value chains grounded in biodiversity products and collective management systems [101,107]. The Strategy is expected to be implemented through the National Bioeconomy Development Plan (PNDBio), which will define resources, actions, responsibilities, targets, and indicators for bioeconomy development in Brazil. While this framework signals a political commitment to valuing sociobiodiversity and the contributions of IP&LC, it also raises a practical question that remains largely unaddressed: how can the principles of sociobiodiversity be operationalized in concrete policy and governance instruments, rather than remaining primarily aspirational? .

At the heart of sociobiodiversity are the stewardship practices carried out by IP&LC. These practices encompass actions to protect, care for, and responsibly use the environment based on TEK, relational values, and collective responsibility [218,219]. Through the sustainable management of forests, rivers, and landscapes, individuals, informal groups, and community-based organizations act as stewards of both species and ecosystems [97,220,221].

Their practices sustain ecological functions while enabling livelihoods through diverse activities such as rotational agroforestry, community-based fisheries, and the use and commercialization of NTFP [222,223].

In this sense, sociobiodiversity products, and in particular NTFPs, occupy a distinctive place within socioecological systems as biocultural keystones, sustaining both ecological functions and cultural traditions through their multiple roles in ecosystem regulation, resource provision, and symbolic meaning [45]. The sustainable use and management of these species by IP&LC thus represents a tangible form of stewardship practice, linking biodiversity conservation with cultural continuity and livelihood strategies. Yet, despite the rapid expansion of the bioeconomy literature, stewardship practices are rarely treated as a central analytical category within bioeconomy frameworks. Dominant interpretations remain predominantly anchored in technological innovation, biomass productivity, and market-oriented value creation [1–12], with limited attention to the social practices and governance arrangements that underpin sustainable resource use [13,29]. Even the literature that explicitly emphasizes sustainability and inclusion [7,29,30] rarely engages with the notion of stewardship as a central analytical category.. Most policies and market mechanisms prioritize material and commodified outputs (biomass yield, productivity, or export potential) while overlooking the immaterial dimensions that sustain ecosystems, such as care, knowledge transmission, and collective governance [44,223]. This narrow valuation reduces biodiversity-based livelihoods to commodity chains and IP&LC merely as suppliers of raw materials rather than as co-creators of sustainability, leaving TEK and community stewardship largely invisible [131,226]. As a result, the social and ecological foundations of the bioeconomy risk being neglected, despite their centrality to the goals of biodiversity conservation and sustainability [223].

Conversely, the literature on stewardship has often evolved in parallel to bioeconomy debates, focusing either on conservation outcomes or on normative discussions of responsibility and ethics [22–27], without systematically examining how stewardship practices are recognized, valued, or governed within economic and policy-oriented frameworks. This matters because Recognition, understood as inclusion and respect [34], in this context, encompasses not only monetary compensation [36,37] but it goes beyond: it also involves creating governance mechanisms that guarantee the active participation and empowerment of IP&LC in decision-making arenas that affect their territories, resources, and ways of life [31]. Recognizing stewardship practices, therefore, is not only an ethical imperative but also a strategic condition for building a resilient and inclusive bioeconomy capable of aligning biodiversity conservation with social justice [34,35].

Against this backdrop, this study addresses a dual gap in the literature. Conceptually, it brings stewardship practices into the core of bioeconomy analysis, highlighting recognition as a key mechanism through which sociobiodiversity principles are translated into governance arrangements. Empirically, this study bridges global academic case studies and Brazilian project-based interventions to examine how different forms of recognition relate to varying degrees of participation, decision-making authority, and empowerment.

This study deliberately brings into dialogue two distinct bodies of empirical material: peer-reviewed global case studies and a portfolio of Brazilian development and conservation projects. These datasets differ in nature, purpose, and scale and are therefore not treated as directly comparable forms of evidence. Rather than aiming at statistical equivalence, the analysis adopts an interpretive and policy-oriented comparative approach.

Global case studies documented in the academic literature are used as emblematic examples of how stewardship practices have been recognized and institutionalized in different regions of the world. These cases provide insights into recognition mechanisms that have already reached a certain degree of stabilization and visibility within governance and policy frameworks. In contrast, the Brazilian dataset reflects the dominant institutional reality through which sociobiodiversity-based practices are supported in the country. In Brazil, the use and management of biodiversity resources by Indigenous Peoples and Local Communities are predominantly promoted through project-based interventions funded by national and international programs.

Analysing these projects as empirical material allows us to examine recognition as it is operationalized in practice, revealing how different types of interventions acknowledge stewardship practices and whether they contribute to increasing participation and decision-making power among beneficiaries. The analytical value of this juxtaposition lies precisely in highlighting the differences between recognition as a codified outcome and recognition as a project-based instrument. By situating Brazilian experiences in light of global emblematic cases, the study seeks to generate insights that can inform policy-makers about which recognition mechanisms are more likely to foster empowerment and long-term stewardship, rather than merely providing material support.

By doing so, the study contributes to clarifying how the social and environmental ambitions of sociobiodiversity-based bioeconomy strategies can be operationalized beyond policy discourse and into concrete institutional practice.

In this sense, this study specifically aimed to:

(1) identify and classify the forms of recognition through which stewardship practices carried out by Indigenous Peoples and Local Communities are valued across different institutional contexts;

(2) analyse how these recognition mechanisms differ between globally documented case studies and project-based interventions supporting sociobiodiversity value chains in Brazil;

(3) assess how different forms of recognition are associated with varying degrees of community participation, decision-making authority, and empowerment, using Arnstein's Ladder of Citizen Participation as an analytical lens. (Beyond its academic contribution, this study seeks to generate analytical insights that can assist policymakers and decision-makers in operationalizing more inclusive bioeconomy strategies.

To do so, we conducted a systematic literature review of English-language articles published between 2019 and 2024 on this topic. We found 38 global case studies reporting concrete examples of stewardship recognition and analyzed a comprehensive database of 384 projects targeting sociobiodiversity chains implemented in Brazil between 2000 and 2023, encompassing initiatives supported by the Amazon Fund and the PPP-ECOS (GEF/UNDP/ISPN). Additionally, to assess the degree of participation and empowerment embedded in different recognition mechanisms, this study draws on Arnstein's Ladder of Citizen Participation [230], a classic framework that conceptualizes participation as a continuum of power distribution between authorities and citizens, ranging from manipulation to full citizen control.

By comparing global experiences with Brazilian projects, this study seeks to identify concrete examples of how recognition-based mechanisms can strengthen the governance foundations of the sociobiodiversity bioeconomy. The comparative approach thus offers both empirical and normative insights: empirically, it maps the diversity of recognition mechanisms worldwide and situates Brazil within that spectrum; normatively, it illuminates pathways through which the Brazilian bioeconomy can institutionalize the value of stewardship as a cornerstone of sustainability transitions.

4.3 Methods

4.3.1 Data collection

4.3.1.1 Systematic literature review

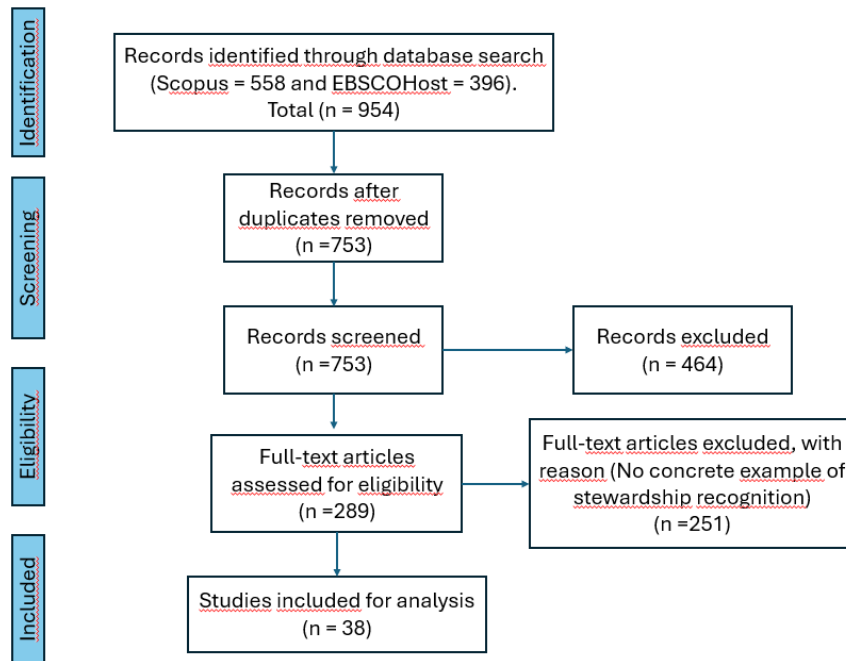
A systematic literature review was conducted following a structured and transparent multi-stage procedure inspired by PRISMA guidelines, adapted to the interdisciplinary scope of stewardship and bioeconomy research. The objective was to identify peer-reviewed studies explicitly documenting concrete cases in which Indigenous Peoples and Local Communities (IP&LC) received some form of recognition for stewardship practices.

The review followed four sequential steps: identification, screening, eligibility assessment, and inclusion. First, searches were performed in Scopus and EBSCOHost using predefined combinations of keywords related to “people”, “nature”, “people-nature interactions”, and “bioeconomy” (see Supplementary Material for complete description). This resulted in 954 records. After removal of duplicates ($n = 201$), 753 titles and abstracts were screened independently by at least two reviewers.

In the screening stage, studies were excluded if they (i) did not refer to concrete stewardship practices carried out by identifiable IP&LC, (ii) addressed conservation outcomes without reference to recognition or reward mechanisms, or (iii) were purely conceptual or theoretical. Full texts of the remaining studies were then assessed for eligibility, resulting in a final sample of 38 case studies that explicitly described how stewardship practices were recognized through material, institutional, participatory, or symbolic mechanisms.

Throughout the process, disagreements between reviewers were resolved through discussion and, when necessary, consultation with a third reviewer. A PRISMA-style flow diagram summarizing the selection process is provided in Figure 1.

Figure 1. PRISMA-style flow diagram of the systematic literature review of global case studies.



Source: Author, 2025

4.3.1.2 Brazilian project database

A comprehensive dataset of 384 projects implemented between 2000 and 2024 was compiled to examine how stewardship practices have been supported and valued in Brazil. Data was extracted from:

- PPP-ECOS – Programa de Pequenos Projetos Ecosociais (ISPN), a long-standing small-grants initiative supporting sociobiodiversity-based livelihoods in the Cerrado and Caatinga biomes; and
- Amazon Fund (BNDES), one of the world's largest results-based climate finance mechanisms focused on sustainable development in the Legal Amazon region.

The construction of this database followed a two-step procedure. In the first stage a web scraping approach and data mining was carried out to survey Brazilian initiatives that promote local community engagement through the use and commercialization of native species/NTFP. We collected data from websites of governmental, non-governmental organizations (NGOs), foundations and funding entities that provide open access. Following a detailed review of the data sources, we identified 1,286 initiatives that are directly related to sociobiodiversity product chains. The selection went down to 384 initiatives (projects) that explicitly provided

information about the type of intervention. Together, these sources represent the most comprehensive and systematic public repositories of community-based sociobiodiversity projects in Brazil. They span more than two decades, cover all major biomes, and provide consistent and transparent documentation of project interventions.

Because all projects aimed to structure sociobiodiversity value chains and improve local livelihoods, the type of intervention was interpreted as a proxy for the form of recognition or reward given to stewardship practices.

In the Brazilian dataset, recognition mechanisms are not always explicitly framed as such. Instead, recognition is embedded in the design of development and conservation interventions aimed at supporting sociobiodiversity-based livelihoods. For this reason, project interventions were interpreted analytically as proxies for recognition mechanisms.

This interpretation is grounded in the understanding of recognition not only as symbolic acknowledgment or direct payment, but as the allocation of resources, rights, or institutional support that signals the social value attributed to stewardship practices. When public programs and funds direct financial resources, infrastructure, technical assistance, or governance roles specifically to communities because of their stewardship of biodiversity, these interventions function *de facto* as forms of recognition, even if they are not labeled as such in project documents.

Importantly, this approach does not assume that all project interventions are equally empowering. Rather, it allows us to examine how different types of project-based recognition vary in their capacity to alter power relations, governance roles, and decision-making authority — a distinction that is subsequently assessed using Arnstein's Ladder.

The two datasets (38 global case studies found in literature review and the 384 Brazilian projects) were not intended to be symmetrical in evidentiary terms. The global cases reflect research-selected examples that meet publication standards and often emphasize successful or innovative governance arrangements. The Brazilian projects, by contrast, represent a near-census of interventions funded over more than two decades, including heterogeneous designs, durations, and outcomes.

To ensure analytical consistency, both datasets were examined through the same coding framework focused on forms of recognition and degrees of decision-making authority. However, interpretation explicitly accounts for their different epistemic statuses: academic case studies as *ex post* analyses of governance outcomes, and project portfolios as *ex ante* or interim expressions of recognition embedded in policy and funding instruments.

4.3.2 Data analysis

To categorize forms of recognition of stewardship practices, an inductive qualitative coding approach was applied across both the international and Brazilian datasets, following grounded theory and qualitative content analysis methods [232–234]. Comparisons between datasets are therefore interpretive rather than inferential. Differences in participation levels are not attributed to community capacity or performance, but to the institutional conditions under which recognition mechanisms are designed and implemented.

Stage 1 – Open coding

All text excerpts describing how communities were recognized or supported for environmental stewardship were coded using *in vivo* terms drawn directly from the material (e.g., subsidy, infrastructure, council participation, cultural festival, land titling).

Stage 2 – Conceptual clustering

Codes were iteratively grouped into broader conceptual clusters reflecting patterns observed across cases. Through continuous comparison and refinement, two general and five specific overarching categories emerged, capturing both material and non-material forms of recognition: material (monetary and non-monetary), legal and institutional, participatory and governance, cultural and symbolic. Material and monetary recognition refers to direct financial transfers or payments provided to communities as compensation or incentive for stewardship practices. It includes cash transfers, wages, subsidies, price premiums, payments for environmental services (PES), and revenue-sharing schemes associated with sustainable production or conservation outcomes. Material non-monetary material recognition encompasses in-kind benefits that enhance the material conditions of production or wellbeing without direct cash transfer. This includes equipment, infrastructure, processing units, food supplies, or technical services offered as project support to strengthen community livelihoods. Non-material recognition captures symbolic, institutional, and participatory mechanisms that confer legitimacy, voice, or visibility to local actors. It includes legal and institutional recognition (formal inclusion in policies or land-use regulations), participatory and governance recognition (representation in decision-making councils or co-management committees), and cultural and symbolic recognition (storytelling, collective brands, awards, or public campaigns).

Stage 3 – Cross-validation and triangulation

The typology was cross-validated between the 38 global case studies and 384 Brazilian projects, ensuring conceptual coherence across contexts. Each project could exhibit multiple forms of recognition.

To assess the degree of community participation and empowerment embedded in the recognition mechanisms, we adopted Arnstein's Ladder of Citizen Participation. Although originally developed in the context of urban planning, the Ladder has been widely employed in different contexts, such as the environment in rural areas [87,88], education [86], and health [89] as a conceptual tool to assess how different forms of participation shape citizens' influence over decision-making processes [86]. Arnstein's original concern was not with participation as a procedural formality, but with participation as a means of redistributing power to groups historically excluded from decision-making processes, particularly marginalized and underprivileged communities. We believe this framework can be used in environmental governance and natural resource management precisely because it offers a clear and parsimonious way to distinguish between participation as consultation and participation as authority. In this sense, its relevance lies less in its historical origin than in its analytical focus on power asymmetries — a central concern in debates on Indigenous rights, co-management, and stewardship recognition.

In applying Arnstein's ladder to Indigenous Peoples and Local Communities (IP&LC), we do not assume that participation should follow Western institutional forms, nor do we equate higher rungs with externally defined notions of "good governance." Rather, the ladder is used comparatively to examine whether recognition mechanisms merely acknowledge communities as implementers of externally designed interventions, or whether they effectively transfer decision-making authority, territorial control, and governance responsibilities to local actors.

This approach aligns with contemporary scholarship that emphasizes empowerment, autonomy, and co-governance as key dimensions of stewardship and sustainable resource management [46,47,53,62]. By explicitly focusing on who decides, rather than how decisions are culturally organized, Arnstein's ladder provides an analytically robust lens to compare heterogeneous recognition mechanisms across contexts, without erasing the plurality of Indigenous and local governance systems. The ladder comprises eight levels grouped into three broad categories: Non-participation, Tokenism, and Citizen Power.

At the lowest levels, manipulation and therapy represent forms of non-participation, in which participation serves primarily to legitimate decisions already made. In the manipulation stage, citizens are included only to endorse pre-determined agendas, while in therapy they are treated as passive subjects to be "guided" or "educated" by authorities rather than as capable

decision-makers. The intermediate levels—informing, consultation, and placation—reflect degrees of tokenism, where citizens are given a voice but limited influence. Informing provides one-way communication: authorities share information but do not invite feedback. Consultation introduces opportunities to express opinions—through surveys or public meetings—yet without guarantees that those views will affect outcomes. Placation allows limited representation, such as advisory roles or minority seats on committees, but real decision-making power remains concentrated with authorities. At the upper levels, partnership, delegated power, and citizen control represent increasing degrees of citizen power. In partnership, decision-making responsibilities are genuinely shared between communities and institutions through co-management or participatory councils. Delegated power grants citizens primary authority over specific areas or programs, with authorities retaining only supportive roles. Finally, citizen control denotes full empowerment, where communities independently design, implement, and oversee decisions concerning their territories and resources [38].

Each example of recognition and its categorization identified in both the global and Brazilian datasets was examined according to the extent to which it enabled communities to influence decision-making, co-manage resources, or exercise autonomy over their territories and production systems. The assignment of participation levels followed a transparent and replicable qualitative procedure. For each global case study and Brazilian project, textual descriptions of objectives, governance arrangements, decision-making processes, and reported outcomes were examined. Classification focused on three analytical criteria: (i) who holds formal authority over rules and resource use; (ii) whether communities participate in decision-making bodies with binding power; and (iii) the degree of autonomy communities have over implementation, monitoring, and benefit allocation.

Based on these criteria, each case was assigned to one of the eight levels of Arnstein's Ladder. For example, cases categorized as Informing involved one-way communication or training without decision-making power; Consultation included opportunities for feedback without guaranteed influence; Partnership involved shared decision-making through councils or co-management arrangements; and Delegated Power or Citizen Control required formal transfer of authority over specific domains, such as fisheries quotas, forest management, or territorial governance.

To enhance consistency, coding was conducted iteratively and discussed among the authors, with ambiguous cases resolved through consensus. Numerical scores (1–8) were subsequently used only as a descriptive device to summarize patterns across datasets, not as precise measurements of empowerment (Table 1).

Table 1. Arnstein's Ladder of Citizen Participation and Numerical Scores Used in This Study

Arnstein's Category	Participation Level	Numerical Score	Analytical Meaning in This Study
Non-participation	Manipulation	1	Communities are formally involved only to legitimize externally defined decisions; no real influence over objectives, rules, or outcomes.
	Therapy	2	Participation framed as awareness-raising or capacity building without any decision-making power; communities treated as passive recipients.
Tokenism	Informing	3	One-way communication or information sharing (e.g., training, reporting, dissemination) with no mechanisms for feedback or influence.
	Consultation	4	Communities are consulted or invited to express opinions, but there is no guarantee that their inputs affect decisions.
	Placation	5	Limited representation or advisory roles for communities; some influence is possible, but decision-making authority remains external.
Citizen Power	Partnership	6	Shared decision-making between communities and external actors through co-management arrangements, councils, or joint governance bodies.
	Delegated Power	7	Communities hold primary authority over specific domains (e.g., resource use rules, quotas, territorial management), with external actors playing a supportive role.
	Citizen Control	8	Full decision-making autonomy by communities over resources, rules, and governance structures; external actors have no controlling role.

Source: Author, 2025

The classification was conducted through qualitative content analysis of the descriptions, outcomes, and governance arrangements. For each example identified in the global and Brazilian datasets, a numerical value from 1 to 8 (from the lower level of participation to the higher level) was assigned according to the degree of decision-making power and autonomy granted to local actors. Average participation scores were then calculated for each dataset – global ($n = 38$) and Brazilian ($n = 384$) – by dividing the sum of the assigned levels by the total number of cases. This procedure enabled a quantitative comparison of empowerment degrees across contexts (Details in SM).

4.4 Results

4.4.1 Stewardship practices around the globe

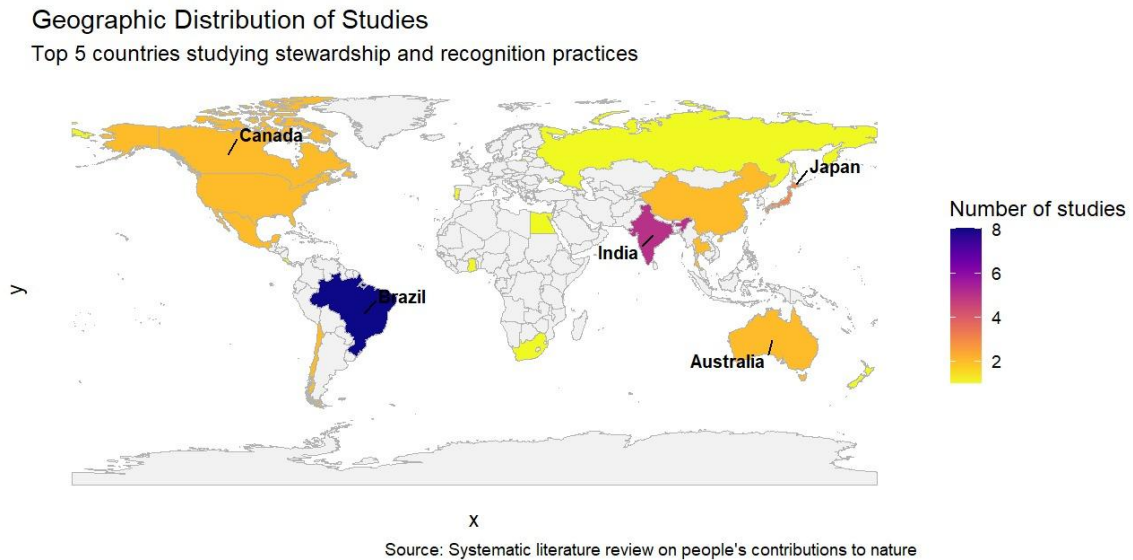
A total of 38 case studies reporting real and concrete examples of stewardship practices recognition were identified in 19 countries across the globe. The highest number of documented cases came from Brazil (8), India (5), and Japan (4), followed by Mexico, Chile, Thailand, Canada, China, and the United States (2 each). Several additional cases Nepal–India–Bangladesh, the United States–Canada–Mexico, and Portugal–Spain (Figure 1).

Across the 38 global case studies analyzed, stewardship practices (Table 1) displayed geographical diversity while converging around three main domains of action: resource use and harvesting, ecosystem management and restoration, and territorial governance and cultural continuity. In Asia, cases from India, Japan, Thailand, and China reveal long-standing systems of community-based land and forest management rooted in TEK. Indian examples highlight rotational and mixed farming systems, sacred groves, and community forestry institutions (Van Panchayats) [235]. At the same time, Japanese satoyama landscapes illustrate the integration of irrigation, paddy-field biodiversity, and forest management through seasonal water control [236,237]. Thai Karen communities demonstrate adaptive forest governance combining PES mechanisms, fire management, and agroforestry diversification [238], whereas Tibetan and Chinese communities practice rotational grazing, wildlife monitoring, and sustainable NTFP harvesting [239,240]. In the Americas, studies from Brazil, Mexico, Costa Rica, Canada, the United States, and Chile emphasize the stewardship of aquatic and forest ecosystems through community-based fisheries, forest restoration, and agroforestry. Brazilian and Mexican cases include sustainable extraction of NTFP and collaborative fisheries [129,241–244], while IP&LC in Costa Rica, Canada, and the U.S. engage in co-management of forests, kelp beds, and wildlife populations [245–249]. In Africa, examples from Ghana, Egypt, and South Africa feature community-led restoration of rangelands and invasive plant control, linking stewardship with livelihood improvement and ecosystem recovery [250–252]. In Oceania, Indigenous fire management in northern Australia and Māori-led restoration in New Zealand exemplify the integration of cultural protocols with ecological restoration and biodiversity monitoring [253,254]. Finally, European and Eurasian cases, from Portugal and Spain’s transboundary river fisheries to Russia’s Khanty and Nenets herders, reveal the persistence of customary governance systems that maintain ecological balance through collective rules and seasonal mobility [255–256]. Taken together, these cases demonstrate that stewardship is not limited to

resource extraction but encompasses complex socio-ecological arrangements that combine local TEK, collective norms, and adaptive management to sustain biodiversity and livelihoods across diverse biomes.

Among these case studies identified worldwide, Brazil emerged as the country with the highest number of documented examples, accounting for eight cases (Figure 1). Examples include rotational NTFP collection and community-managed pirarucu (*Arapaima gigas*) fisheries in the Amazon, where local associations establish harvest quotas; seed collection networks in the Cerrado for large-scale ecological restoration; and agroforestry systems in Atlantic Forest.

Figure 1: Geographic distribution of studies found in the literature review, yellow corresponding to a single case study and purple to eight.



Source: Author, 2025

Following the global analysis, a closer look at the 384 Brazilian community-based projects shows that stewardship practices present in these initiatives are associated with both traditional and commercial uses of native biodiversity, reflecting what IPBES [257] defines as the sustainable use of wild species. These practices are embedded in the structuring of sociobiodiversity value chains, where IP&LC combine livelihood strategies with conservation actions. Sustainable use of wild species is also associated with other types of stewardship practices, including agroforestry and agroecological diversification, where native species are cultivated in combination with annual crops to restore soil fertility and diversify income; forest and landscape restoration, involving seed collection, natural regeneration, and reforestation

with native species; collective management, including local rules for fishing, fire control, and resource sharing; and traditional fire and water management practices, rooted in IP&LC.

In the Amazon, IP&LC carried out sustainable harvesting of native products such as açai (*Euterpe oleracea/precatoria*), Brazil nut (*Bertholletia excelsa*), rubber (*Hevea brasiliensis*), and andiroba (*Carapa guianensis*) oil, along with community-based fisheries management for pirarucu and restoration of degraded areas through natural regeneration and seed collection. In the Cerrado, cooperatives and associations of smallholders and other IP&LC groups, such as Geraizeiros and Veredeiros, implemented agroforestry systems combining pequi (*Caryocar Brasiliense*), buriti (*Mauritia flexuosa*), and baru (*Dipteryx alata*), maintained community seed banks and nurseries, and developed fire management practices adapted to local TEK. In the Caatinga, family farmers and caatingueiros engaged in agroecological and dryland restoration practices that integrated the extraction of umbu (*Spondias tuberosa*), licuri (*Syagrus coronata*), and maracujá-do-mato (*Passiflora cincinnata*) with soil and water conservation techniques. In the Atlantic Forest, quilombola, caiçara, and family farming communities practiced agroforestry, native seed collection, and reforestation connected to river restoration, local markets, and community-based processing units. Several initiatives operated across biomes, such as the Rede de Sementes do Xingu and Rede de Sementes do Cerrado, cooperatives like COOPERACRE and COOPESAB, which coordinated collective processing, product certification, and landscape restoration in multiple territories. Socially, the projects involved a wide range of actors, including IP&LC, women's organizations, and mixed cooperatives. Table 2 presents some representative examples of stewardship practices (see SM for the complete database).

4.4.2 Types of recognition mechanisms in global and Brazilian contexts

The comparative analysis of recognition mechanisms across the global and Brazilian datasets reveals how distinct forms of material and non-material recognition reflect different ways of valuing stewardship practices (Figure 2). Monetary mechanisms were observed in 53% of total global cases like the PES-funded community forestry programs in Thailand [245] and REDD+ initiatives in Costa Rica [238], where local forest users receive regular payments linked to verified conservation outcomes. In the Brazilian dataset, similar monetary incentives were less common (36%).

Non-monetary material recognition, in turn, encompasses in-kind benefits that enhance production or well-being without direct cash transfers. These included the provision of

equipment, infrastructure, and technical assistance aimed at strengthening community livelihoods. This type was predominant among the 384 Brazilian projects (87% of the total), such as the installation of fruit-processing units, oil extraction equipment, or community warehouses under initiatives led by Cooperativa Grande Sertão, Rede do Pequi, and COOPERACRE.

Non-material recognition captures symbolic, institutional, and participatory mechanisms that confer legitimacy, visibility, or decision-making power to local actors. Within this domain, legal and institutional recognition emerged when stewardship practices were incorporated into formal policies or regulations. This was particularly visible in global cases (55%) where IP&LC hold legal authority over resources, such as the Van Panchayat community forests in India [235], co-management of mangroves in Thailand [258], and Indigenous forest governance in Costa Rica and Canada [245,247]. In Brazilian projects, however, such institutionalized forms of recognition were less frequent (23%), appearing mainly in territories with formal legal arrangements (e.g., Extractive Reserves such as Tapajós-Arapiuns and Rio Unini, or the Community Fisheries Agreements of ASPROC in the Amazon), where communities exercise partial governance over natural resources.

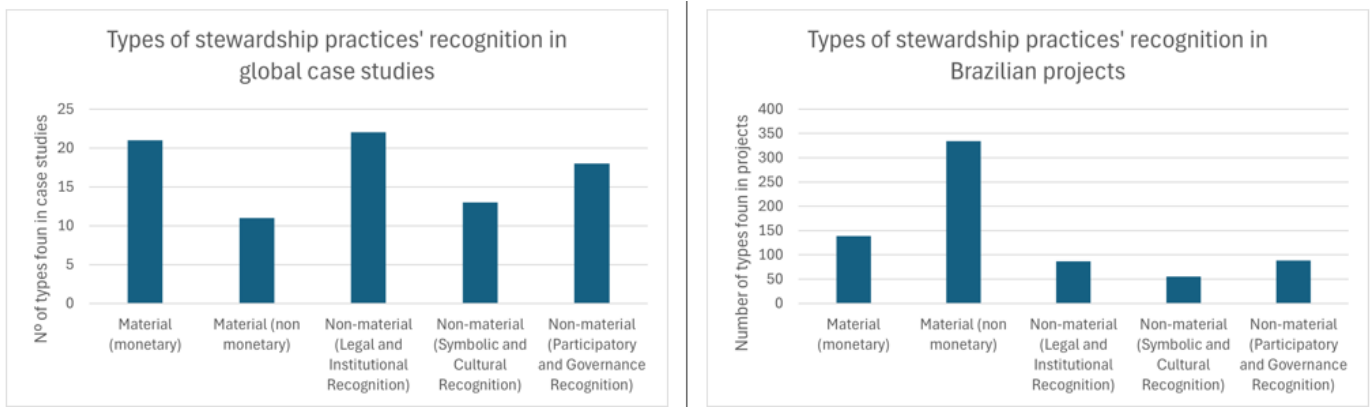
Participatory and governance recognition involved shared decision-making through councils, committees, or collective governance systems. In the global sample, 45% of case studies present this type of recognition. Such arrangements were prominent in Canada's Okanagan Basin co-management councils [246], Japan's Satoyama forest management committees [245,246], and India's community biodiversity registers, where IP&LC co-manage resources with state institutions [235,259]. In Brazilian projects, analogous forms were less frequent (28%) and identified in multi-stakeholder territorial networks, such as Rede de Sementes do Xingu and MIQCB (Women Babassu Breakers Movement), both of which have progressively consolidated community-led governance structures.

Finally, cultural and symbolic recognition, involving storytelling, collective brands, and public campaigns, was present in 33% of global case studies and in only 19% of the Brazilian projects. While such initiatives contribute to visibility and valorization, they rarely involve communities in decision-making. Examples include documentary and video production and public campaigns in Brazil, and heritage-based tourism and festivals in Japan's Satoyama and Chile's marine stewardship initiatives [236,260].

While approximately 70% of the cases (both in global case studies and in the Brazilian dataset) exhibited more than one form of recognition, the distribution of recognition types differs markedly between them. In the global sample, recognition is more evenly distributed

across material (monetary and non-monetary) and non-material (legal–institutional, symbolic–cultural, participatory–governance) forms, with an emphasis in monetary, legal/ institution and participatory/governance recognition, suggesting more balanced combinations of incentives, legal frameworks, and participatory arrangements. In contrast, the Brazilian projects show a strong predominance of non-monetary material recognition while other forms, particularly legal, cultural, or governance-based, remain comparatively limited (Figure 3).

Figure 2: Types of stewardship practices’ recognition in global case studies and in Brazilian projects



Source: Author, 2025

4.4.3 Degrees of community participation and empowerment

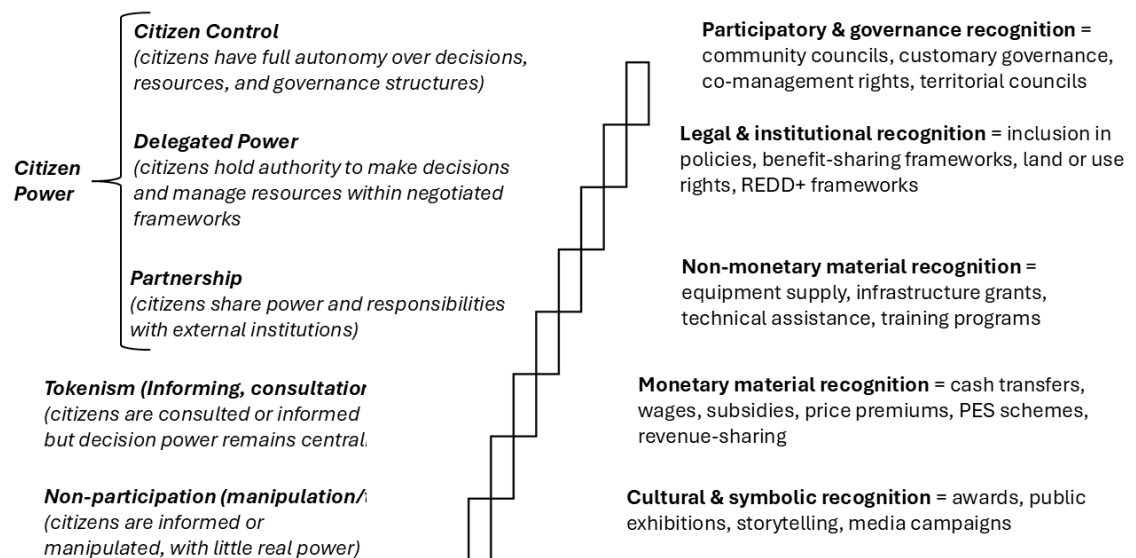
By mapping the typology of recognition mechanisms onto Arnstein’s Ladder of Citizen Participation, it becomes evident that material recognitions (monetary and non-monetary) tend to align with lower to intermediate levels of participation, while legal–institutional and participatory recognitions correspond to higher rungs associated with citizen power and self-governance (Figure 3).

The quantitative comparison between global and Brazilian cases underscores this gradient. Among the 38 global case studies, most examples were concentrated in the intermediate and upper levels of the ladder: 6 cases classified as Informing, 3 as Consultation, 4 as Placation, 10 as Partnership, 12 as Delegated Power, and 2 as Citizen Control. Only one case (3%) was categorized as Manipulation. The mean participation score for the global sample was 5.55, corresponding to a position between Placation and Partnership, indicating moderately high community influence.

In contrast, within the Brazilian dataset of 384 projects, participation was more frequently positioned at the lower and intermediate rungs: 224 cases (58%) were categorized

as Informing, 36 (9%) as Consultation, 4 (1%) as Placation, 66 (17%) as Partnership, 36 (9%) as Delegated Power, and 8 (2%) as Citizen Control. The resulting average participation score of 4.14 suggests that, while participatory elements are recurrent in project design, most recognition mechanisms remain within consultative or partnership-oriented frameworks, with relatively few achieving full decision-making authority.

Figure 3: Conceptual alignment between forms of recognition of stewardship practices and the degree of community participation and empowerment, based on Arnstein's Ladder of Citizen Participation. Each recognition type corresponds to distinct modes of material, institutional, or symbolic valuation, ranging from externally driven awareness and technical assistance (non-participation and tokenism) to autonomous, community-led governance (citizen power).



Source: Author, 2025

When grouped into Arnstein's three broader participation domains – Non-participation, Tokenism, and Citizen Power – clear differences emerge between contexts. In the global sample, 63.2% of the cases reached the Citizen Power range (Partnership, Delegated Power, or Citizen Control), particularly in India, Thailand, Costa Rica, and Canada, where stewardship practices are embedded in legally recognized community governance systems. Conversely, in Brazil, only 28.6% of the 384 projects reached this range, while 68.8% were concentrated within Tokenism (Informing, Consultation, Placation) and 2.6% in Non-participation (Fig. 4)

Table 1. Global examples of stewardship practices by country and social group

Country	Social Group	Stewardship Practice(s)
Australia	Indigenous peoples in northern and central regions (savanna and dryland contexts)	Application of traditional fire management (early dry-season burning) to prevent wildfires, integrate biodiversity conservation, and reduce emissions; adaptive use of ecological knowledge to control erosion and restore ecosystems.
Brazil	Local communities in community-based fisheries (Amazon coast); Indigenous Peoples in Amazon (Tapajós-Arapiuns RESEX), Cerrado (Xavante), quilombola and riparian communities; traditional caívas guardians (southern Atlantic Forest); residents around Chapada dos Veadeiros NP; artisanal fishers (human–dolphin cooperative fishing, Laguna type); fishers from Araçá Bay (SP); rural settlements and community networks (Vale do Paraíba); traditional/local communities (generic Brazil entries)	Community-based fisheries management and spatial/lake zoning; rotational and sustainable harvesting of NTFPs (açaí, Brazil nut, babaçu, pequi); maintenance of native forest cover in caívas; seed collection, preparation and storage for restoration; agroforestry and silvopastoral systems to restore soils and riparian areas; community proposals for closed seasons, gear restrictions and no-take areas (Araçá); sustainable extraction/use of native resources; environmental education linked to river/territorial restoration; collaborative fishing between humans and dolphins, where dolphins herd fish towards fishers, and fishers assist by casting nets, facilitating the capture for both.
Canada	Syilx Okanagan and Heiltsuk First Nations	Adaptive co-management integrating TEK; restoration of aquatic/migratory habitats; fisheries and salmon/stock monitoring; ceremonial stewardship; sustainable marine macroalgae/kelp harvesting with partial cuts and site rotation; family/clan territoriality to ensure long-term resource persistence.
Chile	Diaguita, Mapuche, Kawesqar communities; coastal fishers	Marine co-management and sustainable extraction; formation of local conservation units guided by TEK.
China	Tibetan/highland communities; traditional/local communities involved in conservation of the black snub-nosed monkey	High-altitude rangeland and pastoral management (seasonal use, mobility); community patrolling and wildlife monitoring; prevention of hunting and illegal logging; sustainable NTFP harvesting; participation in protected-area management grounded in sense of place.

Country	Social Group	Stewardship Practice(s)
Costa Rica	Indigenous Peoples in officially recognized Indigenous Territories (Bribri, Cabécar, Brörán, Ngäbe, etc.)	Indigenous forest stewardship combining TEK with REDD+ frameworks; community-based monitoring and reporting; protection of biodiversity and ecosystem services through Indigenous-led territorial governance.
Egypt	Bedouin pastoralists/rangeland systems	Rotational grazing and small-scale agriculture with drought-resistant crops, restoring rangelands and maintaining ecosystem balance.
France	Traditional coastal fishing communities	Traditional coral reef management and marine conservation through community-based practices.
Ghana	Local farmers, hunters, and women gatherers	Sustainable natural resource extraction using customary ecological norms and gender-inclusive stewardship roles.
India	Scheduled Tribes and Traditional Forest Dwellers (e.g. Menda-Lekha, Gadchiroli); Indigenous and local communities of the Indian Himalayan Region (Apatani, farmers in Uttarakhand, Meghalaya, Nagaland); vast group of NE India peoples (Bodo, Mishing, Karbi, Khasi, Naga, Lepcha, Tripuri, etc.); agro-pastoral community of Kibber; Kinnaura community (transhumant pastoralists)	Community forest and biodiversity management (Van Panchayats); sacred groves/forests with strict harvest rules; mixed and terrace farming (baranaja), bamboo drip irrigation, ZABO and alder-based systems; wet-rice + fish systems (Apatani); rotational/controlled harvesting of medicinal and wild edible plants; soil and water conservation; community biodiversity registers; allocation of forest areas to wildlife; rotational/seasonal grazing to prevent pasture degradation.
Japan	Rural farmers, Satoyama communities, residents of Hirasawa and Isobe districts	Communal rules to prevent overharvesting in commons; seasonal water-level control in paddy fields creating multi-habitat wetland systems; maintenance/burning/cutting of reed beds; upkeep of traditional irrigation channels linking village and fields; short-rotation management of satoyama forests to regenerate wild cherry; landscape stewardship for culturally valued forest patches.
Mexico	Indigenous Chiltepec Chinantec; traditional fishing communities	Forest management including clearing, roads, and fire control; sustainable fisheries integrating ecological monitoring to conserve endangered species such as <i>Phocoena sinus</i> .

	Country	Social Group	Stewardship Practice(s)
Zealand	New	Māori communities (Taranaki Whānui)	Culturally guided ecosystem restoration through weed control, native vegetation propagation, and shellfish translocation following Māori protocols (<i>tikanga</i>).
	Portugal/ Spain	Estuarine and riverine fishers of Minho/Miño and Mondego systems	Compliance with annual, jointly defined fishing decrees (seasons, quotas, gear); participation in river restoration projects (fishways, tributary rehab); local surveillance to prevent illegal fishing; cross-border co-governance of shared fish stocks.
Africa	Russia	Khanty and Nenets Indigenous peoples	Seasonal reindeer herding and migration based on ecological knowledge; maintenance of sacred sites and culturally significant landscape features; resistance to oil/gas development in ecologically and spiritually important areas.
	South	Marginalized and unemployed rural residents	Mechanical/manual/chemical control of invasive alien plants; ecological restoration and follow-up maintenance; monitoring to prevent re-invasion; blending TEK and scientific knowledge in species identification and seasonal work.
	Thailand	Karen Indigenous communities in five northern highland conservation actions and social funds; community rules on controlled/seasonal burning; villages; local Muslim fishing communities in mangrove agroforestry with multi-species crops (tea, coffee, persimmon); diversification (beekeeping, weaving, academic tourism); community-based mangrove restoration and monitoring using local ecological knowledge.	Community forest management with fire prevention and reforestation; PES-funded
States	United	Alaska Native communities (Kotzebue, Kivalina), Paiute of caribou pass; allow salmon to reach refuge areas); maintenance of spiritual reciprocity with animal populations; TEK-based forest and fuel management in Jeffrey pine stands; reintroduction of prescribed fire; monitoring of culturally important gathering sites.	

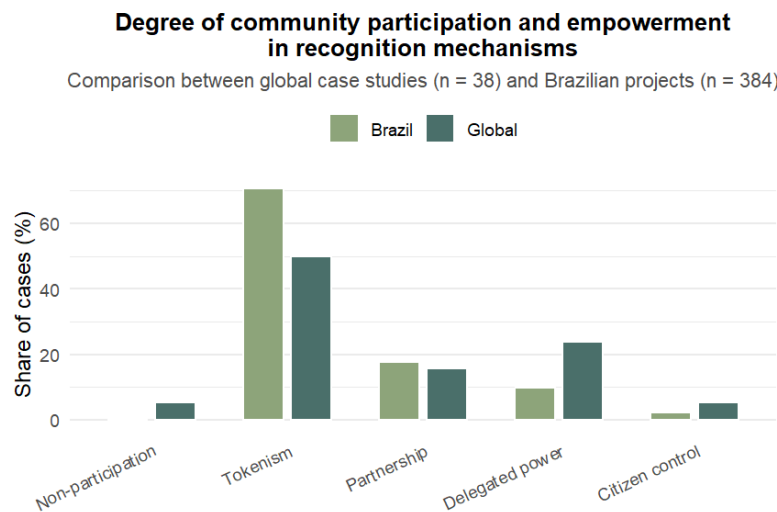
Source: Author, 2025

Table 2. Representative examples of stewardship practices identified among sociobiodiversity projects in Brazil

Region/Biome	Social Group / Organization	Stewardship Practice(s)
Amazon	Riverine and extractivist communities (Tapajós-Arapiuns, Unini); ASPROC; COOPAVAM; COMARU; Rede Origens Brasil; rubber tapper and women's associations; Indigenous Peoples of Alto Rio Negro; CODAEMJ (Cruzeiro do Sul, AM)	Sustainable harvesting of açai, Brazil nut, and rubber; community-based fisheries management (<i>pirarucu</i> quotas); forest product processing (oils, butters, and cosmetics); agroforestry and reforestation with native species; territorial monitoring and participatory restoration; certification and traceability systems; and women-led bioeconomy enterprises.
Cerrado	Cooperativa Grande Sertão; Rede do Pequi / CAA-NM; Associação Pacari; Cooperativa Central do Cerrado; <i>geraizeiros</i> and <i>veredeiros</i> communities	Sustainable collection of pequi, baru, and buriti; medicinal plant cultivation and seed banks; agroforestry systems; traditional fire management; restoration of gallery forests and veredas wetlands.
Caatinga	Family farmers and extractivist groups; ASA (Articulação Semiárido Brasileiro); COOPESAB (Bahia)	Sustainable use of umbu, licuri, and <i>maracujá-do-mato</i> ; water and soil conservation; agroecological diversification; women-led processing initiatives; and dryland restoration through cisterns and reforestation programs.
Atlantic Forest	Family farmers (Vale do Ribeira, São Paulo); community organizations from Paraitinga Valley (São Paulo); Quilombola communities (Campinho da Independência, Rio de Janeiro)	Agroforestry and silvopastoral systems; seed collection and replanting of native tree species; riparian forest and river restoration; and community-run markets linking local food systems with ecosystem recovery.
Pantanal	Local cattle ranchers and fisherfolk associations (Mato Grosso and Mato Grosso do Sul)	Traditional grazing combined with participatory fire management and wetland conservation ensuring biodiversity and water regulation.
Cross-biome initiatives	COOPERACRE (Amazon–Cerrado); Rede de Sementes do Xingu (Cerrado–Pantanal); COOPESAB (Cerrado–Caatinga)	Collective processing of native oils and nuts; women-led sustainable extraction; and seed collection networks for large-scale ecological restoration.

Source: Author, 2025

Figure 4. Comparison of degree of community participation and empowerment between global case studies and Brazilian projects.



Source: Author, 2025

4.5 Discussion

The prominence of Brazil within the global dataset, accounting for 21% of the international case studies, may reflect the country's exceptional socio-environmental diversity. It harbours between 15% and 20% of global biodiversity [102,261], holds the largest number of endemic species, the world's largest tropical forest (the Amazon), and two of the nineteen global biodiversity hotspots: the Atlantic Forest and the Cerrado [59,73]. Its territory also encompasses significant cultural diversity, represented by 355 officially recognized Indigenous lands, 253 Afro-descendent territories, and 28 groups of traditional communities [262]. Or maybe this highlight can be explained by Brazil's leadership in creating a national protected areas system or the emergence of strong and influential nongovernmental conservation organizations, and the advance of conservation science in the country [104].

What is particularly noteworthy is that, when these internationally visible Brazilian cases are contrasted with the national portfolio of 384 community-based projects, a dual reality emerges: while a few landmark cases reached the upper rungs of Arnstein's ladder (especially Delegated Power), the majority of implemented projects remain concentrated at intermediate or consultative levels of participation. In the global review, Brazilian cases ranged from Placation (e.g. families in the South region participating in a research project were able to access

resources from government programs to implement improvements on their properties) to Delegated Power (e.g. community-based pirarucu quotas in the Amazon, the Araçá Bay participatory management process, and the Volunteer Environmental Agents programme in Amazonas). Some of them, such as the Rede de Sementes do Cerrado and restoration/seed-supply arrangements around Chapada dos Veadeiros National Park, show how technical collaboration with the Chico Mendes Institute for Biodiversity Conservation (ICMBio), universities, and NGOs was gradually formalized, giving local collectors an authorized role in large-scale restoration and generating stable income from seed sales [263]. Others, like the Guardians of Araçá Bay, illustrated how participatory research and local mobilization were translated into institutional recognition through judicial decisions and coastal zone planning instruments that incorporated caiçara stewardship practices [264]. Still others, such as the legal and symbolic protection of the human–dolphin cooperative fishery in Laguna (Santa Catarina), revealed how cultural valorization can support conservation practices even when it does not fully transfer decision-making power [129].

By contrast, most of the projects mapped in Brazil were oriented to productive inclusion through alternative uses and commercialization of extractive products as a strategy to increase family income [265]. Organizations received equipment, processing units, training, and support to access markets; far fewer received recognition that altered who decides over access rules, benefit-sharing, territorial monitoring, or long-term financing [101]. These initiatives undoubtedly strengthened local livelihoods and organizations, but they rarely created enduring institutional arrangements or legally binding forms of recognition [265], particularly because they are short-term interventions [266]. In terms of Arnstein’s ladder, they sit predominantly in the tokenism–partnership band: communities are informed, consulted, equipped, and sometimes co-implement actions, but the authority to define rules, allocate benefits, or sustain funding remains external [167]. In practical terms, communities are recognized as implementers of conservation-and-livelihood activities, but less frequently as rule-makers or co-managers of territorial assets.

This asymmetry points to a governance gap. Many of the Brazilian cases that reached delegated power in the global dataset did not emerge solely from ordinary short-term initiatives. They were the outcome of long-duration institutional struggles (Araçá), state-endorsed programmes (Volunteer Environmental Agents), or multi-level coalitions that successfully inserted TEK into formal decision-making arenas (seed-restoration markets in the Cerrado). In those experiences, recognition materialized not as a temporary initiative output but as an

institutionalized mechanism – codified in decrees, participatory councils, protected-area management rules, or national policies for IP&LC [237,241]. This is precisely what allowed them to climb the upper rungs of Arnstein’s ladder.

From another angle, the two datasets reveal a structural tension in the current bioeconomy debate. Sociobiodiversity value chains are *de facto* anchored in stewardship practices carried out by IP&LC [223], but the instruments that recognize these practices (basically material) still operate, in Brazil, mainly through externally designed, short-term charity-based initiatives that are more likely reproducing dependency rather than strengthening local capacities or empowering communities [44,107]. Globally, we found a higher incidence of legal/institutional and participatory/governance recognitions in the upper rungs (partnership, delegated power, and, in a few cases, citizen control), especially in countries where community tenure, IP&LC territorial rights, co-management of fisheries, or community forestry are already institutionalized (India, Costa Rica, Canada, Chile). In these contexts, recognition is not merely symbolic or compensatory, but it is constitutive of governance, where communities are formally authorized to manage forests, rivers, coastal zones, or rangelands, and economic instruments (PES, revenue-sharing, community funds) are attached to that authority [203,228,267].

Our results show that (1) recognition mechanisms take diverse material and non-material forms, (2) community participation levels vary widely across contexts, and (3) balanced combinations of incentives, legal frameworks, and participatory arrangements correlate with higher degrees of empowerment. These findings have three main implications for fostering inclusive governance and valuing the contributions of IP&LC in the transition toward a biodiversity-based bioeconomy.

First, beyond their material dimension, sociobiodiversity products embody intangible values that distinguish them from conventional commodities [268]. Each product represents the outcome of continuous relational and governance efforts – the collective monitoring of territories, the enforcement of customary rules, the negotiation of access and use, and the intergenerational transmission of ecological knowledge. Such practices anchor production in care, reciprocity, and responsibility toward ecosystems, making IP&LC not only producers but custodians of biodiversity. Yet, these contributions remain largely invisible within market logics that reward volume and price rather than ecological stewardship or cultural continuity. Markets alone are unlikely to recognize or remunerate these immaterial values, as they operate on criteria that exclude collective governance, traditional knowledge, and interdependence with nature. A truly recognition-based bioeconomy therefore requires public policies and

institutional arrangements that create incentives to value and reward the relational work sustaining socio-biodiversity, acknowledging that the protection of ecosystems and the reproduction of cultural and ecological knowledge are public goods that merit collective investment.

Second, recognition should not be equated with payments or value addition alone. Monetary and in-kind support remain essential, especially given that many sociobio-diversity chains operate in contexts of economic vulnerability where the market value of native products is often far below the costs required to sustain livelihoods [107]. Financial incentives, therefore, can play a vital role in addressing structural inequalities and compensating for the undervaluation of local stewardship. Yet, the international cases show that these measures only become transformative when they are coupled with redistributive governance arrangements. Recognition reaches the upper rungs of Arnstein's ladder when it appears not merely as financial aid, but as a right-bearing condition: when PES schemes, community forestry concessions, or co-management agreements confer both resources and authority. In such settings, stewardship is institutionalized as a legitimate governance function, not as a temporary project deliverable [203,228,267].

These findings directly inform the implementation of the Brazilian National Bioeconomy Strategy Decree n° 12.044/2024 and the forthcoming National Sociobiodiversity Bioeconomy Plan. The Decree n° 12.044/24. already defines bioeconomy as “based on values of justice, ethics, and inclusion” and acknowledges TEK. To translate this principle into practice, policies must bridge the gap between participation and authority, and mechanisms of recognition that explicitly finance the governance work carried out by communities are needed. Where recognition climbs the ladder, moving from information to co-decision, stewardship practices become durable, intergenerational, and investable. Where it remains confined to the lower rungs, the bioeconomy stays dependent on short project cycles, vulnerable to budget fluctuations, and weakly articulated with territorial institutions. In sum, a biodiversity-based and socially just bioeconomy will only emerge if public policy values not only the products of sociobiodiversity, but also the institutions, relationships, and governance capacities that make them possible.

The comparative analysis yields three key lessons for the design of recognition-based bioeconomy policies.

First, recognition mechanisms that rely exclusively on material support—whether monetary or in-kind—are insufficient to promote empowerment when they are not coupled with

decision-making authority. While such mechanisms can improve livelihoods in the short term, they tend to reproduce asymmetric governance arrangements in which communities remain implementers rather than co-governors.

Second, the durability of stewardship recognition depends on its institutionalization. Global cases show that recognition becomes transformative when it is embedded in legal frameworks, co-management agreements, or formally recognized territorial rights. In contrast, project-based recognition remains fragile, highly dependent on funding cycles, and vulnerable to policy discontinuities.

Third, participation only translates into empowerment when it alters who defines rules, allocates benefits, and monitors compliance. Mechanisms positioned at the upper rungs of Arnstein's ladder demonstrate that stewardship recognition is most effective when communities are formally entrusted with governance responsibilities, rather than merely consulted or informed.

These lessons suggest that advancing a sociobiodiversity-based bioeconomy requires shifting from recognition as support to recognition as governance.

4.6 Conclusion

Our study showed that building a stronger sociobiodiversity-based bioeconomy in Brazil requires moving beyond project-based support toward enduring systems of recognition and shared governance. Beyond documenting existing recognition mechanisms, this study highlights the conditions under which recognition contributes to empowerment and durable governance. The lessons derived from the comparative analysis reinforce that markets and projects alone are insufficient to value stewardship. Recognition must be designed as an institutional and political process that redistributes authority, not only resources. The country's vast socio-environmental diversity already sustains multiple stewardship practices carried out by IP&LC, but these remain undervalued within prevailing policy and market frameworks. To realize the principles established by Decree no. 12.044/2024, public policy must reward not only the tangible products of sociobiodiversity but also the collective governance, TEK, and relational labour that sustain them. This involves integrating financial and non-financial incentives with legal and participatory mechanisms that grant communities co-management authority over territories and resources. In practical terms, markets alone will not internalize these immaterial values. It is the role of the State to design instruments, such as tailored PES

schemes, community funds, and procurement policies, that link economic incentives with empowerment and long-term governance. Only by aligning recognition, redistribution, and authority can Brazil consolidate a bioeconomy that is truly socially just and institutionally resilient

5 MUTUAL LEARNING ACROSS DIFFERENT BIOECONOMY TRANSITION PROCESSES IN THE NETHERLANDS AND BRAZIL¹⁰

5.1 Abstract

The transition to a sustainable bioeconomy is widely promoted as a strategic response to global crises such as climate change and biodiversity loss. However, the implementation of bioeconomy strategies varies across regions, shaped by diverse institutional arrangements, actor networks, and territorial dynamics. This article explores two contrasting bioeconomy transition processes in different subnational contexts – Noord-Brabant (The Netherlands) and Northern Minas Gerais (Brazil) in order to examine how bioeconomy transitions unfold. Using the Multi-Level Perspective framework, complemented by grassroots innovation theory, we show that the Dutch case is characterized by a centralized, state-coordinated strategy embedded in an industrial regime, while the Brazilian case illustrates a decentralized, bottom-up trajectory grounded in traditional knowledge, sociobiodiversity, and community-led governance. We discuss complementarities and learning opportunities between the two approaches and argue that integrating grassroots and institutional capacities is crucial to unlocking the transformative potential of the bioeconomy in diverse contexts. These differences expose both the limitations of techno-centric approaches and the transformative potential of biodiversity-centered, inclusive strategies. The results point to the value of cross-country learning, where the integration of advanced technological solutions and biorefinery applications to expand sociobiodiversity-based value chains could foster a more inclusive and sustainable global bioeconomy.

Keywords: sustainable development; circular bioeconomy; sociobiodiversity; Multi-Level Perspective; grassroots innovations; SDGs; biological resources; traditional peoples and communities; bio-based value chains

¹⁰ Manuscript submitted to the Journal “Discover Sustainability”

5.2 Introduction

Bioeconomy has been widely promoted as a strategic response to the systemic challenges of the 21st century, such as climate change, biodiversity loss, and dependence on fossil fuels [1–5]. However, bioeconomy is not a homogeneous project, but a plural and evolving field shaped by specific national priorities and governance structures.

The Netherlands was among the early adopters of a national bioeconomy strategy. [273]. The "Framework Memorandum on the Bio-based Economy" defines bio-based economy (a preferred term for “bioeconomy”) [274] as “a green or sustainable economy which uses resources from living nature, including biomass and renewable resources”. This approach is deeply integrated with the circular economy, particularly in biomass valorization through cascading use and waste repurposing, and is aligned with EU policies [275]. The national strategy “A Circular Economy in the Netherlands by 2050” sets ambitious targets: a 50% reduction in virgin raw material use by 2030 and to become completely circular by 2050 [276]. Structured policies, roadmaps, and support schemes have been introduced to set up an encouraging ecosystem for innovation, while focusing on regional networks and facilitating both top-down and bottom-up solutions to the bioeconomy transition [277]. Despite all governmental efforts to implement circular bio-based principles, there are critics regarding the negative environmental impact of the Dutch economy's participation in global value chains [278,279]. Three-quarters of the material resources needed for its economy are imported, and more than half of the greenhouse gas emissions and more than 80% of land use related to the Dutch economy and consumption take place abroad [280].

Brazil ranks as the second-largest global producer of biofuels (trailing only the United States) and is recognized as a key player in the bioeconomy worldwide [281]. With decades of large-scale production experience that dates back to the 1930s, when ethanol blending policies were first implemented and more significantly in the 1970s, with the establishment of the National Alcohol Program (Proálcool), the country has developed a highly efficient agro-industrial sector closely tied to government initiatives [281]. This has led to the consolidation of a powerful agro-industrial bioeconomy centered around large-scale monocultures, biorefineries, and biotechnology-driven innovation. Being the most established bio-based sector (aside from food and other traditional crop uses), biofuels dominate the bioeconomy in Brazil [34]. However, due to the negative environmental impact and social exclusion associated with this agrobusiness model, a new narrative of sociobiodiversity-based bioeconomy has

gained momentum [42,69,101,105–107,121,158,159,282], especially among civil society and some research sectors. This narrative is supported by the fact that Brazil holds exceptional biological and cultural diversity, with several grassroots initiatives (GI) rooted in traditional knowledge (TK) and territorial practices located throughout the country. These two distinct and often in conflict bioeconomy trajectories (agro-industrial bioeconomy and sociobiodiversity-based bioeconomy) coexist and interact in complex and often uncoordinated ways [32]. The National Bioeconomy Strategy, launched in 2024, has a broad definition of bioeconomy as a sustainable development model guided by principles of justice, ethics, social inclusion, and scientific and TK. The National Plan, the main implementation instrument of the Strategy and still under development, seeks to accommodate the contrasting views of different bioeconomic sectors.

Both Brazil and the Netherlands have been able to advance in terms of science and technology to develop cutting-edge agriculture and have become major world producers and exporters of agricultural products. In both countries, agribusiness has a significant share of GDP. The Netherlands is a leader in efficient and sustainable agriculture and the second-largest exporter of agricultural goods in the world [283]. Brazil ranks second internationally in grain exports [284] and has the most advanced tropical agriculture technologies on the planet [285]. However, in addition to the fact that there are limits to continued growth in production and income over time, intensive industrial agriculture has been identified as responsible for serious environmental problems in both countries [286]. Faced with the urgency of the global climate crisis and the national commitments that have been made, this traditional agricultural model has been increasingly challenged and therefore needs to be reinvented in the context of bioeconomy with a combination of local skills and social and environmental concerns [287].

Brazil and the Netherlands are two countries that embody contrasting trajectories in the bioeconomy. While the Netherlands has advanced a state-led, technology- and efficiency-oriented model strongly integrated with the circular economy [269,274], Brazil represents an emerging and plural bioeconomy where the coexistence of industrial biofuels and sociobiodiversity-based initiatives highlights tensions between competing development visions [32]. For a deep and illustrative analysis, we selected two subnational territories – Noord-Brabant (NL-NB) Province, in the Netherlands, and Northern Minas Gerais (MG), in Brazil – to examine distinct bioeconomy transition pathways. While the Dutch case represents a highly institutionalized setting where niche innovations are embedded in industrial regimes and supported by coordinated state strategies, the Brazilian case illustrates a grassroots-driven

context where transition processes emerge from bottom-up initiatives rooted in TK and community-based governance.

The study's originality is framed by explicitly mobilizing the Multi-Level Perspective (MLP) to analyze how niche innovations, regime dynamics, and landscape pressures unfold differently across these contexts, clarifying whether bioeconomy transitions are primarily propelled by industrial biotechnology or by grassroots, community-oriented ecological innovations [5,215]. NL-NB is a leading European hub for circular bio-based innovation, integrating research institutes, companies, and regional government in transition processes [288–290]. Conversely, Northern MG, Brazil, is nationally recognized for GI that mobilize sociobiodiversity, TK, and territorial governance to promote sustainable livelihoods [51,52,41,124,291,292]. The choice of these specific regions is based on the following reasons: 1. Both regions contribute significantly to the agricultural GDP of their respective country [293,294], playing a pivotal role in national food production systems while simultaneously experimenting with innovative approaches that link farming practices to broader bioeconomy transitions [281,288,295]. The high GDP of agricultural sectors in both regions is one of the sectors most affected by climate change (changing precipitation patterns), while having a great impact on the environment due to the pressure it exerts, namely on land use change from native vegetation to agricultural areas, as well as on the waste and emissions it generates [35,36,229,286]. Together, these cases provide a unique empirical lens to examine the tensions and complementarities between top-down and bottom-up approaches to bioeconomy transitions.

Our research questions are as follows: how bioeconomy implementation and transition processes unfold in two contrasting regional contexts in the Netherlands and Brazil?; Are there opportunities for mutual learning between different transition models in The Netherlands and Brazil? How can these case studies might contribute to the Multi Level Perspective (MLP) framework of analysis?

To answer these questions, we address three main objectives: (i) to understand how bioeconomy implementation and transition processes occur in each case study; (ii) to explore mutual learning opportunities across contrasting transition models; and (iii) to assess how the empirical findings challenge, complement, or refine the assumptions of the MLP framework, particularly regarding the inclusion of territorial justice, GI, and sociobiodiversity.

5.2.1 Theoretical framework

5.2.1.1 Multi-Level Perspective theory

Transition to sustainability is a fundamental and necessary change in the structure, culture, and practices of societies to face complex global challenges. It is a long-term process resulting from a co-evolution of economic, technological, institutional, cultural and ecological developments at different scale levels [312]. MLP is one of the most influential approaches in the field of socio-technical transitions. Developed by Geels [313,314], the theory is based on the premise that deep changes in socio-technical systems occur through dynamic interactions among three analytical levels: innovation niches (micro-level), dominant sociotechnical regimes (meso-level), and the exogenous landscape (macro-level). Niches represent protected spaces where technological, organizational, or social innovations emerge and are tested; regimes encompass the institutional structures, practices, norms, and actor networks that uphold the stability of existing systems; and the landscape refers to broader and slower-moving trends (such as demographic shifts, economic crises, international treaties, and climate change) that exert pressure on regimes and create windows of opportunity for innovation. The hierarchical structure of the MLP implies that regimes are situated within broader landscapes, and niches operate within these regimes.

According to MLP, transitions are coevolutionary processes. Landscape pressures destabilize regimes, creating space for niche innovations to scale up and transform the dominant system. But niches also play a vital role, as they serve as “seeds of change” [312], although “the environment into which these seeds are sown is, of course, the main determinant of whether they will sprout” [314]. That means innovations typically emerge in niches but are shaped by the conditions, constraints, and opportunities present in the surrounding regimes and landscapes. A key insight of the MLP is that only when these dynamics in the three levels (macro, meso and micro) come together in particular ways may a mutual reinforcement effect emerge as a necessary condition for achieving a transition [315] or a transformation [316].

While MLP has offered valuable insights into transitions in industrialized countries, it has also been criticized for its limited applicability in contexts characterized by inequality, epistemic diversity, and historical marginalization, often present in the Global South [13,315], where systemic change may not emerge from formally incubated niches, but rather from deeply rooted, community-based practices that operate outside institutionalized innovation systems. In

such contexts, practices challenge the assumptions of MLP by foregrounding alternative forms of knowledge, collective agency, and value systems that do not align with market-driven or techno-scientific logics. This raises the question of whether the niche-regime-landscape architecture is sufficient to account for the plurality of transition dynamics observed in diverse territorial realities [309]. In particular, it calls for a re-examination of the niche level itself. Rather than assuming a uniform model of niche development, we argue for a finer analytical lens, recognizing the distinct origins, logics, and conditions under which grassroots innovations emerge and persist.

5.2.1.2 Deep root systems and alternative transition pathways

The concept of grassroots innovations has gained prominence in sustainability transitions literature as a way to recognize inclusive, bottom-up processes driven by civil society organizations, social movements, and community-based actors [306,307,310,311]. Unlike conventional innovation models, typically led by firms and research institutions aiming at technological efficiency and market scalability, grassroots innovations prioritizes social needs, ecological values, and local empowerment [311]. They often emerge in response to systemic exclusions, mobilizing alternative knowledge systems and collective creativity to address everyday challenges with limited resources [317]. While this literature has been crucial in legitimizing non-technocratic forms of innovation, it often conceptualizes grassroots innovations as discrete initiatives occupying protected “niches” within the MLP framework [306].

In the context of sociobiodiversity-based bioeconomy in Brazil, it is likely that many grassroots innovations are embedded in what we define as deep root systems: territorialized, traditional socioecological systems that sustain entire ways of life grounded in alternative relations with nature. In this sense, besides the conventional levels (landscape, regime and niches), we suggest an additional infra-niche that is sustained by deep root systems and serves as incubation spaces for experimentation and resistance, especially in contexts of marginalization (Figure 1).

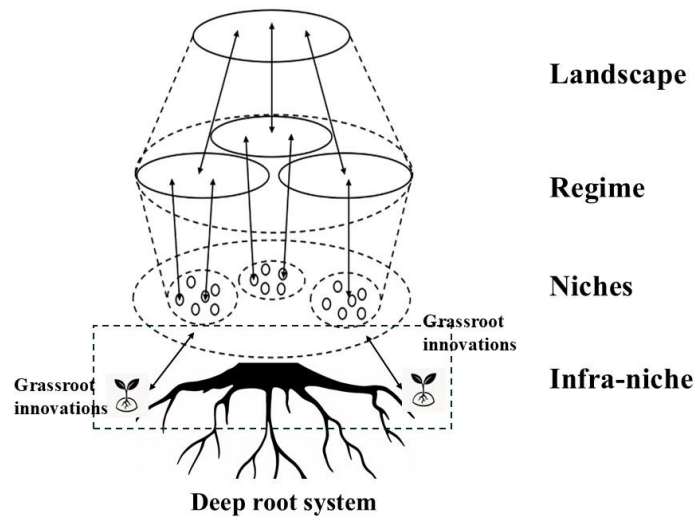


Figure 1: Multi-level dynamics in our adapted framework of MLP theory. Source: Adapted from Geels (2002).

At the infra-niche level, the deep root systems encompass shared cosmologies, collective informal institutions, environmental ethics, and TK, all of which inform how communities produce, govern, and sustain life. These systems are shaped by a direct material and symbolic dependence on nature, where biodiversity is not merely a resource, but a relational element of identity, spirituality, and subsistence. As Fraser & Glass [318] suggest through the metaphor of “deep root systems,” transitions do not start from isolated initiatives, but from social ecosystems capable of nurturing values, practices, and relationships that sustain alternative futures.

5.3 Materials and Methods

5.3.1 Data collection and analysis

Data collection was carried out in two main phases, combining a structured literature review with qualitative fieldwork in Brazil and the Netherlands. This mixed approach was designed to provide both a broad overview of the academic debate and an in-depth understanding of the perspectives of key actors involved in the bioeconomy in the two countries.

A structured research of academic publications and official reports was conducted in the databases Google Academics, Scopus and Web of Science. We searched for the term

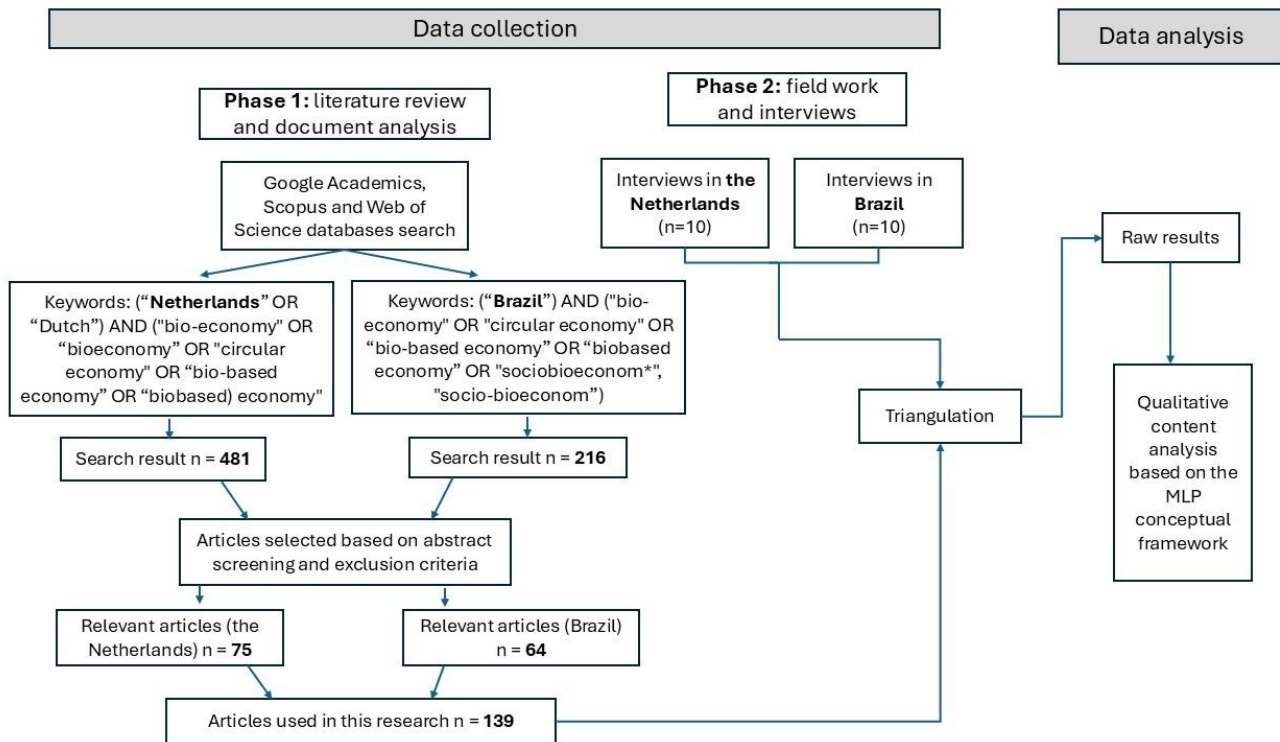
“bioeconomy” in combination with “The Netherlands”/“Brazil” and its synonyms within titles, abstracts and keywords. We found 481 peer-reviewed publications for the Dutch case, dating from 2006 to 2024, and 216 publications for the Brazilian case, dating from 2016 to 2024.

Abstracts of the 697 publications found in the two case studies were carefully screened to confirm whether the documents directly addressed the research topic. During this stage, we applied the following exclusion criteria: (a) the article does not directly address the topic; (b) it does not address the bioeconomy in the Brazilian or Dutch context; (c) it deals with overly technical case studies, focusing on innovations, technological experiments or the analysis of specific components/substances; and (d) it does not offer free access to the full text. Based on these criteria, 558 documents were excluded, leaving 139 publications for in-depth analysis, 75 related to the Dutch case and 64 from the Brazilian case.

Semi-structured interviews were carried out with key stakeholders to complement and triangulate the literature review. In the Netherlands, 10 interviews were conducted between April and July 2024 with representatives from government, research and educational institutions, and private companies. In Brazil, 10 interviews were conducted between September and November 2023 with representatives from local cooperatives, civil society organizations, government institutions, and the private sector.

Interviews were combined with field visits to relevant organizations and territories in both countries, which provided direct insights into socio-ecological and institutional contexts and enabled a richer interpretation of stakeholders’ narratives. Interviews covered themes such as key actors, barriers and challenges, strategies adopted, and successful initiatives, with respondents asked to illustrate enabling conditions. Triangulation of data between different actors allowed a more comprehensive and contextualized understanding. All interviews were anonymized using country-specific codes (e.g., NL01, BR01), and the full list of interviewees and questionnaires is provided in Supplementary Information – SI 1.

A theory-informed coding framework was applied to all documents and interview transcripts, based on MLP dimensions. The coding categories included landscape pressures, regime characteristics, niche innovations, strategic visions, governance structures, operational instruments, and actor coalitions. Figure 2 summarizes the methods.

Figure 2: Data collection and analysis process (adoption of PRISMA).

Source: Authors, 2025

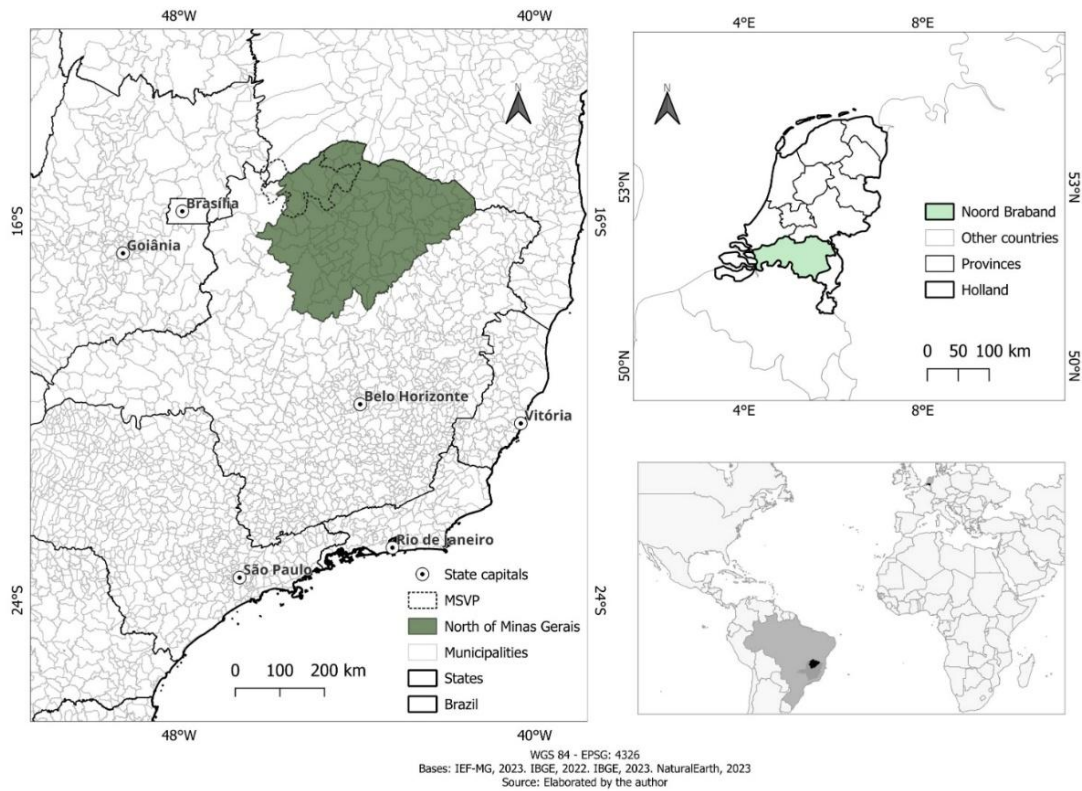
5.3.2 Case studies

Case studies were selected because they jointly meet the following criteria: (i) salience in national agricultural economies (measurable contribution to agricultural GDP and agri-food value chains); (ii) active bioeconomy initiatives (policies, programs, pilot projects) enabling observation of implementation; (iii) data/stakeholder accessibility for triangulation (documents, interviews, and observation); and (iv) analytical contrast between trajectories (technology-/industry-oriented vs. sociobiodiversity-/territory-oriented). Accordingly, NL-NB represents a leading regional hub of circular, technology-intensive agri-food industries; Northern MG represents a biodiversity-rich territory with strong agricultural activity and sociobiodiversity value chains.

Anchored in the MLP, we compared the regions (Figure 3) along six shared dimensions: (1) Landscape pressures (e.g., climate/market shocks, national/EU policy signals); (2) Regime characteristics (dominant agri-food structures, industrial biotechnology footprint); (3) Niche innovations (biorefineries, circular technologies vs. sociobiodiversity and community-based

arrangements); (4) Governance and actor coalitions (roles of state, industry, civil society, research); (5) Agricultural economic profile (sectoral specialization, links to agricultural GDP); and (6) Outcomes/indicators (circularity, biodiversity considerations, inclusion).

Figure 3: Map with geographical location of the two-case studies A) Noord-Brabant in the Netherlands and B) Northern Minas Gerais in Brazil.



Source: Authors, 2025

5.3.2.1 Noord-Brabant, the Netherlands

NL-NB is a southern Province of the Netherlands, bordering Belgium and comprising five major regional hubs, including Eindhoven, Breda, and 's-Hertogenbosch. With a population of approximately 2.6 million, it is the second most populous province in the country and one of the leading contributors to national GDP [288]. Brabant is the strongest agricultural area in the Netherlands, home to 25% of the top 40 global agrifood companies [294]. Agriculture and cattle breeding have shaped the past of the Province. Ideally located as the gateway to Europe, the region also offers the full agrifood value chain. From agriculture, breeding, food processing and equipment through to specialized packaging and food-grade

logistics [294]. The Province has built a high-tech region of significant size with Brainport Eindhoven, 8 open innovation campuses, and players like Philips, ASML Holding N.V., and VDL Groep B.V. [288]. The manufacturing and chemical industry, agri-food and tourism are strong in Brabant. In recent years, together with partners in West Brabant and the South West of the Netherlands, the Province has invested in funding a strong economic bio-based ecosystem. In this way, they have contributed to innovation in material and product development, scaling up activities to green chemistry and creating a market boost for bio-based products [295]. The region combines a strong industrial base with advanced knowledge infrastructure, high levels of urbanization, and productive agricultural areas, forming a complex and highly integrated socio-economic landscape.

5.3.2.2 Northern Minas Gerais, Brazil

Northern MG State, Brazil, is a region of ecological transition between the Cerrado and Caatinga biomes. The Cerrado (Brazilian savannah) is considered one of the world's biodiversity hotspots due to its great biological richness [104], but it is largely undervalued and poorly protected [319]. It is one of the largest and least densely populated regions in the state, historically marked by exclusionary land occupation processes, land concentration, and the marginalization of traditional peoples and communities (TPC) [41], mostly as a consequence of being a vital agricultural frontier, accounting for 40% of the country's total crop production [320]. On the other hand, the region harbors a unique mosaic of veredas, chapadas, and water recharge areas that are fundamental to the environmental balance of central Brazil. This peripheral condition has contributed to the conservation of extensive mosaics of native vegetation and the continuation of livelihoods based on the sustainable use of local resources. The Sertão Veredas–Peruaçu Mosaic (MSVP), located in this region, stands out as a territorial arrangement covering 31 protected areas (including federal, state, and private lands) across 27 municipalities, covering an area of over 1.8 million hectares [321]. It also includes Indigenous lands (Xakriabá), quilombola territories, and numerous traditional communities such as geraizeiros, veredeiros, and vazanteiros, groups that have developed territorial practices that combine collective land management, extractivism, subsistence agriculture, and deep TK associated with native Cerrado species. It is a key area for the conservation of the Cerrado and its social and cultural heritage. This context supports the adoption of best practices in agriculture and initiatives to strengthen the value chains of Cerrado fruits, together with

integrated and participative management in order to ensure compatibility among biodiversity conservation and the valorisation of social diversity of the region.

5.4 Results

5.4.1 The Dutch case

At the landscape level, NL-NB Province is shaped by a convergence of long-term structural pressures and emergent socio-environmental imperatives. Historically, the Netherlands has faced territorial constraints, high population density, and strong dependence on imported raw materials, which have made resource efficiency and waste minimization central to its development logic [206]. More recently, macro-level forces such as the European Green Deal, international climate agreements, and rising societal concern over environmental degradation have added momentum to sustainability-oriented transitions. Interviewees also mentioned specific challenges that have reinforced calls for systemic change, such as nitrogen emissions from intensive livestock farming and the need to decarbonize industrial production (Interviews NL2, NL3). These pressures have pushed the NL-NB to develop regionalized strategies that operationalize circular and bio-based approaches (Interview N7).

At the regime level, supportive schemes aligned with national and EU objectives have been introduced to set up an encouraging ecosystem for innovation, while focusing on regional networks and facilitating both top-down and bottom-up solutions to bioeconomy transition [277]. Structured policies (we found 12 bioeconomy-related policies in the Netherlands – SI 2), roadmaps, innovation contracts (Green Deals), transition agendas, regional accelerators and tax incentives on research and development (R&D) (WBSO Program) create space for experimentation while facilitating the incorporation of innovations into mainstream practices. These instruments, extensively mentioned by interviewees, articulate roles for government, private companies, research institutions and civil society organizations, fostering collaboration and boosting innovation and entrepreneurship [290]. A good example is the agricultural co-operative Cosun. Embedded in the regional agro-industrial system, this entity has strategically integrated circularity into its operations through the valorization of biomass residues, the development of bio-based ingredients, and investment in renewable energy. Its Innovation Center functions as a hub for applied research and industrial symbiosis, facilitating collaborations with startups, research institutions, and regional governments. By participating

in public–private initiatives like Green Circles, Cosun not only promotes environmental innovation but also contributes to introducing circular practices into mainstream agro-industrial value chains, reinforcing its position as a regime actor committed to incremental but systemic transformation.

Five operational government agencies in the region (Brabantse Ontwikkelings Maatschappij -BOM, AgriFood Capital, Brainport Development Eindhoven, Rewin and Midpoint Brabant) have been specifically established to support industry [288]. They play a fundamental role in the development of clusters and innovation ecosystems, thereby accelerating the transition to the bioeconomy [290]. In addition to facilitating public-private partnerships (PPP), these organizations are involved in attracting investments and funding, accessing EU funds (such as Horizon Europe and Interreg) and national programs (such as the Dutch Bioeconomy Policy) for regional projects. They work closely with municipalities and industries to foster synergies across value chains; support startups by offering mentorship, incubation, and access to networks for emerging companies in strategic sectors; and collaborate with educational institutions (many in applied sciences like e.g., Avans Hogeschool) to train the workforce in bioeconomy and sustainable technologies [295]. Their role is essential in transforming academic research into sustainable businesses, thereby strengthening regional competitiveness in a strategic sector. Public-private innovation hubs like the Bio-based Delta and the Green Chemistry Campus exemplify how circular principles are increasingly adopted by incumbent actors, particularly in the agro-industrial and chemical sectors [289].

NL-NB Province also benefits from the national government's strategy of adopting the Transition Management Theory (TMT) as a guiding framework for its policies since the early 2000s [272,280,322,323]. Developed at Dutch universities as a result of dialogues among scientists, politicians and practitioners around sustainability transitions [324], TMT is a multi-level model of governance and a normative complement to the MLP that shapes processes of co-evolution using visions, transition experiments and cycles of learning and adaptation [325,326]. It was implemented in sectors such as energy, mobility, and waste management between 2000 and 2010 [277,327] and consisted of creating innovative spaces, articulating stakeholder networks, and facilitating social learning through iterative cycles of planning, implementation, and monitoring [326,328]. Although the term was not explicitly mentioned, all elements of the theory came up in the interviews, demonstrating how embedded it is in different sectors. The central role of government in this process was also extensively mentioned by the interviewees.

NL-NB is home to a multiplicity of innovation niches linked to the circular bioeconomy. Key initiatives include circular agro-industrial clusters that valorize organic waste, precision agriculture technologies, and bio-based material startups. One very cited example (Interviews NL1, NL7, NL10) of niche innovation in the Province is Peel Pioneers, a startup that has developed a circular solution for processing orange peels from the juice industry. Rather than being incinerated or wasted, these peels are transformed into valuable ingredients such as essential oils, dietary fibers, and animal feed additives [329]. According to interviewees, the scaling up of Peel Pioneers' operations was only possible through a mix of financial schemes and partnerships with other stakeholders in the value chain (supermarkets, logistics companies and food producers). The initiative exemplifies how niche actors, supported by regional innovation policies and sustainability targets, are creating circular value chains that align with both market logic and ecological goals.

Another worth mentioning initiatives present in the Dutch case are the living labs, such as Kleine Aarde in Boxtel (Interviews NL3, NL4), experimental spaces where circular practices are tested, adapted, and scaled through real-life community engagement [330]. These bottom-up initiatives foster learning-by-doing and cross-sectoral collaboration, enabling citizens, researchers, and local governments to co-create sustainable solutions [331]. They promote reflexive governance and allow for the articulation of alternative visions of sustainability. Such initiatives suggest a growing awareness of the need to complement technological transitions with culturally resonant and socially grounded approaches [332]. Cultural issues, such as changes in traditional societal values or in how people perceive environmental issues, were cited by all interviewees as the most important challenge for a real transition to sustainability.

5.4.2 The Brazilian case

The landscape and regime levels in the northern part of MG State in Brazil are dominated by centralized agri-export systems, with the focus on the production of agricultural commodities for export promoted by local and federal governments as the mainstream "development" strategy [319]. Deforestation, land degradation, water scarcity and the advance of mechanized monocultures have put additional stress on the ecological resilience of the Cerrado biome [229,333]. Climate change further intensifies these pressures (Interview BR3), altering rainfall regimes, increasing fire risks, and compromising the resilience of traditional agro-extractive systems [334]. Although some policies have advocated for the strengthening of

sociobiodiversity value chains (National Plan for the Promotion of Sociobiodiversity Product Chains) and regulating the access to and role of TK on biodiversity and the sharing of benefits (Biodiversity Law Nº13.123/2015), they still remain peripheral to mainstream economic policies. The majority of the bioeconomy-related policies in Brazil (we found 55 – SI 2) are geared towards the agribusiness sector. Moreover, they are sectoral and poorly integrated, probably reflecting the divisions within society regarding how the bioeconomy strategy is understood and what is expected from it [32].

The dominance of monoculture-based agribusiness continues to concentrate land and resources [109], historically excluding TPC from development policies and markets (Interview BR12), whose territorial rights remain partially recognized and often threatened by agribusiness expansion and legal insecurity. Institutional fragmentation and limited coordination between environmental, agricultural, and development policies [32,335] hinder the integration of sociobiodiversity value chains. Native species in Brazil have been predominantly marketed as unprocessed raw materials with low added value [131]. Discussions and proposals for a sociobiodiversity-based bioeconomy have mainly been focused on the Amazon [107,42,101,121,158], although growing recognition of the Cerrado's importance for biodiversity, water regulation, and climate stability, both nationally and internationally, has contributed to the emergence of new policy windows. These include the debate over extending the soy moratorium to the Cerrado and greater visibility of the biome in global environmental agendas [336,337].

On one hand, Northern MG holds immense biodiversity, TK, and sociocultural diversity that allowed the emergence of family or community-based GI, such as inter-community networks (Fórum de Desenvolvimento Sustentável do Norte de Minas Gerais, Articulação no Semiárido Mineiro e a Articulação Rosalino de Povos e Comunidades Tradicionais, among others), and traditional value chains based on native species like pequi (*Caryocar brasiliensis*), coquinho azedo (*Butia capitata*), and buriti (*Mauritia flexuosa*). They function as pre-institutional spaces of experimentation and care, capable of resisting homogenizing pressures from dominant regimes, offering potential for innovative transitions towards a more sustainable multifunctional productive landscape that support human well-being (Interview BR6) [114,129]. While often invisible to mainstream transition theory, these systems are central to place-based sustainability.

In the municipality of Januária, for example, the initiative Sabores do Agreste, led by local women, promotes the transformation and commercialization of native fruits into jams,

sweets, and preserves, blending TK with gastronomic innovation. Likewise, Pequitina, a brand created by a single woman producer, specializes in pequi-based products. These initiatives demonstrate the vitality of individual and community-led innovations in peripheral regions, while also revealing the structural challenges they face in achieving scale and institutional recognition. Often operating at what we describe as an “infra-niche” level – below conventional innovation structures – such efforts cultivate environmental stewardship, cultural identity, and collective agency long before being formally acknowledged in dominant policy or market frameworks.

While impactful at the local level, such initiatives often act informally, depending on short-term funding and face logistical challenges in transportation, storage, and certification (Interviews BR3, BR6). The Cooperativa Grande Sertão, based in Montes Claros, stands out as a prominent actor committed to helping to overcome these challenges. Formed by smallholder farmers and extractivists, the cooperative focuses on the processing and commercialization of native fruits (Interview BR3), benefiting more than 2,000 families from 350 communities across 35 municipalities in Northern MG [48]. It has 280 members, and 18 socio-productive ventures are directly linked to the cooperative, meaning they sell their products to it [48]. Through partnerships with universities, NGOs, and government programs, it has managed to scale its operations, develop new product lines, and enter institutional markets. The cooperative also plays a key role in mediating contracts between agro-extractive producers in Northern MG and companies like Natura on the commercialization of buriti oil for cosmetic production. Acting as an intermediary between local producers and the private sector, the cooperative ensures that contracts comply with the principles of fair and equitable benefit-sharing, in line with the Convention on Biological Diversity (CBD) and Brazilian legislation. Revenues from this partnership have been reinvested directly into strengthening the local value chain, including expanding extraction and processing capacity, acquiring equipment, and reinforcing collective management.

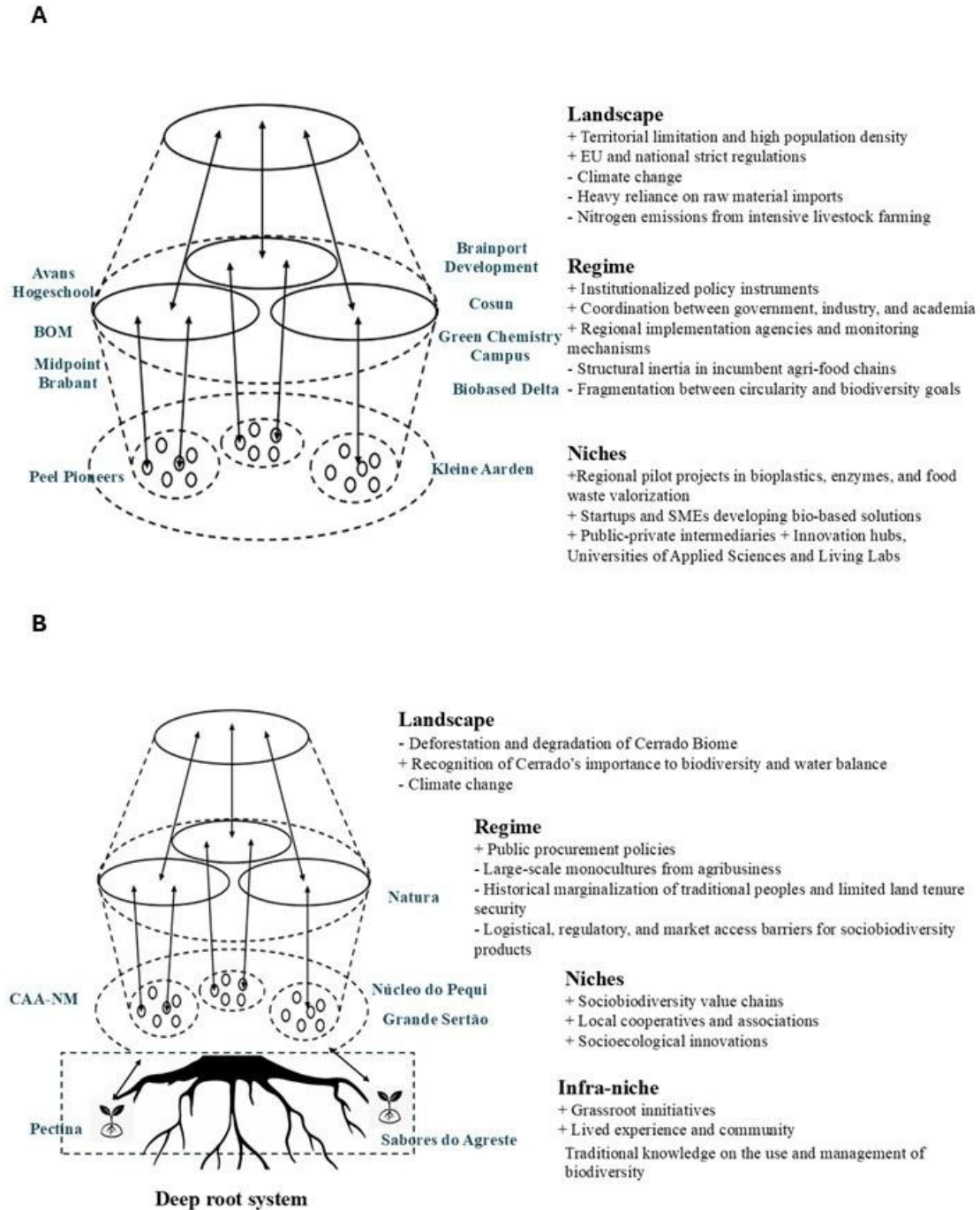
The Center for Alternative Agriculture in Northern Minas Gerais (CAA-NM), in turn, provides essential technical assistance, advocacy, and training to rural communities across the region. According to interviewees, they play an important role because rural technical assistance often fails to include native species, and access to formal markets remains concentrated in conventional supply chains (Interview BR6). So, CAA-NM is instrumental in supporting agroecological practices and developing methodologies to strengthen the

organizational capacity of local groups, including women and youth (Interviews BR9, BR11, BR13).

An important territorial governance actor is the Rede Núcleo do Pequi, a network that articulates associations, cooperatives, NGOs, and researchers across Northern MG to promote sociobiodiversity-based economies (Interviews BR3, BR6). Rooted in community organizing and advocacy, the network, alongside other local and regional actors, plays a pivotal role in advancing territorial governance, disseminating knowledge on sustainable harvesting techniques, and influencing public policies aimed at the protection and valorization of native species. One outcome of this broader and long-standing mobilization was the approval of the National Law 15.089/2025 (Pequi Law) that establishes the National Policy for the Sustainable Management, Cultivation, Extraction, Consumption, Commercialization, and Processing of Pequi and Other Native Fruits and Products of the Cerrado. Pequi is not only a key source of food and income, but also a symbol of cultural identity, territorial belonging, and TK for TPCs in Cerrado. Rather than emerging in isolation, this achievement builds on earlier institutional milestones such as State Law No. 13.965/2001, which established the Pró-Pequi Program to promote the cultivation, extraction, commercialization, and processing of pequi and other native Cerrado fruits. The pequi Law reflects the convergence of long-term efforts led by TPCs and socio-environmental organizations.

Figure 4 synthesizes, through the analytical lens of the MLP theory, the interactions between landscape pressures, regime configurations, and niche-level dynamics observed in the two case studies. In the NL-NB Province, the representation emphasizes the relatively coherent alignment between institutional frameworks, technological innovation niches and multi-actor governance arrangements. In contrast, the Northern MG case illustrates a more heterogeneous and socially embedded transition dynamic, in which GI emerge from deep root systems operating below the niche level (infra-niches). While both cases reveal multi-scalar interactions influencing bioeconomy pathways, the Dutch configuration reflects a stronger integration between niches and regime structures, whereas the Brazilian configuration demonstrates how territorially anchored community innovations can persist and expand despite limited articulation with dominant regime actors. These differences, further explored in the Discussion section, highlight distinct entry points and constraints for fostering transformative change in each context.

Figure 4: Multi-level representation of the Dutch (A) and Brazilian (B) cases of bioeconomy transition. The actors and initiatives shown are illustrative examples, not an exhaustive inventory of the diversity present in each region.



Source: Authors, 2025

5.5 Discussion

Our comparative analysis reveals structural differences in how the Netherlands and Brazil advance bioeconomy transitions. In the Dutch case, actors across government, academia, and the private sector converge in formalized networks and forums that facilitate coordination. Instruments such as TMT programs and regional innovation hubs provide clear direction and mobilize resources, contributing to a more favorable regime environment for the development of bio-based industries [206,338]. Although the Dutch policy framework relies on relatively few regulatory instruments, they are integrated and strategically aligned, enabling synergies across circular economy and bioeconomy agendas. This integration enhances access to funding, applied research, and market opportunities for technological innovations such as biorefineries and bio-based materials.

By contrast, the Brazilian case is characterized by fragmentation: multiple coalitions operate simultaneously, with sociobiodiversity initiatives, agribusiness, and industrial biofuels each following divergent pathways. While the country has a wide range of sectoral policies, they often lack coordination, and most incentives continue to favor agribusiness rather than biodiversity-based value chains [32,186]. As a result, the discourse in favor of a sociobiodiversity-oriented bioeconomy is not consistently translated into practice, and GIs struggle to scale in the absence of stable financial mechanisms, recognition, or enabling infrastructure. The gap between ambitious policy visions and effective implementation echoes global concerns that bioeconomy strategies do not automatically deliver sustainability outcomes [339,340].

The literature confirms that both contexts face barriers in the transition to a sustainable bioeconomy, but their intensity varies. In the Netherlands, the main challenge lies in balancing innovation-driven strategies with broader sustainability concerns, such as social inclusiveness and biodiversity safeguards [206]. In Brazil, the barriers are more systemic: weak coordination across ministries, lack of tailored extension services for native species, and limited access to credit for community-based enterprises [32,339]. Conversely, enabling factors also differ: Dutch transitions benefit from network governance and regional clustering of actors, while Brazilian GIs demonstrate resilience through community stewardship and adaptive governance, despite structural constraints.

Overall, the findings highlight that the regime context in the Netherlands is comparatively more favorable to advancing bioeconomy transitions, particularly through

technological innovation. Brazil, meanwhile, illustrates the persistent lock-ins of an agribusiness-oriented model, where sociobiodiversity-based approaches remain marginal despite their transformative potential. These contrasting trajectories underscore the importance of aligning ecological and technological approaches: sustainable bioeconomy transitions require not only innovation and industrial efficiency but also policies that strengthen biodiversity-based value chains [82], integrate diverse coalitions, and ensure equitable benefit-sharing.

While the MLP framework provides powerful tools for understanding transition dynamics in industrialized contexts, our findings suggest that there are limitations in fully capturing the territorial and sociocultural dimensions of grassroots transitions in the Global South [309]. The comparative analysis of the Brazilian and Dutch cases reveals contrasting trajectories and governance dynamics that shape how bioeconomy transitions unfold in each country (Table 1).

Table 1: Comparative findings: Brazil (Northern Minas) and the Netherlands (Noord-Brabant)

Dimension	Brazil (Northern Minas Gerais)	Netherlands (Noord-Brabant)
Regulatory framework	Multiple sectoral frameworks (agriculture, biodiversity, environment, sociobiodiversity) with limited coordination; regulatory fragmentation; most incentives favor agribusiness over biodiversity-based chains.	Fewer regulatory instruments, but more integrated and aligned with national circular economy and bioeconomy strategies; clear direction (2050 CE goal, 2030 material reduction target).
Policy instruments	Programs focused on agribusiness competitiveness; some initiatives for sociobiodiversity (e.g., PGPM-Bio, local cooperative projects), but limited scaling; weak credit/finance for biodiversity value chains.	Transition agendas for key sectors (biomass & food, plastics, construction, manufacturing, consumer goods); stable funding mechanisms; strong support for R&D and innovation
Actors and coalitions	Fragmented coalitions: agribusiness, industrial biofuels, and sociobiodiversity actors operate separately; cooperatives and CSOs act as intermediaries but lack systemic support.	Strong multi-actor governance (triple helix of government, academia, private sector); network governance ensures alignment; transition brokers facilitate coordination.
Visions of bioeconomy	Competing visions: sociobiodiversity-oriented (civil society), agrobioeconomy (agribusiness), and industrial biofuels (energy sector); sustainability discourse not fully implemented in practice.	Dominant vision centered on technological efficiency and circular economy; emphasis on biorefineries, bio-based materials, and resource efficiency.
Niche innovations	Grassroots initiatives in sociobiodiversity value chains (e.g., pequi, native fruits, oils); strong stewardship and community-based practices, but limited access to markets and finance.	Technological and industrial niches (biorefineries, circular agri-food clusters, material innovation); supported by R&D and policy frameworks.

Regime characteristics	Favorable to agribusiness expansion; weak institutional support for biodiversity-based models; limited coordination between ministries and policies.	Regime open and favorable to circular bio-based innovations; integration of CE and BE agendas reinforces coherence.
Landscape pressures	Climate change, deforestation, biodiversity loss; global trade dynamics; social inequalities and rural poverty; international debates on Amazon.	EU Green Deal, global decarbonization targets, material scarcity, climate pressures; strong public awareness and demand for circular solutions.
Implementation gap	Strong discourse around sociobiodiversity-based bioeconomy, but weak implementation due to lack of coordination, funding, and political priority.	More consistent alignment between discourse and practice, though challenges remain around inclusiveness and biodiversity safeguards.

Source: Authors, 2025

In the Dutch case, the government plays a central and deliberate role in coordinating the transition to sustainability, integrating bioeconomy and circular economy under a national strategy, and by adopting structured methodologies such as TMT [275,326]. This top-down approach is supported by solid research-policy linkages with robust intermediary institutions facilitating PPP, participatory roadmapping, and long-term investment in circular and bio-based solutions [277,280]. This deliberate coordination facilitates systemic alignment and fosters a more coherent pathway for transition. However, one of the persistent bottlenecks is the difficulty of scaling up niche innovations beyond the pilot stage [280]. Many startups and small firms still fail to survive this transition to maturity, suggesting that an overemphasis on technological readiness and market logic may overlook the role of embedded, small-scale solutions (Interview NL10). This suggests that even in highly coordinated environments, transition trajectories can be limited by regime inertia and market logics that prioritize techno-economic performance over social and ecological embeddedness.

In the Brazilian case, by contrast, the transition is decentralized and not strategically planned. The state has not assumed a leading role in coordinating bioeconomy models. Although several policies have been established, there are few concrete instruments to ensure their effective implementation [341]. And despite growing discourse in favor of sociobiodiversity, its contributions risk remaining confined to marginal niches while the dominant regime remains tied to large-scale commodity production and technoscientific innovation [32]. In this context, in the Northern MG, the trajectory of sociobiodiversity-based bioeconomy has emerged not from protected technological niches, but largely from below, through GI deeply embedded in ecological territories and TK systems [41]. These initiatives have generated resilient socio-technical configurations anchored in deep root systems that

precede formal policy recognition. As our findings show, infra-niches such as women-led cooperatives, territorial networks, and informal markets have nurtured biodiversity-based economies long before a national strategy was enacted [291,292,342]. This bottom-up pathway carries the advantage of socioecological legitimacy, cultural resonance, and community ownership, but faces important structural constraints, such as lack of long-term public support, fragmented policies, limited coordination across scales, and difficulties in accessing markets and infrastructure [51,77].

Each case offers important lessons, and our findings suggest that fostering just and effective transitions requires more than technocratic governance or market optimization [30,216]. It involves recognizing and supporting a plurality of bioeconomy models, including those that emerge from below and that challenge dominant paradigms. That means that neither top-down nor bottom-up dynamics alone are likely sufficient to produce sustainable and inclusive bioeconomic transitions [277].

The Dutch case demonstrates the importance of institutional coordination and supportive policy environments, while the Brazilian case highlights the transformative potential of embedded GIs and their capacity to reframe economic and ecological logics. The framework we used invites further reflection on how transition theories such as MLP can be enriched by integrating concepts like infra-niches and deep root systems, particularly in Global South contexts where diverse knowledge systems and community-led practices play a central role in reimagining the future.

While the Dutch approach has succeeded in building a well-structured ecosystem for innovation, one of its persistent challenges lies in the transition from pilot initiatives to full-scale implementation. This limitation raises the question of whether the dominant model, centered on market-driven efficiency and technology readiness, may overlook the viability of socially grounded, smaller-scale bioeconomic practices. In this regard, the Brazilian case offers a valuable counterpoint. Rather than aspiring to rapid upscaling, many GI in Brazil have evolved gradually within deep-rooted socioecological systems, prioritizing local well-being, biodiversity conservation, and cultural continuity over economies of scale. This suggests that transition policies might benefit from embracing plural notions of value and success, moving beyond techno-economic scaling to include criteria such as ecological resilience, social cohesion, and territorial equity.

Building on these insights, three concrete recommendations emerge for policy-makers and practitioners. First, integrate ecological and technological approaches by designing policies

that valorize both biodiversity-based and industrial bio-based solutions, creating complementarities rather than competition [82]. Second, strengthen coordination mechanisms: in the Netherlands by embedding biodiversity safeguards into circular strategies, and in Brazil by overcoming regulatory fragmentation through inter-ministerial and multi-sectoral alignment. Third, develop tailored financial instruments that enable GIs and sociobiodiversity enterprises to access credit, scale operations, and connect to wider markets, while continuing to support technological innovation. Together, these recommendations contribute to the international debate on how to design bioeconomy transitions that are not only technologically advanced but also socially inclusive and ecologically sustainable.

Cooperation between countries with different abilities and territorial vocations can play a key role in building a globally just bioeconomy. For instance, in terms of policy and institutional instruments, the Dutch case offers valuable insights into the benefits of strategic planning, governance orchestration, and institutional support to innovation. Brazil could benefit from adopting elements such as transition roadmaps, stable funding instruments, and regional agencies that facilitate collaboration between stakeholders. The application of TMT could support the country in building a long-term bioeconomy strategy with transition agendas and measurable indicators and to create multi-stakeholder arenas to orchestrate conflicting interests towards an effective transition to a sustainability pathway. Regarding the concrete structuring of a sociobiodiversity-based economy, Dutch companies could support the creation of new products and services derived from Brazilian native species and based on TK with industrial applications across multiple sectors, including food, cosmetics, and pharmaceuticals. The application of Dutch expertise in technological innovation, industrial process optimization, and advanced biorefinery systems could support the structuring and scaling of circular value chains based on sociobiodiversity resources, enhancing local value addition while maintaining socio-environmental integrity. Brazil already possesses refineries for alcohol production, which could potentially be adapted to support other value chains grounded in sociobiodiversity, enabling diversified processing and product innovation at the community level.

Conversely, the Brazilian experience offers lessons in resilience, social embeddedness, and the transformative potential of GI. The Netherlands could benefit from incorporating into its territory mechanisms that better support small-scale farmers who adopt traditional or agroecological practices, and who are often overlooked in top-down, industrial-oriented approaches. The work of cooperatives such as Grande Sertão illustrates how sociobiodiversity value chains can deliver both environmental and socioeconomic benefits. These community-

rooted pathways can inspire European contexts to integrate territorial justice and ecological knowledge more effectively into their transition agendas. Besides, by supporting the structuring of sociobiodiversity-based value chains in Brazil and consequently the benefit sharing derived from the access to genetic resources and TK, the Netherlands would improve its international reputation as an important contributor in the achievement of multiple international goals, such as the SDGs [343], but also the CBD and the Nagoya Protocol [77].

To make this mutual learning more effective, structured exchanges between actors from both countries could be promoted, such as field visits, joint living labs, and cross-learning workshops. These spaces would enable farmers, cooperatives, policy-makers, researchers, and intermediary organizations to directly experience each other's realities, exchange practices, and collaboratively identify what elements of each model can be adapted to their own contexts. For example, Brazilian grassroots actors could explore Dutch tools for financing and regional innovation ecosystems, while Dutch smallholders could gain insights into how sociobiodiversity-based economies integrate cultural identity, stewardship, and collective governance. Such intercultural dialogue, grounded in territorial experience and real-world experimentation, could foster the co-construction of a more diverse and context-sensitive sustainability transition.

Another original contribution of this work is to analyze very contrasting perspectives on bioeconomy transitions in both the Global North and the Global South, as most of the existing literature on bioeconomy has concentrated in the Global North [65–72] and on national strategies, visions, and policy frameworks. Comparative reviews of strategies have advanced important global mappings, but they remain largely descriptive and focused on policy ambition rather than on grounded practices and implementation challenges [10,11,18,22,73]. Influential works have shown how the bioeconomy is conceptualized as a “master narrative” [74] or as competing visions – biotechnology, bio-resource, and bio-ecology – but without systematically examining how these narratives unfold in specific territories and socio-ecological contexts [9,13] from the North and South of the Globe. By focusing on NL-NB in the Netherlands and the Northern MG in Brazil, this manuscript addresses this gap by bringing empirical, territorial evidence into the debate, showing how bioeconomy transitions materialize in practice through interactions between actors, institutions, and landscapes. Besides, the focus on economic activities based on “the use of biological” or “non-fossil resources” per se does not necessarily mean bioeconomy is sustainable [14,70,71,75], and there is a global concern that the pace of transition in place is likely insufficient to meet the Sustainable Development Goals (SDGs) of

the 2030 Agenda [72], exposing the gap between policy ambition and systemic transformation and resulting in an increased call for urgent transformative change [33,73]. Implementation thus remains a major challenge for all countries [74].

Another contribution from this work is that these two cases also provide examples that allow us to explore the strengths and limitations of conventional frameworks in explaining sustainability transitions. While this article adopts the MLP as a starting point for analysis, it argues for the need to expand it through insights from grassroots innovation literature, particularly to capture territorial dynamics, power asymmetries, and plural knowledge systems that often characterize transitions in underrepresented regions. Instead of generalizing North-South differences, by placing these two distinct trajectories in dialogue, we aim to highlight not only the diversity of bioeconomy models, but also the potential complementarities and opportunities for mutual learning between North and South [5,6].

These objectives are relevant because they offer a dual contribution. First, empirically, by providing an in-depth territorial analysis of two contrasting yet representative regions implementing bioeconomy, addressing a gap in comparative research on regional strategies across the Global North and Global South, especially regarding how local potentials and knowledge systems can be mobilized and support distinct institutional settings [76]. Second, theoretically, by advancing sustainability transition studies through the explicit application of the MLP, complemented with insights from grassroots innovation research [77–82], and highlighting the importance of integrating ecological, social, and epistemic diversity into transition theories and policy designs. Although there is a comprehensive literature on grass root innovation, To our knowledge, no previous studies are scarce that work have systematically compared these two countries through such a combined lens, making this study a distinct and novel contribution to both the scholarly literature and the policy debate on sustainable bioeconomy transitions. It is important to highlight, however, that we did not develop the measurement of the success of these strategies for example through quantitative indicators, and this is one of the limitations of the methodology we adopted.

5.6 Conclusion

This study addressed three interconnected goals: understanding how bioeconomy implementation and transition processes unfold in two contrasting regional contexts; identifying opportunities for mutual learning between different transition models; and critically

assessing the MLP through the lenses of territorial justice, grassroots innovations and sociobiodiversity. This study shows distinct trajectories, institutional logics, and actor constellations that shape bioeconomy transitions in the Netherlands and Brazil in different ways.

From a policy perspective, in the Dutch case, achieving a truly sustainable bioeconomy requires more than incremental improvements in efficiency or resource substitution. It calls for deeper transformations that question prevailing patterns of production and consumption, address the ecological footprint of globalized supply chains, and prioritize regenerative approaches over “techno-fixes”. This includes integrating biodiversity goals not just as a central criterion in shaping bio-based strategies, but also in the countries that supply the Netherlands with bio-based products. Without addressing these structural dimensions, circular bioeconomy strategies risk reinforcing existing hierarchies rather than enabling transformative change.

In the Brazilian context, advancing a sustainable bioeconomy demands reconfiguring the role of sociobiodiversity from a peripheral alternative to a central pillar of national strategies. Rather than competing with biomass- and biotechnology-oriented trajectories, the immense richness of Brazil’s native species and TK systems might serve as a structuring axis for an inclusive bioeconomy that might even transform and diversify the prevailing few-crop commodity focus. This requires governance and institutional arrangements capable of integrating diverse knowledge systems, supporting decentralized innovation, and fostering value chains rooted in ecological and cultural assets. Bridging these agendas can unlock synergies between conservation, economic development, and social inclusion, positioning Brazil as a global leader in a plural and territorially grounded bioeconomy.

Brazil and the Netherlands offer complementary strengths and valuable opportunities for reciprocal learning in advancing sustainable bioeconomy agendas. Brazil — with its immense biodiversity, rich sociobiodiversity traditions and active small-scale producers working in managed forests and agroforestry — provides fertile ground for an inclusive, socially just and ecologically grounded bioeconomy model rooted in traditional knowledge and community-based value chains. [agroberichtenbuitenland.nl](#)¹ Meanwhile, the Netherlands brings a long history of circular-economy expertise, efficient biomass valorization, and well-developed institutional frameworks for bio-based innovation. [agroberichtenbuitenland.nl](#)¹ By connecting these strengths — for example via partnerships that link Brazilian producers of agroforestry-based bioeconomy goods to Dutch markets or technologies — it is possible to implement circularity in Brazil while incorporating grassroots biodiversity-rich practices, and

for the Netherlands to learn how to integrate sociobiodiversity, traditional knowledge, and community-oriented production into its bio-based systems. agroberichtenbuitenland.nl This synergy can help shape bioeconomy agendas that are both economically viable and socially and ecologically just, offering a model of global cooperation rooted in local context and mutual learning.

While the study provides valuable insights into the role of grassroots and institutional dynamics in shaping bioeconomy transitions, it is not intended to offer generalizable conclusions. Moreover, while the qualitative approach allowed for an in-depth understanding of actors, practices, and governance structures, further research is needed to assess the long-term outcomes, economic viability, and ecological impacts of the transition pathways identified. Future research could also deepen these findings by examining how grassroots innovations grounded in “deep root systems” evolve within infra-niche spaces and interact with niche and regime dynamics over time. Longitudinal and multi-scalar studies could shed light on the mechanisms through which these initiatives either scale out, up, or deep, and on the institutional arrangements that enable or constrain such transition to bioeconomy processes.

6 DISCUSSION AND CONCLUSION

This PhD thesis examined how informational (data/visibility), institutional (coordination/governance), normative (recognition/valuation), and relational (empowerment/support networks) conditions interact to shape the consolidation of a sociobiodiversity-based bioeconomy in Brazil. Drawing on national mapping, institutional network analysis, global evidence on recognition mechanisms, and a North–South comparative perspective, the study tested the general proposition that the sociobiodiversity-based bioeconomy in Brazil only materializes as something different to the conventional bioeconomy if sociobiodiversity is not treated merely as a source of biomass or products and instead structures how value is defined, recognized, and institutionalized, which depends on overcoming its invisibility and strengthening institutional and governance arrangements. Consolidating this type of bioeconomy requires the convergence of four interdependent conditions: data visibility, coordinated governance, plural value recognition, and the empowerment of community-based organizations within supportive institutional networks. The results reveal a field characterized by statistical invisibility, fragmented governance, and limited market integration, but also marked by strong community agency, emerging institutional ecosystems, and nascent forms of recognition that begin to value cultural and territorial dimensions of sociobiodiversity. Altogether, the findings suggest that the sociobiodiversity-based bioeconomy represents not a single sector or policy field, but a living system of interactions among knowledge, value, and governance that remains under construction and negotiation.

6.1 Data and visibility as preconditions for planning

This thesis emphasizes that no coherent strategy for a sociobiodiversity-based bioeconomy can be built without reliable and systematic data. Chapter 1 mapped, for the first time, the national landscape of sociobiodiversity products in Brazil, integrating data from IBGE, CONAB, SisGen, and Conexsus to assess supply, demand, and the main actors involved. A total of 152 sociobiodiversity products were identified in the literature, yet 80% of publications focus on only a handful, confirming the narrow empirical scope of most studies [167]. The most cited were Brazil nut, açaí, vegetal rubber, buriti, pequi, and babassu. Of the total, only 36 products had consistent historical production data available in IBGE databases,

confirming that sociobiodiversity chains remain largely invisible within official statistics [78,131], which focus primarily on the extraction of a few native products of commercial interest. Together, these markets generated approximately R\$ 50 billion in 2023, with cassava accounting for 27.2% of total value, followed by bananas (23.2%), açaí (11.1%), and cocoa (7.7%).

Using Costa's (2021) criteria, only 23% (36 products) could be classified by market dynamics: 8 were dynamic (açaí, natural rubber, cocoa, palm oil, guava, honey, Brazil nut, yerba mate), 6 promising (palm heart, mangaba, pine nuts, umbu, tonka beans, pequi), 9 stationary, and 12 declining. These figures highlight that only 5% (8 of 152) of the mapped products can be considered both relevant and dynamic, occupying a small niche in global markets. On the production side, 822 community-based organizations were identified as marketing the 36 analyzed products, most operating under the family farming framework. Cassava is the most traded product, commercialized by 86% of all organizations, followed by açaí, honey, and cocoa. However, only 5% of organizations report value-added processing, with most products sold fresh or minimally processed. Sixty percent sell through intermediaries, and 80% depend on public procurement programs (PAA, PNAE, or PGPM-Bio). Despite the existence of 64 species eligible for PGPM-Bio, only 17 receive subsidies, and 47% of organizations lack valid family farming registration, reflecting the sector's high informality.

On the innovation front, SisGen data reveal approximately 17,000 plant species with ongoing R&D activities, although only 1,953 species have more than 10 access records, and 95 of the most accessed species are already traded by community-based enterprises—indicating significant untapped potential.

The case study in Northern Minas Gerais further highlights that there are inconsistencies across national and local cooperatives' data for emblematic products such as pequi.

These results show that Brazil's sociobiodiversity economy is characterized by concentration, informality, and limited innovation linkages. Well-structured chains are generally associated with large-scale or semi-cultivated systems (e.g., açaí, natural rubber, cocoa), while extractivist chains, even with high social and economic relevance for local livelihoods (such as pequi, baru, babaçu, carnaúba, licuri, and umbu), remain fragile, seasonal, and dependent on public procurement. The contrast between the 17,000 native species with research records and the 36 with market data illustrates how limited visibility constrains the transition from biodiversity potential to economic value. In this sense, the chapter confirms that data integration and market visibility are prerequisites for a sociobiodiversity-based

bioeconomy: without systematic information on what is produced, where, by whom, and under which ecological conditions, neither planning nor coordination can be effectively achieved.

6.2 Coordination and governance as structural conditions

This thesis proposes that the consolidation of a sociobiodiversity-based bioeconomy depends on the establishment of coordinated governance mechanisms capable of integrating this economy into mainstream planning, markets, and innovation systems while maintaining its ecological and cultural distinctiveness. Chapters 2 and 4 reveal that institutional fragmentation remains a central barrier to this integration.

Chapter 2 shows that although Brazil's sociobiodiversity support architecture involves thousands of initiatives, they have limited systemic coordination. Most projects targeting the structuring of community-based sociobiodiversity value chains are small-scale, offering grants of up to US\$50,000. They are focused on very specific issues: organizational strengthening and capacity building (53%), financial support or infrastructure investment (40%), and market access (26%), with only 20% of them combining all three dimensions simultaneously. These results indicate that most interventions remain fragmented and production-oriented. Besides, although the network is formed by at least 15 different types of actors, it is not balanced. Government entities account for 36% of all partnerships, followed by universities and research institutions (11%), rural extension agencies (10%), and civil society organizations (9%), together forming the backbone of sociobiodiversity governance. A critical insight emerging from this research is the limited involvement of the private sector in supporting sociobiodiversity chains, primarily on the demand side. Private companies represent only 2% of reported partners, confirming the marginal participation of the private sector as a buyer or investor. Market participation remains dominated by community-based organizations, NGOs and local government through public procurement policies. This gap reveals the need for new political and financial instruments (including fiscal incentives and blended finance) that make sociobiodiversity value chains attractive to private actors while preserving community control and ecological integrity. Without such mechanisms, the sociobiodiversity-based bioeconomy risks remaining dependent on public or donor funding and may struggle to reach scale. Hence, coordination must not only occur within government but also across sectors, bridging public policy, civil society, and responsible enterprise.

At the same time, the study also shows that intermediary organizations (such as ISPN, IEB, FASE) have emerged as connectors that partially compensate for this lack of a central coordinating state apparatus. These organizations try to link community-based organizations with public and private funding sources, markets, and technical assistance. On the other hand, of the 91 native species supported by projects, only 20 received funding at least every two years over three decades, while the remaining 70 species were supported only sporadically.

These findings confirm that Brazil's sociobiodiversity-based economy remains heavily dependent on short-term projects and external intermediaries, lacking institutional mechanisms for cumulative learning and long-term coordination. The study highlights that while intermediary organizations have been essential in expanding access to finance and technical assistance – where the Amazon Fund alone allocated in 10 years over R\$3 billion to sociobiodiversity initiatives – they have not been able to overcome structural asymmetries in power, continuity, and market access. Only 32% of the 384 projects included any component of value addition, and only 5% of community-based organizations identified by Conexsus produce value-added goods. The persistence of a “project logic” reinforces dependency and prevents the consolidation of enduring value chains. The results thus suggest that the transition toward a sociobiodiversity-based bioeconomy requires a shift from fragmented, donor-driven support to integrated and adaptive governance systems capable of ensuring long-term institutional learning, financial stability, and private-sector engagement.

Findings from Chapter 4 reinforce the second hypothesis (H2) when contrasting two structurally distinct models of bioeconomy governance. In the Netherlands, particularly in the province of Noord-Brabant, the bioeconomy operates through a highly institutionalized and state-coordinated system, in which five regional innovation agencies (BOM, AgriFood Capital, Brainport Development, Rewin, and Midpoint Brabant) were created to work as integrative nodes linking policy, research, and private-sector investment. Supported by national instruments, such the Green Deals and tax incentives (WBSO), this model institutionalizes transition management cycles that foster experimentation, evaluation, and upscaling within a coherent governance framework. By contrast, in Brazil, coordination remains fragmented and public policies for biodiversity conservation, rural development, and innovation continue to operate in silos. Although 55 federal policies related to bioeconomy, most are designed around agribusiness or bioindustrial production, with little articulation toward sociobiodiversity-based systems. Sociobiodiversity governance initiatives are predominantly bottom-up, emerging from networks of community-based organizations, NGOs, and intermediary actors that compensate

for weak state orchestration. The Northern Minas Gerais case illustrates this adaptive, decentralized form of governance: local cooperatives such as Grande Sertão and organizations like CAA-NM and the Rede Núcleo do Pequi have built territorial governance systems linking biodiversity use, livelihoods, and advocacy, culminating in policy innovations such as the National Pequi Law (Law 15.089/2025). Yet, these experiences remain isolated exceptions rather than components of a national strategy.

Collectively, these findings show that while top-down coherence in the Dutch model enables scaling and policy alignment, Brazil's bottom-up experimentation provides legitimacy and cultural rootedness—but struggles to achieve continuity or systemic integration. This asymmetry confirms that consolidating a sociobiodiversity-based bioeconomy requires hybrid governance architectures that bridge formal policy coordination with the adaptive capacities of grassroots and intermediary networks, ensuring both institutional coherence and ecological-cultural distinctiveness.

6.3 Empowerment and institutional support as enabling conditions

This thesis proposes that the consolidation of a sociobiodiversity-based bioeconomy depends on the empowerment of community-based organizations and the evolution of institutional support ecosystems capable of connecting local initiatives with policies, markets, and financial instruments in a sustained and equitable manner. Chapter 2 shows that empowerment emerges not as an isolated outcome of capacity-building programs, but as a progressive construction of stable relational infrastructures. Results showing that only nine community-based organizations were able to receive direct funding from the Amazon Fund underscore the administrative and legal barriers that still hinder smaller entities from accessing large-scale mechanisms and that most grassroots actors depend on intermediaries for mediation, technical assistance, and project management. They also reveal that initiatives that integrate organizational strengthening, financial mechanisms, and market access tend to generate autonomy and more resilient and durable outcomes, transforming project-based actions into enduring territorial processes. Some grassroots organizations that were able to access higher funding are the ones who have evolved into hybrid organizations, combining productive, political, and intermediary functions. Empowerment, in this sense, refers to the capacity of local actors to influence governance spaces, negotiate partnerships on equitable terms, and articulate their own development trajectories within plural value systems. Yet, sustaining such processes

requires long-term institutional commitment and flexible financing architectures capable of adapting to local dynamics. The persistence of project-based logics and donor-dependent cycles continues to constrain these networks, underscoring the need to recognize them as structural components of Brazil's sociobiodiversity-based bioeconomy rather than as temporary beneficiaries of external support.

Chapter 3 extends this analysis by examining how recognition mechanisms contribute to empowerment through governance, cultural, and economic dimensions. In the global sample, recognition is more evenly distributed across material (monetary and non-monetary) and non-material (legal–institutional, symbolic–cultural, participatory–governance) forms, with an emphasis in monetary, legal/ institution and participatory/governance recognition, suggesting more balanced combinations of incentives, legal frameworks, and participatory arrangements. In contrast, the Brazilian projects show a strong predominance of non-monetary material recognition (87%) while other forms, particularly legal (23%), cultural (19%), or governance-based (28%), remain comparatively limited. Monetary recognition mechanisms were relatively rare (36%) and often indirect, resulting from improved collective organization rather than formal compensation instruments.

Applying Arnstein's framework, most global examples were concentrated in the intermediate and upper levels of the ladder while within the Brazilian dataset, participation was more frequently positioned at the lower and intermediate rungs. The results show that mechanisms situated at the top of the empowerment ladder, such as legal recognition, co-management rights, and participation in decision-making councils, are the ones that most effectively redistribute power, transforming communities from aid recipients into governance actors. In contrast, mechanisms restricted to financial compensation or symbolic acknowledgment, while valuable, tend to reinforce dependency and limited autonomy.

6.4 Recognition and valuation as normative conditions

This thesis argues that the consolidation of this bioeconomy depends on the recognition and valuation of both the material and non-material dimensions of sociobiodiversity products, dimensions that include knowledge, identity, and stewardship. The results of Chapter 3 confirm that recognition is not merely a moral principle but a functional condition for sustainability transitions. Across the international and Brazilian cases analyzed, recognition mechanisms play two interlinked roles: they legitimize community knowledge and stewardship and create

incentives for sustainable use, redistributing visibility and authority within policy systems. Recognition takes multiple forms, each with distinct but complementary effects. Legal instruments (such as territorial rights or community management rules) secure the conditions for stewardship; economic mechanisms (like differentiated pricing or payments for ecosystem services) reward the responsible use of biodiversity; governance arrangements (such as participatory councils and co-management schemes) redistribute decision-making power; and cultural valorizations (including heritage branding and symbolic acknowledgment) strengthen identity, pride, and intergenerational knowledge transmission. Together, these mechanisms redefine what counts as value and who counts as a value creator. The analysis also reveals that the more participatory and co-managed these mechanisms are, the greater their potential to foster empowerment and long-term stewardship. Recognition, therefore, emerges as both a social and political act of redistribution—of income, visibility, and authority—bridging the gap between intangible contributions and material outcomes.

6.5 Convergence and interdependence of conditions

The development of the four Chapters points to the conclusion that the consolidation of a sociobiodiversity-based bioeconomy depends on the systemic convergence of informational, institutional, normative, and relational dimensions. These dimensions are analytically distinct yet mutually reinforcing. Visibility provides the informational foundation for coordination; coordination creates the institutional space for recognition; recognition strengthens empowerment by legitimizing local actors; and empowerment, in turn, reinforces the conditions for sustained data generation, coordination, and valuation. Conversely, weakness in any of these areas tends to reproduce dependency, informality, and invisibility. The Brazilian case thus illustrates both the opportunities and contradictions of an emerging sociobiodiversity economy: while it offers a path toward plural and inclusive development, it also exposes the institutional fragility of the structures meant to sustain it.

In conclusion, this thesis demonstrates that Brazil's sociobiodiversity-based bioeconomy remains a work in progress (still defined more by potential than by consolidation) but one that points toward an alternative vision of development. It is a vision that challenges the dominance of commodity-centered models by foregrounding the diversity of life, knowledge, and culture as legitimate sources of value. The findings confirm that sustainable transitions in Brazil will depend less on biodiversity itself than on new relationships: between

data and governance, between recognition and empowerment, and between communities and markets.

The sociobiodiversity-based bioeconomy thus emerges not as the opposite of the industrial bioeconomy, but as its necessary complement: a paradigm that redefines value creation as a collective process rooted in stewardship, reciprocity, and care for the territories and ecosystems that sustain life.

6.6 Policy recommendations

The synthesis of findings yields several implications for policy and practice.

To overcome the statistical invisibility of sociobiodiversity value chains, public policy should invest in co-produced data infrastructures, developed jointly with community-based organizations and local producers. This entails: a) developing participatory methodologies for data collection, adapted to seasonal, extractivist, and diversified production systems, rather than imposing standardized agricultural metrics that fail to capture sociobiodiversity dynamics; b) training producers and local organizations in basic data recording (volumes, prices, processing, losses, ecological conditions), strengthening local data literacy as part of empowerment strategies; c) providing simple digital tools, such as low-bandwidth mobile applications compatible with basic smartphones, allowing offline data entry and later synchronization, thus reducing technological barriers in remote territories; d) integrating community-generated data into official systems (e.g., IBGE, CONAB, PGPM-Bio), through institutional arrangements that recognize local organizations as legitimate data producers rather than informal actors.

Such an approach would not only improve data quality and coverage but also transform data production into a governance instrument, strengthening visibility, accountability, and local control over information flows. Data infrastructures, in this sense, should be treated as socio-institutional assets rather than merely technical tools.

Second, policy design should prioritize coordinated and adaptive governance mechanisms, capable of integrating biodiversity conservation, rural development, innovation, and market policies to overcome the persistent fragmentation of policies, programs, and projects supporting sociobiodiversity chains. The dominance of short-term, project-based interventions prevents cumulative learning, institutional memory, and long-term value chain consolidation. This requires:

- Creating permanent inter-ministerial coordination spaces linking environment, agriculture, social development, science and technology, and industrial policy, with explicit mandates to address sociobiodiversity. But coordinated governance cannot be achieved solely through formal inter-ministerial arrangements. It also depends on relational infrastructures that allow different actors to interpret data, align expectations, and negotiate priorities. Without arenas for interaction, coordination risks remaining a formal aspiration rather than an operational reality.
- Strengthening territorial governance arrangements, recognizing cooperatives, associations, and territorial networks as meso-level governance actors rather than mere project beneficiaries;
- Institutionalizing permanent spaces of dialogue and exchange among the diverse actors involved in sociobiodiversity-based bioeconomies as learning cycles, where pilot initiatives are systematically evaluated, adapted, and scaled through feedback mechanisms, rather than replicated mechanically. The empirical analysis shows that many initiatives in place often operate in parallel, with limited opportunities for sustained interaction beyond project-specific arrangements.

Policy frameworks should therefore support the creation and consolidation of multi-actor platforms that function as spaces for: a) dialogue and trust-building between community-based organizations and external actors (companies, financiers, policymakers), reducing asymmetries of information and power; b) collective problem-solving, allowing actors to jointly address bottlenecks related to logistics, quality standards, financing, certification, and market access; c) exchange of experiences and practices, enabling horizontal learning across territories, value chains, and organizational forms; d) alignment of expectations and values, particularly regarding sustainability criteria, benefit-sharing, and acceptable forms of market integration.

Drawing on the comparative insights from the Dutch case, this thesis suggests that Brazil could benefit from the creation—or strategic designation—of regional development and innovation agencies with explicit mandates to foster sociobiodiversity-based bioeconomies. Similar to the role played by regional agencies in the Netherlands, such entities would operate as integrative nodes, articulating public policy, research and extension systems, private-sector actors, and community-based organizations within a triple- or quadruple-helix framework. Given Brazil's territorial diversity, these agencies should not follow a uniform national

template, but rather be territorially embedded, responding to region-specific ecological conditions, cultural contexts, productive capacities, and development priorities. Their functions could include coordinating multi-actor dialogue, aligning fragmented policy instruments, supporting experimentation and learning across value chains, and translating territorial demands into actionable policy and investment agendas. Where new institutions are not feasible, existing entities with adequate technical and convening capacity could be formally designated to assume this role. Such regional intermediary structures would help bridge the gap between bottom-up initiatives and national strategies, transforming dispersed experiments into coordinated transition pathways while preserving the ecological and cultural specificity that defines sociobiodiversity-based systems.

Another recommendation concerns the architecture of the support to sociobioeconomies initiatives itself. It is important to shift from isolated projects to programmatic approaches, with multi-year funding horizons and clear pathways from capacity-building to market consolidation. That means the creation of a stable support ecosystems that combine organizational strengthening, financial instruments, and market access over time. Policy efforts should therefore focus on: a) reducing administrative barriers that prevent community organizations from accessing public funds directly, including simplified legal and financial requirements proportional to organizational scale; b) ensuring long-term funding for intermediary organizations, recognizing their role as connectors, translators, and stabilizers within sociobiodiversity networks; c) designing flexible financial instruments, including blended finance and revolving funds, adapted to seasonal production, collective organization, and territorial embeddedness; d) supporting hybrid organizational forms, capable of combining productive, political, and intermediary functions without penalizing them through rigid institutional classifications.

Third, recognition mechanisms should be embedded within legal, economic, and governance instruments to ensure plural valuation and equitable benefit-sharing. This includes: a) expanding legal recognition, through land tenure security, collective rights, and formal recognition of community management systems; b) designing economic instruments that go beyond price support, such as differentiated procurement criteria, long-term purchasing contracts, and payments linked to stewardship outcomes; c) institutionalizing participatory governance spaces, ensuring that community-based organizations participate in decision-making councils, policy design, and program oversight; d) supporting cultural and territorial valorization, through geographical indications, collective brands, and narratives that

acknowledge knowledge, identity, and care as sources of value. Crucially, recognition mechanisms should be designed to move actors upward along the empowerment ladder—from consultation and compensation toward co-decision and co-management—thus transforming communities from beneficiaries into governance actors.

Finally, the low engagement of the private sector calls for the design of economic instruments or purpose-built incentives and safeguards that encourage fair and responsible partnerships with community producers, ensuring that market participation reinforces rather than undermines territorial and cultural integrity. Policy instruments should aim to: a) create fiscal and financial incentives for companies that engage in long-term, fair, and transparent partnerships with community producers; b) condition incentives on social and environmental criteria, ensuring respect for community governance, benefit-sharing, and ecological limits; c) promote demand-side innovation, encouraging companies to adapt products, logistics, and procurement models to sociobiodiversity realities rather than forcing communities to conform to industrial standards.

Beyond these immediate priorities, Brazil's three decades of experience in supporting sociobiodiversity value chains offer valuable lessons for the next phase of bioeconomy development. At the same time, it opens opportunities for international cooperation, particularly through partnerships with countries that face similar sustainability challenges or hold complementary strengths in bio-based innovation, governance, and territorial planning. While Brazil demonstrates that biodiversity can anchor plural development models grounded in stewardship, reciprocity, and collective agency, it also exposes the persistent structural barriers that constrain their consolidation. Limited data visibility, short-term project funding, and fragmented governance continue to reproduce dependency and informality, preventing these initiatives from scaling beyond their territorial roots. Moreover, the lack of integration between conservation, rural development, and innovation policies, combined with the minimal engagement of private actors, highlights the difficulty of transforming dispersed experiments into coherent national strategies. Grounded in mutual learning rather than solely technology transfer, international cooperation can accelerate the design of fairer and more resilient transition pathways.

6.7 Scientific originality and contribution of this Thesis

Over the past decade, a growing body of scholarship has sought to conceptualize and advance Brazil's sociobiodiversity-based bioeconomy, recognizing its potential to reconcile biodiversity conservation, cultural diversity, and sustainable livelihoods. This debate, still in active evolution, has placed sociobiodiversity at the center of discussions on sustainability, justice, and territorial development. Garrett et al. [107] provide a valuable macro-level diagnosis of Amazonian socio-bioeconomies, outlining policy interventions to accelerate niches, destabilize regimes, and tilt the landscape through multi-scalar governance reforms. Their analysis identifies barriers and levers for transformation, contributing to a strategic vision of how systemic change could be achieved. Similarly, recent literature has highlighted important theoretical and prescriptive frameworks for a biodiversity-based bioeconomy, emphasizing the integration of circularity, justice, and regenerative development principles [42,105,106,158]. However, these analyses remain largely conceptual and focused primarily on the Amazon, offering limited empirical evidence of how transitions unfold in practice.

In a complementary direction, Queiroz-Stein & Siegel [32] and Queiroz-Stein et al. [186] offer a robust empirical contribution by examining the coalitions, narratives, and actor configurations that shape Brazil's emerging bioeconomy. Their work provides critical insights into the political and discursive arenas where agendas are negotiated and contested, shedding light on how competing visions of bioeconomy gain legitimacy. Yet, their analytical emphasis lies on the formation of coalitions and the structuring of discourse, rather than on the material and institutional processes through which these ideas become operationalized in programs, networks, and concrete territorial arrangements.

This thesis builds upon and extends these contributions by bridging conceptual, political, and empirical perspectives into an integrated analytical framework that views the consolidation of a sociobiodiversity-based bioeconomy as a process dependent on the convergence of four interrelated conditions—informational, institutional, normative, and relational. Together, these dimensions explain not only why sociobiodiversity has remained peripheral within Brazil's national bioeconomy agenda, but also how it could evolve into a central axis of sustainable development. This systemic approach connects data visibility, coordinated governance, plural value recognition, and networked empowerment as co-constitutive drivers of transformation rather than independent domains of intervention.

Empirically, the thesis contributes an unprecedented multi-scalar and longitudinal reconstruction (1995–2025) of the institutional landscape surrounding sociobiodiversity value chains. By systematically mapping 1,286 initiatives, a refined sample of 384 projects, and hundreds of organizations, it reveals the co-evolution of support mechanisms and community-based enterprises over three decades. Previous studies have often examined specific NTFP chains or local experiences [122,167], but none has investigated the structural evolution of Brazil's sociobiodiversity economy or the empirical configuration of its support networks. This thesis fills that gap by combining large-scale data mining, network analysis, and grounded qualitative coding to reconstruct how informational, financial, and organizational dynamics interact over time. The result is the first comprehensive visualization of Brazil's support ecosystem, showing how funding agencies, NGOs, and cooperatives function as experimentalist governance systems that collectively stabilize cooperation, foster learning, and connect local initiatives to broader policy and market structures.

Conceptually, the thesis advances the debate on recognition and valuation by operationalizing the immaterial dimensions of value—stewardship, knowledge, and cultural meaning—into an empirical typology of recognition mechanisms (legal, cultural, governance-based, and economic). It further measures empowerment using Arnstein's ladder, transforming an ethical ideal into a measurable governance variable and bridging the IPBES framework of plural valuation [223] with the institutional architecture of Brazil's bioeconomy [105,122,167]. This methodological innovation allows for the evaluation of recognition-based policies and their contribution to transformative change.

Finally, the comparative Brazil–Netherlands analysis extends transition theory by empirically adapting the MLP theory to Global South realities. The thesis introduces the notions of infra-niches and deep root systems to capture the embeddedness of sociobiodiversity initiatives within cultural and territorial relations—dimensions often neglected in transition studies centered on industrialized-country experiences [106,107,186]. In methodological terms, the thesis combines large-scale quantitative mapping with grounded qualitative inquiry, producing a rare epistemological synthesis that bridges data-driven and context-sensitive approaches. This integrated design enables a systemic, multi-layered understanding of how Brazil's sociobiodiversity-based bioeconomy has evolved—not only as a set of discourses and policies but as a living network of projects, institutions, and practices that continuously reshape the meaning of value and sustainability.

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APPENDIX A – Supplementary information of Chapter 2

List of 152 Brazilian sociobiodiversity products found in the literature review

Açaí
Acerola
Alligator
Alligator wood
Andiroba
Angico
Araçá
Araçá-boi
Araçá-pêra
Araticum
Aroeira-pimenteira
Aruanã
Arumã
Arumbeva
Babassu
Bacaba
Bacuri
Balata
Banana
Barbatimão
Baru
Batiputá
Bitter amapá
Bracatinga
Brazilian nut
Buriti
Butiá
Caatinga passion fruit
Cagaita
Cajá

Cajuaçu
Cajuí/ Savannah cashew
Cambuí
Camu-camu
Candombá
Cará
Caraguatá
Carnaúba
Caroá
Cashew (Pulp and nut)
Cassava flour
Cataia
Caucho
Cherry
Chichá
Cocoa
Coconut
Community-based tourism
Copaíba
Crem-potato
Croá
Cubiu
Cupuaçu
Dendê
Extractive timber
Fava d'anta
Frog embira
Fruit pulps
Golden grass
Gravatá
Guabiroba
Guarana
Guava
Gueroba

Handcrafts
Honey
Inajá
Ingá
Ipê/pau d'arco
Ipecacunha/poaia
Jaborandi
Jabuticaba
Janaúba
Jaracatiá/wild-papaya
Jatobá
Jenipapo
Jiquitaia pepper
Juçara
Jurubeba
Licuri
Long pepper
Maçaranduba
Macaúba
Major-gomes
Mallow
Mama-cadela
Mandacaru
Mangaba
Mangabeira
Mangarito
Marmeleiro
Milk-vine
Mini cucumber
Monkey Paxiubinha
Murici
Myrtle
Murumuru
Native fishes

Native plants seed

Oiticica

Ora-pro-nóbis

Palm heart

Passion fruit

Patauá

Pepper

Pequi

Physalis

Piaçava

Pine

Pine nut

Piquiá

Pirarucu

Pitanga

Pitomba

Pracaxi

Priprioca

Pupunha

Purslane

Sardine

Savannah pear

Sempre-vivas

Seriguela

Serrana guava

Sesame

Sorva

Sour coquinho

Sphagnum

Sucuuba

Taioba

Tamarind

Tambaqui

Taperebá

Timbo-vine

Tonka bean

Tucaneiro/viola-wood

Tucum

Tucumã

Ucuuba

Umari

Umbu

Umbu-cajá/taperebá

Urucum

Uvaia

Uxi

Vegetable oils

Vegetal rubber

Velame

Vine

Water-vine

White Breu

White Cinnamon

Yerba mate

APPENDIX B – Supplementary information of Chapter 3

Programa	Características	Principais resultados	Lições aprendidas	Recomendações	Fontes
Programa Piloto para a Proteção das Florestas Tropicais do Brasil (PPG-7)	Criado em 1992, anunciado após a Cúpula do G7 em Houston (1990) e formalizado com a criação do Fundo Fiduciário das Florestas Tropicais (RFT). • Primeira fase estimada em US\$ 250 milhões, com depósitos iniciais de US\$ 53,6 milhões. • Estrutura em múltiplos subprogramas: Projetos Demonstrativos (PDA/PDPI), Proteção de Terras Indígenas (PPTAL), ProManejo, ProVárzea, Subprograma Política de Recursos Naturais (SPRN), entre outros. • Perfil de beneficiários: órgãos governamentais (Ibama, órgãos estaduais), ONGs nacionais e internacionais, redes da sociedade civil (ex.: GTA e RMA) e populações locais (extrativistas, indígenas, agricultores familiares)	Fortalecimento institucional para a gestão ambiental integrada. • Promoção do manejo florestal sustentável e da pesquisa aplicada. • Projetos demonstrativos inovadores em conservação e uso sustentável. • Consolidação de áreas protegidas e fortalecimento da organização social. • Criação de mecanismos de governança coletiva envolvendo múltiplos atores. • Influência em políticas públicas federais (PAS, PPCDAm). Aproximadamente 600 entidades da Rede GTA e 257 da Rede Mata Atlântica apoiadas diretamente. • Criação de cerca de 40 Reservas Extrativistas (RESEX) e da categoria de Reservas de Desenvolvimento Sustentável (RDS). • Reconhecimento e demarcação de novas terras indígenas, com	Participação social foi incorporada, mas limitada no início (problemas de burocracia, lentidão na liberação de recursos e instabilidade institucional prejudicaram o desempenho, resistência do governo e pouca capacidade institucional das ONGs amazônicas). • A dispersão geográfica e temática reduziu impacto agregado, com excesso de caráter “piloto”. • Governança excessivamente burocrática e dependência do PNUD limitaram eficácia. • Cooperação internacional foi via de mão dupla: trouxe e exportou inovações em gestão florestal	Definir áreas geográficas prioritárias para concentrar esforços e ampliar escala de impacto. • Ampliar geração de renda local via cadeias sustentáveis e estratégias territoriais. • Fortalecer capacidades nacionais, reduzindo dependência de agências internacionais de execução. • Integrar e articular os subprogramas para evitar fragmentação. • Transformar experiências em políticas públicas de caráter nacional (ex.: ARPA, RESEX, PDS). • Aprimorar mecanismos financeiros e cooperação internacional, conectando-os a convenções e marcos multilaterais (Agenda 21, CDB, Quioto, UNFF, OTCA)	BRASIL, Ministério do Meio Ambiente, dos Recursos Hídricos e da Amazônia Legal. Programa Piloto para Proteção das Florestas Tropicais do Brasil-PPG7 Subprograma a Projetos Demonstrativos - PD/A: uma contribuição para o uso inteligente das Florestas Tropicais - Brasília, 1998.58 p.

		institucionalização pela Funai. • Ordenamento territorial de várzeas e lagos (ProVárzea). • Criação do ARPA – Áreas Protegidas da Amazônia. • Fortalecimento de órgãos estaduais ambientais, batalhões de polícia ambiental e Ministérios Públicos			Rueda, R. P.; Abdala, F. A.; Vivan, J. L.; Barbanti Jr., O.; Pinto, R. F. S. (2006) Relatório Consolidado de Avaliação do PPG-7. Ministério do Meio Ambiente.
Subprograma Projetos Demonstrativos (PD/A)	• Subprograma do PPG-7, iniciado em 1995, com foco em apoiar projetos de organizações de base comunitária, ONGs e associações locais. • Objetivo: demonstrar práticas sustentáveis de uso dos recursos naturais e fortalecer a sociedade civil. • Estrutura participativa inédita: redes da sociedade civil (GTA na Amazônia e RMA na Mata Atlântica) com assento nos comitês de decisão. • Agente financeiro: Banco do Brasil, que repassava diretamente os recursos às entidades. • Valor comprometido na fase inicial (até 1997): US\$ 20,3	Recebidas 548 propostas, das quais 97 aprovadas (79 na Amazônia Legal e 18 na Mata Atlântica). • Perfil dos proponentes: 63% organizações de base comunitária (associações, cooperativas, sindicatos, organizações indígenas), que receberam 57% dos recursos; 36% ONGs; 1% instituições governamentais. • Temáticas predominantes: sistemas agroflorestais e recuperação de áreas degradadas (71%); manejo florestal (15%); manejo de recursos aquáticos (10%);	A participação direta de comunidades foi essencial, mas revelou fragilidades: muitas organizações de base careciam de capacitação técnica, de gestão e de acesso a mercados. • As redes GTA e RMA mostraram grande capacidade de articulação e de dar legitimidade social ao programa. • O desenho do subprograma permitiu fortalecer a sociedade civil amazônica, dando	Garantir continuidade e mecanismos de financiamento de longo prazo para projetos bem-sucedidos, evitando caráter exclusivamente piloto. • Ampliar a capacitação em gestão, comercialização e organização social das entidades apoiadas. • Fortalecer a articulação do PD/A com outros subprogramas do PPG-7 (ProManejo, ProVárzea, PPTAL) e com políticas públicas estruturantes. • Expandir o escopo para novos componentes, como Educação Ambiental (CEDUC) e Projetos Demonstrativos Indígenas (PDI). • Estimular a replicação em escala de experiências comunitárias exitosas, integrando-as a políticas de crédito,	

	milhões (sendo US\$ 13,5 milhões do PD/A e US\$ 6,8 milhões de contrapartida das entidades).	preservação ambiental estrita (4%). • Criação de metodologias participativas e experiências inovadoras de agroextrativismo, agroecologia e manejo comunitário, que se tornaram referência.	visibilidade às demandas locais. • Limitações: dispersão temática, dificuldade de sustentabilidade econômica de projetos após o apoio inicial, e falta de articulação sistemática com outros programas públicos.	mercados institucionais e programas territoriais.	
Pequenos Projetos Ecosociais (PPP-ECOS)	Criado em 1994, como braço brasileiro do <i>Small Grants Programme</i> (GEF/PNUD), com coordenação do ISPN. Foco inicial no bioma Cerrado e áreas de transição; a partir de 2012 expandiu-se para Caatinga e, com o Fundo Amazônia, para estados do Arco do Desmatamento (MA, TO, MT) e a partir de 2019 foco em paisagens produtivas ecossociais prioritárias (GEF-7). Apoia organizações de base comunitária (associações, cooperativas, sindicatos, povos indígenas, quilombolas, assentados da reforma agrária) e ONGs locais, privilegiando proponentes de pequeno porte muitas vezes em seu primeiro projeto. Apoio por editais anuais, com valores de até US\$ 35 mil por projeto (ou US\$ 50 mil em	Até 2009: 289 projetos apoiados no Cerrado, beneficiando ~8.600 famílias; 146 mil hectares conservados sob uso sustentável; apoio em mais de 40 terras indígenas, cobrindo 5 milhões ha. 1995–2012: 318 projetos apoiados, executados por 211 organizações diferentes, com repasse total de mais de US\$ 7,6 milhões (Cerrado e Caatinga). Exemplos emblemáticos: criação da RDS Nascentes Geraizeiras (MG, 38 mil ha); fortalecimento do CIMQCB (quebradeiras de coco babaçu), que conquistou a PGPM-Bio para a castanha de babaçu; consolidação de redes de sementes florestais (Rede de Sementes do Cerrado).	Pequenos projetos têm grande impacto quando conectados às demandas locais. A abordagem bottom-up fortalece o protagonismo das comunidades e captura inovações. O PPP-ECOS funcionou como primeiro apoio para muitas comunidades, ajudando a estruturar associações e o campo socioambiental no Cerrado. A baixa burocracia e flexibilidade do programa aumentaram a inclusão de organizações sem histórico de acesso a financiamentos. Estímulo a intercâmbios e redes resultou no	Garantir a continuidade do programa em meio a disputas por recursos internacionais. Ampliar a visibilidade internacional do Cerrado e da Caatinga, conectando o PPP-ECOS a debates globais (CDB, UNCCD, mudanças climáticas).. Melhorar documentação, indicadores e avaliação de impactos, para demonstrar eficiência e influenciar políticas públicas. Fortalecer a autonomia organizacional das comunidades, reduzindo a dependência de ONGs intermediárias. Ampliar a inserção dos resultados em políticas públicas nacionais, garantindo escala e sustentabilidade. Escalar as experiências exitosas, conectando-as a políticas públicas e mercados diferenciados (PAA, PNAE, PGPM-Bio, certificações, fundos estaduais de clima). • Criar linhas permanentes de financiamento de base comunitária,	ISPN. (2013). Portfólio ISPN 2013: 1995–2012 – PPP-ECOS. Brasília: Instituto Sociedade, População e Natureza. ISPN. (2018). Portfólio Cerrado e Caatinga 2013–2018: PPP-ECOS. Brasília: Instituto Sociedade,

	projetos de consolidação), duração de até dois anos, recursos do GEF, depois Fundo Amazônia/BNDES, União Europeia, Laudes Foundation, Fundo Clima, entre outros. Governança inovadora: Comitê Gestor Nacional criado em 1995, incluindo governo, ONGs, academia, setor privado e especialistas, referência para arranjos posteriores como o Fundo Amazônia.	Números consolidados (até 2017): 566 projetos em 26 estados e DF; mais de 15 mil famílias beneficiadas; 812.500 ha sob manejo sustentável; 7.200 ha em restauração; 15,5 milhões tCO₂e de emissões evitadas .	fortalecimento de movimentos como a Rede Cerrado. Pequenos projetos podem gerar grandes impactos quando bem articulados com redes e territórios. • O programa foi porta de entrada para centenas de organizações de base que acessaram seu primeiro financiamento via PPP-ECOS. • Flexibilidade administrativa e baixa burocracia foram diferenciais que garantiram inclusão de grupos que não acessariam editais convencionais. • A estratégia de fomentar redes de apoio (Rede Cerrado, CIMQCB, Rede de Sementes do Cerrado, movimentos quilombolas e indígenas) gerou efeitos multiplicadores. • A atuação em biomas invisibilizados (Cerrado e Caatinga) contribuiu	evitando que os projetos permaneçam em caráter apenas experimental. • Fortalecer capacitação em gestão, comercialização, inovação tecnológica e advocacy das organizações apoiadas. • Estimular modelos híbridos de financiamento (blended finance, crédito comunitário, fundos rotativos) para garantir sustentabilidade financeira.	População e Natureza. ISPN. (2017). PPP-ECOS e Fundo Amazônia: Portfólio 2013–2017. Brasília: Instituto Sociedade, População e Natureza. ISPN. (2018). PPP-ECOS: aprendizado s colhidos. Brasília: Instituto Sociedade, População e Natureza. ISPN. (2014). Sementes lançadas, frutos colhidos: PPP-ECOS.
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			para colocar esses territórios na agenda socioambiental nacional e internacional. • Limitações: ausência de mecanismos de continuidade de financiamento para escalar experiências; dificuldade de mensurar impactos de longo prazo; vulnerabilidade a descontinuidade política e financeira.		Brasília: Instituto Sociedade, População e Natureza. ISPN. (2015). Pequenos Projetos Ecosociais de Quebradeiras de Coco Babaçu: reflexões e aprendizados. Brasília: Instituto Sociedade, População e Natureza. ISPN. (2019). PPP-ECOS a partir de 2019: novos portfólios e perspectivas. Brasília: Instituto Sociedade,
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					População e Natureza. ISPN. (2023). Manual do Beneficiário PPP-ECOS – GEF-7 (2019–2026). Brasília: Instituto Sociedade, População e Natureza.
Fundo Amazônia	Instituído pelo Decreto nº 6.527, de 1º de agosto de 2008, para captar doações e apoiar, com recursos não reembolsáveis, ações de prevenção, monitoramento e combate ao desmatamento, conservação e uso sustentável na Amazônia Legal. Voltado inicialmente a projetos estruturantes de O BNDES é o gestor (análise, contratação, monitoramento e transparência). Estrutura de governança com dois comitês: COFA (diretrizes, com governo federal, estados e sociedade civil) e CTFA (especialistas que atestam as reduções de emissões). A	107 projetos apoiados desde 2009; total desembolsado R\$ 1,56 bi; total de doações recebidas R\$ 3,5 bi (valores acumulados até 2023). Em 2023, recorde de R\$ 1,3 bi em alocações (R\$ 553 mi aprovados + R\$ 786 mi em chamadas). Entre os marcos reportados: 1,1 milhão de imóveis no CAR apoiados; 326 órgãos ambientais fortalecidos; 196 UCs apoiadas; 101 Terras Indígenas apoiadas; 652 organizações comunitárias fortalecidas; 239 mil pessoas beneficiadas com atividades	O modelo com COFA/CTFA e transparência contínua é frequentemente citado como inovação — mas a dissolução de 2019 mostrou a vulnerabilidade institucional. Chamadas e projetos “estruturantes” (CAR, PGTAs, monitoramento) geram escala e efeito sistêmico quando acoplados a políticas federais/estaduais. (Diretrizes 2013–2014 e	Consolidar arranjos legais e operacionais que reduzam risco de novas interrupções; manter COFA/CTFA ativos e com diversidade de representação. Continuar combinando grandes projetos estruturantes (PPCDAm e agendas setoriais: CAR, fiscalização, restauração, saneamento rural, educação alimentar nas escolas) com mecanismos capilares (chamadas/aglutinadoras) e metas territoriais claras (arco do desmatamento, TIs/UCs mais pressionadas). Em relação aos Projetos Produtivos Sustentáveis, as recomendações giram em torno de dar escala, sustentabilidade e autonomia às cadeias apoiadas, fortalecendo sua	BNDES. (2010). Fundo Amazônia: Relatório de Atividades 2010. Rio de Janeiro: Banco Nacional de Desenvolvimento Econômico e Social. BNDES. (2011a). Fundo

atuação se ancora no PPCDAm (lançado em 2004 e retomado na 5ª fase em 5/6/2023, meta de desmatamento zero até 2030). Linhas de apoio incluem: gestão de áreas protegidas; controle/monitoramento e fiscalização; manejo florestal; atividades produtivas sustentáveis; ZEE/ordenamento/regularização fundiária; conservação da biodiversidade; restauração. Em 2013–2014 ganharam ênfase: CAR (regularização ambiental), chamadas públicas para atividades produtivas sustentáveis e apoio a PGTA's em Terras Indígenas. Historicamente: Noruega (maior doador), Alemanha/KfW, Petrobras; em 2023 entram Suíça, EUA e Reino Unido; anúncios adicionais de UE, Dinamarca e reforço da Noruega; em jan/2024 contrato com Japão. Em 2023, R\$ 726 milhões em novas doações e R\$ 741 milhões em contratos assinados; doações anunciadas somam ~R\$ 3,1 bilhões. Lançada em 2014, a Chamada Pública para Projetos Produtivos Sustentáveis surgiu para responder a uma crítica	produtivas sustentáveis; 32.837 incêndios/queimadas combatidos; 1.896 missões de fiscalização. (Indicadores agregados de projetos apoiados). O Fundo impulsionou instrumentos estruturantes (CAR, monitoramento via INPE/Prodes & Deter; prevenção/combate a incêndios com Prevfogo e CBMs; gestão de TIs e UCs; editais de produção sustentável). Em 2014, projeto emblemático de monitoramento por satélite ao INPE (R\$ 67 mi). A Chamada “Projetos Produtivos Sustentáveis” em 2014 trouxe capilaridade e inclusão, conectando recursos bilionários do Fundo a centenas de pequenas associações e cooperativas. Fortaleceu cadeias estratégicas da sociobiodiversidade, contemplando uma ampla gama de produtos da sociobiodiversidade: Castanha-do-brasil (infraestrutura de beneficiamento, logística,	2023–2025 reforçam isso) Avanços em outputs (CAR, UCs, fiscalização), mas dificuldades de mensurar impactos de longo prazo em renda, inclusão produtiva e bem-estar. Mostrou que pequenos recursos podem ter grande impacto, quando conectados a cadeias territoriais e que projetos articulados a políticas públicas (CAR, PGTA, fiscalização) geraram escala e efeito sistêmico. Reforçou a importância das aglutinadoras como intermediárias que simplificam o acesso, ampliam a capilaridade (associações, cooperativas, comunidades), mas exigem apoio técnico e monitoramento robusto. Também evidenciou o risco de dependência das comunidades em relação a essas organizações. Revelou a necessidade de monitoramento	conexão com políticas públicas e mercados, e garantindo que os benefícios socioeconômicos sejam distribuídos de forma justa entre os grupos comunitários. Necessidade de evitar sobreposição entre projetos e garantir que os aprendizados sejam internalizados pelas organizações locais. Investir em capacitação em gestão administrativa, contábil e comercial para que as comunidades ganhem autonomia na gestão de projetos e dependam menos das aglutinadoras para acessar recursos. Incentivar que as aglutinadoras atuem mais como incubadoras e formadoras de capacidades, não apenas como repassadoras de recursos. Consolidar a governança do Fundo para evitar novas paralisações (governo Bolsonaro). Combinar grandes projetos estruturantes com editais capilares, com foco em áreas críticas do arco do desmatamento. Fortalecer cadeias de sociobiodiversidade (produção, beneficiamento, compras públicas — ex.: alimentação escolar, saúde) e assistência técnica/infraestrutura, vinculando-as a metas de restauração e CAR/PRA. (Estratégias 2023 e editais Amazônia na Escola; Restaura Amazônia). Estimular sinergia entre cadeias apoiadas pelo Fundo e agendas de restauração, CAR/PRA, regularização fundiária e bioeconomia.	Amazônia: Relatório de Atividades 2011 – Volume 1. Rio de Janeiro: Banco Nacional de Desenvolvimento Econômico e Social. BNDES. (2011b). Fundo Amazônia: Relatório de Atividades 2011 – Volume 2. Rio de Janeiro: Banco Nacional de Desenvolvimento Econômico e Social. BNDES. (2012). Fundo
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	recorrente: o Fundo Amazônia apoiava apenas grandes projetos estruturantes, pouco acessíveis a comunidades locais. A ideia foi criar um instrumento específico para canalizar recursos a associações, cooperativas, povos indígenas e quilombolas, através de aglutinadoras (ONGs e fundações com maior capacidade de gestão). Essa chamada marcou a entrada estruturada da sociobiodiversidade no Fundo, conectando conservação florestal com geração de renda. O BNDES contratava aglutinadoras (como ISPN, Fundação Amazônia Sustentável – FAS, Imaflora, IPAM, entre outras). Cada aglutinadora lançava editais simplificados e repassava recursos em valores menores (em média R\$ 200–300 mil) para organizações comunitárias. Além dos repasses, ofereciam assistência técnica, capacitação e apoio em gestão para os grupos beneficiados.	certificação). Óleos vegetais (andiroba, copaíba, babaçu, buriti). Frutos nativos (açaí, cupuaçu, buriti, bacaba). Borracha nativa (seringueiros em reservas extrativistas). Mel e meliponicultura. Artesanato indígena e comunitário (fibras, sementes, madeira certificada). Sementes florestais (formação e fortalecimento de redes como a Rede de Sementes do Xingu e do Cerrado). (castanha, babaçu, açaí, óleos, mel, sementes, artesanato). Criou novos arranjos institucionais (aglutinadoras) que se tornaram referência em governança socioambiental. Fortaleceu a criação e consolidação de redes regionais, como: CIMQCB (Comissão Interestadual das Mulheres Quebradeiras de Coco Babaçu), que ganhou escala e inserção nacional. Redes de Sementes Florestais, que passaram a fornecer insumos para restauração ecológica em larga escala. Promoveu investimentos em agroindústrias comunitárias, galpões de beneficiamento e	específico de impactos econômicos e sociais nas cadeias (renda, inclusão de gênero, juventude). Consolidou a percepção de que a sociobiodiversidade é vetor de bioeconomia, não apenas de conservação. O desafio permanece em garantir continuidade, escala e autonomia às organizações comunitárias beneficiadas, pois há dependência das aglutinadoras.	Monitoramento e equidade: criar linhas de base, reforçar indicadores sociais/distributivos e ampliar salvaguardas. Diversificação de doadores: manter e expandir cooperação internacional (EUA, Reino Unido, UE, Japão, etc.) e fortalecer cooperação regional (OTCA). Evitar que o apoio seja episódico; criar linhas permanentes de financiamento comunitário no Fundo Amazônia. Prever recursos de consolidação para organizações que avançaram em infraestrutura, mas precisam de apoio recorrente para se firmar no mercado.	Amazônia: Relatório de Atividades 2012. Rio de Janeiro: Banco Nacional de Desenvolvimento Econômico e Social. BNDES. (2013). Fundo Amazônia: Relatório de Atividades 2013. Rio de Janeiro: Banco Nacional de Desenvolvimento Econômico e Social. BNDES. (2014). Fundo Amazônia: Relatório de Atividades 2014. Rio de
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		certificações que aumentaram o valor agregado dos produtos. Ampliou a participação de povos indígenas e quilombolas, via PGTA's (Planos de Gestão Territorial e Ambiental) que também incluíam cadeias produtivas.			Janeiro: Banco Nacional de Desenvolvimento Econômico e Social. BNDES. (2023). Fundo Amazônia: Relatório de Atividades 2023. Rio de Janeiro: Banco Nacional de Desenvolvimento Econômico e Social. INESC. (2021). Estudo sobre aprendizagem e resultados do Fundo Amazônia. Brasília: Instituto de
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					Estudos Socioeconômicos. ISPN; BNDES. (2020). Amazon Fund's Benefits Distribution Study. Brasília: ISPN/BNDES. BNDES. (2018). The Amazon Fund: pathways to social inclusion. Rio de Janeiro: Banco Nacional de Desenvolvimento Econômico e Social.
Programa Ecofortes	Criado em 2013, no âmbito do Plano Nacional de Agroecologia e Produção Orgânica (Planapo),	Ecoforte-Redes (2014–2017): apoiou redes de agroecologia, produção orgânica e	Participação social inédita: o programa foi construído de forma	Ampliar escala e continuidade: garantir edições permanentes, evitando descontinuidade.	Fundação Banco do Brasil.

	fruto da PNAPO (Decreto nº 7.794/2012). Surge de mobilização dos movimentos sociais do campo (Marcha das Margaridas, ANA, ABA, MST) e da demanda por fortalecimento das redes territoriais de agroecologia. O Ecoforte é singular entre os programas de apoio rural no Brasil porque parte da demanda da sociedade civil organizada, valoriza o trabalho em redes, e conecta agroecologia, extrativismo e sociobiodiversidade a políticas nacionais (PNAPO/Planapo). Sua trajetória mostra inovações (participação social, apoio em rede, inclusão de diversidade), mas também desafios de escala, continuidade e burocracia. Implementado por Acordo de Cooperação Técnica (2013) entre 11 instituições (MDA/SAF, MMA, MDS, Embrapa, Conab, Mapa, BNDES, Banco do Brasil, Fundação Banco do Brasil – FBB, entre outras). Financiamento: Fundo Amazônia, Fundo Social do BNDES, recursos da FBB. Gestão: FBB coordena e lança os editais, em conjunto com o	extrativismo sustentável em todos os biomas; valorizou redes mistas com associações, cooperativas, ONGs e povos e comunidades tradicionais. Ecoforte Extrativismo (2016): voltado a organizações de base ligadas ao uso sustentável da sociobiodiversidade (castanha, babaçu, óleos, borracha, açaí, mel etc.). Recursos: dezenas de milhões de reais aplicados em mais de 150 projetos de redes, cooperativas e organizações comunitárias (dados variam por edição). Benefícios relatados: fortalecimento institucional das redes; capacitação e assistência técnica; infraestrutura e logística; inclusão de mulheres e jovens; valorização da sociobiodiversidade. O programa abrangeu demandas centrais da sociedade civil: mobilização em rede, formação e ATER, diversidade e inclusão.	conjunta entre governo e sociedade civil, fortalecendo a legitimidade e a PNAPO. Apoio em rede: mostrou que financiar redes (e não apenas organizações isoladas) fortalece dinâmicas territoriais e multiplica impactos. Foco em diversidade: inclusão de povos indígenas, comunidades tradicionais, mulheres e jovens foi diferencial em relação a outros programas. Desafios identificados: recursos abaixo do previsto; entraves burocráticos na execução; necessidade de continuidade para consolidar resultados.	Simplificar processos: reduzir burocracia e agilizar repasses. Reforçar articulação com PNAPO/Planapo: para dar coesão nacional às experiências locais. Fortalecer indicadores de impacto: medir renda, inclusão social e impactos ambientais dos projetos. Ampliar inclusão: seguir priorizando mulheres, jovens, povos indígenas e comunidades tradicionais. Integração com políticas públicas: articular Ecoforte a compras públicas (PAA, PNAE), PGPM-Bio e políticas de crédito rural.	Edital Ecoforte Redes 2024 (prorrogado) . Brasília: Fundação Banco do Brasil, 2024. Fundação Banco do Brasil. Edital nº 2016/007 – Ecoforte Extrativismo. Brasília: Fundação Banco do Brasil, 2016. Fundação Banco do Brasil. Programa Ecoforte: aprendizado. Brasília: Fundação Banco do Brasil, 2019. Instituto de Pesquisa
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	Comitê Gestor do Ecoforte e em diálogo com a sociedade civil. Inspiração: programa Cataforte (apoio a redes de catadores). Editais principais: Ecoforte-Redes (2014), Ecoforte Extrativismo (2016), e chamadas subsequentes. O Edital Ecoforte Redes 2024 retoma o fortalecimento de redes de agroecologia, reafirmando o papel do programa como instrumento da PNAPO.				Econômica Aplicada – IPEA. Análise do Programa Ecoforte. Brasília: IPEA, 2019.
Fundo Caixa Socioambiental	Criado em 2010, no Ano Internacional da Biodiversidade (ONU), como desdobramento da política de responsabilidade socioambiental da Caixa Econômica Federal. Tem como objetivo financiar projetos de inclusão social, proteção ambiental e desenvolvimento econômico sustentável. Funciona a partir de editais periódicos (como o Edital Fundo Caixa), chamando OSCs, associações comunitárias e entidades de pesquisa para execução dos projetos. Privilegia editais acessíveis a organizações de base comunitária (não apenas grandes ONGs ou governos), permitindo que essas entidades acessem recursos diretamente, segundo suas próprias demandas e	Apoio a centenas de iniciativas em todo o Brasil, conectadas a mitigação e adaptação climática. Entre 2019–2021 foram apoiados mais de 1.200 projetos - Exemplos: Proteção de florestas (236 projetos, R\$ 10,5 mi), segurança e soberania alimentar (272 projetos, R\$ 8,5 mi), geração de renda a partir do manejo de cadeias produtivas, certificação, comercialização (247 projetos, R\$ 8,2 mi), defesa de direitos socioambientais (132 projetos, R\$ 4,7 mi).	Reconhecimento das comunidades como sujeitos políticos e atores principais do processo de transformação. Ou seja, associações, cooperativas, sindicatos, povos indígenas, quilombolas, grupos de mulheres e juventudes rurais têm protagonismo na proposição, execução e gestão dos projetos financiados. Processos de escuta profunda e diálogo com beneficiários são centrais para identificar demandas e fortalecer soluções locais. Fortalecimento de redes locais e articulação com	Ampliar escala e capilaridade: replicar modelos em diferentes biomas e territórios. Fortalecer a sustentabilidade dos projetos: apoiar ações que integrem geração de renda, conservação ambiental e inclusão social. Aprimorar indicadores: monitorar resultados em termos de carbono evitado, florestas restauradas e renda gerada. Articular com políticas públicas: vincular projetos a PAA, PNAE, PGPM-Bio e programas estaduais/municipais. Garantir continuidade e financiamento híbrido: combinar doações com mecanismos de cofinanciamento (matchfunding, setor privado, fundos internacionais).	Caixa Econômica Federal. (2019). Fundo Socioambiental CAIXA: livro institucional . Brasília: Caixa Econômica Federal. Caixa Econômica Federal. (2021). Edital Fundo Socioambie

	prioridades. Isso reforça a ideia de que a solução para os desafios socioambientais nasce nos territórios, a partir da experiência acumulada pelas populações locais em práticas de manejo sustentável, conservação e organização social. Consolidou-se como um dos principais instrumentos de apoio a pequenas e médias organizações comunitárias no Brasil. Ele é diferenciado por seu foco em comunidades protagonistas, fortalecimento de redes, inclusão social e ambiental, e pela grande capilaridade territorial. No entanto, enfrenta desafios de escala e continuidade, sendo recomendada maior integração com políticas públicas e diversificação de fontes de financiamento. Em 2024 foi lançada a chamada “Teia da Sociobiodiversidade”, que visa apoiar até 400 organizações locais tradicionais em todo o Brasil (escala muito maior do que muitos editais anteriores locais ou regionais), por meio de dois editais (2024 e 2025). Prazo de execução de até 14 meses. Duas linhas temáticas: 1. Negócios da		políticas públicas aumenta a capilaridade e os impactos. Mais de 70% dos recursos são doações diretas, privilegiando acesso democrático a pequenos grupos e OSCs .		ntal CAIXA. Brasília: Caixa Econômica Federal. Caixa Econômica Federal. (2022). Projetos selecionados – Fundo CAIXA: Teia da Sociobiodiversidade. Brasília: Caixa Econômica Federal. Caixa Econômica Federal. (2022). Relatório de projetos apoiados pelo Fundo Socioambiental CAIXA. Brasília: Caixa
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	Sociobiodiversidade; 2. Soluções Baseadas na Natureza (SbN). A chamada Teia da Sociobiodiversidade inova ao combinar escala, acessibilidade e fortalecimento institucional, com critérios explícitos para inclusão social (gênero, juventude) e apoio técnico contínuo. É um passo além de editais tradicionais, porque não apenas financia projetos, mas também investe em capacitação e autonomia das comunidades.				Econômica Federal.
Fundo Casa Socioambiental	Criado em 2005 como Fundo Casa de Apoio Socioambiental, uma iniciativa pioneira de filantropia socioambiental colaborativa no Brasil e América Latina. - Inspirado no modelo dos small grants funds e apoiado por fundações internacionais (Ford, Avina, Oak Foundation, Climate and Land Use Alliance, entre outras) e instituições nacionais (Fundo Amazônia, Fundo Socioambiental CAIXA, FBB). - Estrutura de governança: Conselho Deliberativo com representação de organizações da sociedade civil, e gestão executiva da Associação Fundo Casa. - Foco: financiar organizações de base comunitária e grupos locais	Mais de 3.700 projetos apoiados desde 2005 em 38 países da América Latina e Caribe, totalizando R\$ 132 milhões em investimentos socioambientais diretos (dados consolidados 2024). - Perfil das organizações beneficiadas: 80% são associações comunitárias, cooperativas, sindicatos rurais, povos e comunidades tradicionais (PCTs) e organizações de mulheres. - Temas centrais de atuação: segurança alimentar e agroecologia (31%), conservação e restauração (26%), justiça climática e povos indígenas (18%),	Modelo de grantmaking descentralizado e de baixo custo: pequenas doações têm alto impacto em territórios tradicionais, onde o investimento direto em comunidades é mais eficaz que grandes programas governamentais. Apoio de base contínuo: a estratégia de financiamento de longo prazo para as mesmas redes (ex.: Rede Cerrado, Rede de Sementes do Xingu, CNS, COIAB) gera sustentabilidade	Consolidar mecanismos de financiamento híbrido: ampliar o uso de matchfunding com bancos públicos e fundações privadas. - Aprofundar o acompanhamento de resultados: desenvolver indicadores de impacto em renda, restauração e equidade social. - Fortalecer a autonomia organizacional: garantir apoio institucional, não apenas a projetos pontuais. - Priorizar a juventude e gênero: consolidar linhas de financiamento específicas para mulheres e jovens em territórios tradicionais. - Replicar o modelo de microgrants: inspirar políticas públicas de apoio direto às comunidades com base no modelo do Fundo Casa (ex.: subvenções comunitárias via MMA ou MAPA).	

	que atuam em temas de justiça climática, conservação, direitos territoriais, gênero, povos indígenas, comunidades tradicionais e agroecologia. • Abrangência: atuação em todos os biomas brasileiros e expansão para América Latina e Caribe a partir de 2017. • Instrumentos: microdoações (pequenos projetos até R\$ 100 mil), chamadas públicas temáticas, parcerias institucionais (CAIXA, FBB, União Europeia, USAID) e programas regionais (Fundo Casa Amazônia, Cerrado Vivo, Teia da Sociobiodiversidade).	direitos territoriais e fortalecimento organizacional (17%), economia da sociobiodiversidade (8%). • Exemplos concretos: – Associação Wyty-Catê das Comunidades Timbira (MA/TO): fortalecimento territorial e produção de óleo de babaçu. – Rede de Sementes do Xingu (MT): ampliação da coleta e comercialização de sementes nativas para restauração. – Associação de Mulheres Agroextrativistas do Médio Juruá (AMARUJ): valorização do óleo de andiroba e copaíba. – Cooperativa dos Agricultores Familiares do Alto Sertão de Sergipe (COOPERCUC): beneficiamento de umbu e licuri. • Capilaridade e territorialização: presença em todos os biomas brasileiros, com foco crescente em Amazônia, Cerrado e Caatinga. • Fase recente (2021–2024): o fundo ampliou parcerias	institucional e confiança local. • Governança participativa: o Conselho com forte presença da sociedade civil garante legitimidade e representatividade. • Importância do apoio flexível: permitir que organizações definam prioridades e usem os recursos conforme necessidades locais fortalece o protagonismo comunitário. • Articulação em rede: parcerias entre fundos (FSA, FBB, CAIXA, GEF, UE) ampliam escala e diversificam fontes, mas exigem coordenação e clareza de papéis.	• Sistematizar e divulgar aprendizados: transformar o acúmulo de 20 anos em publicações e evidências para influenciar políticas de bioeconomia e justiça climática.	
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		institucionais (Fundo CAIXA, FBB, UE, CLUA), lançando o programa Teia da Sociobiodiversidade com meta de 400 organizações apoiadas até 2025.			
Funbio	Criação e papel institucional: O Fundo Brasileiro para a Biodiversidade (FUNBIO) foi criado em 1995, a partir de uma parceria entre o Governo Federal (MMA), o Banco Mundial (GEF) e a sociedade civil, em resposta à ratificação da Convenção sobre Diversidade Biológica (CDB). Desde então, tornou-se o principal mecanismo de financiamento privado e fiduciário da conservação no Brasil, gerindo recursos de mais de R\$ 3,8 bilhões (2024) em projetos de conservação, uso sustentável e clima. Função estratégica: O FUNBIO atua como organização intermediária entre governos, agências multilaterais, fundações internacionais e implementadores locais — oferecendo gestão financeira, técnica e fiduciária de projetos complexos. Principais programas históricos:	Desde 1995, o FUNBIO já apoiou mais de 500 projetos em todos os biomas brasileiros, consolidando 44 fundos fiduciários ambientais e 70 parcerias internacionais. • Sob sua gestão, foram criadas e/ou consolidadas 160 Unidades de Conservação (UCs), abrangendo mais de 60 milhões de hectares de áreas protegidas (ARPA, GEF Terrestre, Fundo Mata Atlântica). • Geração de mais de 20 mil empregos diretos e indiretos em conservação e bioeconomia local. Resultados do Programa COPAÍBAS: • Abrangência: foco em mais de 400 Terras Indígenas elegíveis, em dois biomas (Amazônia e Cerrado). • Projetos selecionados (2023–2024): incluem redes de sementes e agrofloresta	(a) Ao longo da trajetória do FUNBIO: • A combinação de solidez fiduciária com flexibilidade operacional consolidou o FUNBIO como modelo de referência internacional em gestão de fundos ambientais. • A experiência de longa data com UCs e REDD+ mostrou que a conservação só é sustentável se houver inclusão social e territorialização das políticas climáticas. • O sucesso do ARPA e de outros programas reforçou a importância da autonomia institucional e da continuidade financeira. (b) Lições emergentes do COPAÍBAS:	Consolidar o modelo COPAÍBAS como política estrutural do FUNBIO, replicando-o em outros biomas e temáticas (ex.: biodiversidade marinha e Cerrado). • Estabelecer indicadores de impacto integrados (socioeconômico, territorial e climático), que mensurem resultados além da execução física (ex.: autonomia, renda, governança). • Ampliar mecanismos de cofinanciamento (Fundo Amazônia, Fundo Clima, CAIXA, União Europeia), criando um “blended model” para projetos indígenas e comunitários. • Fortalecer redes regionais indígenas de sementes, restauração e cadeias produtivas — como vetores da bioeconomia indígena. • Reduzir burocracias operacionais, ampliando o uso de ferramentas digitais e processos simplificados para prestação de contas. • Expandir a formação de lideranças femininas e jovens indígenas em gestão e finanças socioambientais	

	• Programa Áreas Protegidas da Amazônia (ARPA) (desde 2003) — maior programa de conservação de florestas tropicais do mundo, com mais de 60 milhões de hectares de UCs apoiadas. • TerraMar (costeiro e marinho, 2014–2020). • GEF Mar (2016–2023), GEF Terrestre, Fundo Mata Atlântica, Projeto Áreas Protegidas e Biodiversidade (GEF Terrestrial), e programas temáticos de restauração e combate à desertificação no Cerrado. • Parcerias internacionais: Noruega (NICFI), Alemanha (KfW), Reino Unido (Darwin Initiative), Banco Mundial, BID, GEF, WWF, CI e Fundo Amazônia. Lançamento do Programa COPAÍBAS (2021–2022): Surge como nova geração de programa climático e territorial, financiado pela Iniciativa Internacional de Clima e Florestas da Noruega (NICFI), com ênfase em povos indígenas, comunidades tradicionais e áreas protegidas (PICAs) nos biomas Amazônia e Cerrado.	(Rede Xingu, Rede Cerrado, Associação Krahô, COIAB), associações de mulheres indígenas e organizações interétnicas. • Eixos temáticos: (i) elaboração e execução de PGTA/IGATIs; (ii) fortalecimento institucional e formação de lideranças; (iii) manejo sustentável de recursos naturais (sementes, óleos, SAFs, restauração); (iv) segurança alimentar e vigilância territorial. Resultados esperados (até 2025): – 30 PGTA/IGATIs implementados; – 150 organizações indígenas fortalecidas; – 50 iniciativas produtivas sustentáveis apoiadas (sementes, óleos, SAFs); – aumento da capacidade de gestão territorial em 10 milhões de hectares de TIs. Impacto qualitativo: O COPAÍBAS é o primeiro programa do FUNBIO a aplicar uma arquitetura de governança indígena	• O modelo “Aglutinador–Aglutinadas” representa um avanço na democratização do acesso a grandes recursos internacionais, superando a barreira burocrática enfrentada por organizações indígenas e comunitárias. • O formato em duas fases (Preparatória e Implementação) permite maturação institucional antes da execução plena, reduzindo riscos de inadimplência e garantindo mais qualidade na aplicação dos recursos. • A inclusão de salvaguardas sociais e de gênero fortalece a transversalidade de equidade dentro do programa. • A governança descentralizada aumenta legitimidade e corresponsabilidade entre atores locais.		
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	Objetivo: apoiar ações que contribuam para a redução do desmatamento, conservação florestal e implementação de políticas climáticas (REDD+ e PNGATI). Diferencial metodológico: introduz o modelo “Aglutinador”, no qual uma instituição com capacidade técnica (ONG ou organização indígena regional) coordena subprojetos locais de organizações indígenas de base (“Aglutinadas”). Exige que 50% do orçamento total seja repassado diretamente às organizações de base. Recursos e estrutura: orçamento inicial de R\$ 30 milhões (Chamada 17/2022), com projetos de até R\$ 6 milhões, contrapartida de 10%, e estrutura em duas fases — Preparatória (fortalecimento institucional) e Implementação (execução). Foco territorial: Terras Indígenas e seus entornos nos biomas Amazônia e Cerrado; prioridade para o Cerrado em pelo menos três projetos.	descentralizada com repasses diretos, fortalecendo o protagonismo e a gestão comunitária.			
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IEB	O IEB é uma associação sem fins lucrativos fundada em 1998, com foco no fortalecimento de pessoas e organizações para a sustentabilidade socioambiental. Atua em quatro programas estruturantes: (i) Povos Indígenas (governança, gestão territorial, defesa de direitos, PNGATI); (ii) Povos do Cerrado (cadeias de fitoterápicos e baru, registro do ofício das raizeiras e raizeiros); (iii) Ordenamento e Governança Territorial na Amazônia – Ordam (regularização fundiária, protocolos de consulta, formação e gestão de territórios tradicionais); e (iv) Territorialidades (manejo florestal comunitário, gênero, economia da sociobiodiversidade e tecnologias sociais). O IEB atua como organização intermediária (aglutinadora), articulando redes e fortalecendo organizações de base. Conta com parcerias estruturantes com USAID, Fundação Gordon & Betty Moore, Misereor, BNDES (Iniciativa Lira), PNUD, GEF, MMA, Funbio e COIAB. Possui escritórios em Brasília, Belém,	Escala e impacto (2023): atuação em mais de 10 milhões de hectares de florestas comunitárias, apoio a 18 mil famílias, e 715 horas de formação envolvendo 770 pessoas. Povos Indígenas: apoio direto a 9 associações no sul do Amazonas (APITEM, OPIAM, APIJ, OPIAJBAM, OPIAJ, OPIPAM, APITIPRE, APILCamm, FOCIMP) e ao CIR (Roraima); formação de 16 comunicadores indígenas (Rede Vozes da Mata); elaboração de 9 protocolos de consulta; 85 indígenas formados na TI Camicuã e 113 na TI Marmelos; 5.276 pessoas beneficiadas pelo projeto Liga da Floresta. Povos do Cerrado: fortalecimento das cadeias de fitoterápicos e castanha-do-baru, com 763 participantes; destaque para as mulheres raizeiras e extrativistas e parcerias com Funbio/GEF, Iphan e UnB.	Governança em rede: O IEB demonstra como uma organização intermediária pode gerar impacto sistêmico ao articular múltiplos atores (indígenas, extrativistas, governos, doadores). • Protagonismo comunitário: O modelo privilegia autonomia local e metodologias participativas; destaque ao protagonismo indígena na elaboração de PGTAs, protocolos e monitoramento territorial. • Integração entre biomas: O IEB atua simultaneamente em Amazônia e Cerrado, articulando conservação, inclusão produtiva e valorização cultural. • Capacitação e formação: Formações contínuas em gestão, comunicação e incidência política fortalecem as bases locais e permitem continuidade após o	Consolidar o papel do IEB como aglutinador de médio porte, fortalecendo seu caráter de hub técnico e formativo para organizações comunitárias. • Dar continuidade à formação de redes regionais e temáticas (ex.: OCA, Vozes da Mata, A-Mana), com foco em territorialização da bioeconomia. • Ampliar as linhas de financiamento plurianual e flexível, reduzindo a dependência de projetos de curto prazo. • Fortalecer mecanismos de mensuração de impacto, especialmente sobre inclusão produtiva, renda, gênero e mudanças climáticas. • Aprofundar a integração entre biomas (Cerrado–Amazônia) e consolidar o Cerrado como foco estratégico da sociobiodiversidade. • Expandir as ações de comunicação e editoração (Mil Folhas) como instrumentos de difusão de conhecimento e valorização cultural	
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	Manaus e Humaitá, e coordena projetos locais e nacionais.	Ordam: monitoramento de 8 milhões ha, 5.789 participantes em cursos, e 6 territórios tradicionais com regularização iniciada. Fortalecimento da rede OCA (Observatório da Castanha-da-Amazônia). Territorialidades: implementação de 25 viveiros comunitários e 100 mil mudas plantadas; 409 famílias agroextrativistas engajadas. Criação da rede A-Mana (1.500 mulheres agroextrativistas).	encerramento dos projetos. - Mulheres e juventude: Inclusão transversal de gênero e juventude em todos os programas; o empoderamento feminino é elemento estruturante nas cadeias da sociobiodiversidade. - Desafios: Sustentabilidade financeira de longo prazo e mensuração de impactos (ambientais e econômicos) ainda são desafios reconhecidos.		
Idesam	Fundado em 2004, com sede em Manaus (AM). Em 2024 completou 20 anos de atuação. Missão Promover a valorização e o uso sustentável dos recursos naturais da Amazônia, articulando conservação ambiental, desenvolvimento social e mitigação das mudanças climáticas. Campos de atuação Estruturação de cadeias de valor da sociobiodiversidade; aceleração de negócios sustentáveis (AMAZ Aceleradora); governança territorial (Observatório da BR-	3,6 milhões de hectares de floresta tropical apoiados na conservação. 80 hectares restaurados por meio de sistemas agroflorestais (SAFs). 7.500 árvores plantadas na RDS Uatumã (Programa Carbono Neutro). Econômico • R\$ 10,5 milhões comercializados em produtos da sociobiodiversidade em dois anos. - R\$ 4,6 milhões em comercialização apenas em 2023.	O modelo de intervenção mostra que a conservação florestal só é sustentável se associada à geração de renda, combatendo o ciclo de pobreza e desmatamento. Fortalecimento das organizações locais O apoio técnico contínuo e a presença territorial são fundamentais para consolidar empreendimentos de base comunitária e	Necessidade de diversificar fontes e mecanismos de financiamento, ampliando parcerias com fundos internacionais, setor privado e bancos de desenvolvimento. Escala e replicabilidade Fortalecer o compartilhamento de metodologias de produção sustentável (como SAFs e café agroflorestal) para outros territórios da Amazônia. Capacitação continuada Consolidar programas de formação em gestão e governança territorial adaptados às realidades locais. Políticas públicas Maior integração com políticas nacionais de bioeconomia e	

	319); serviços ambientais e carbono neutro; restauração e produção sustentável; inovação tecnológica (Amazônia Lab). Programas e iniciativas • Programa Carbono Neutro (desde 2010) – compensação de emissões de GEE via SAFs na RDS do Uatumã. • Café Apuí Agroflorestal – referência em agricultura regenerativa e restauração produtiva. • AMAZ Aceleradora – negócios de impacto socioambiental. • PPBio – Programa de Produção Sustentável e Bioeconomia. • Castanha e Cacau: Melhores Práticas – série de estudos sobre cadeias da sociobiodiversidade. Público beneficiado 2.329 famílias atuando com o Idesam em 2023, das quais 1.731 com geração de renda direta em cadeias produtivas sustentáveis. Abrangência territorial Amazônia brasileira – atuação direta em Unidades de Conservação como RDS Uatumã e municípios como Lábrea, Apuí e Manicoré. Prêmios e reconhecimento Eleita “Melhor ONG de Meio Ambiente do Brasil” em 2023 (Prêmio	• Aumento de 34% na renda média de extrativistas (de R\$ 2.303 para R\$ 3.095) e R\$ 8.900 de renda média por produtor de café agroflorestal. • Social e organizacional • 87 negócios e organizações apoiadas em 32 cadeias de valor sustentáveis. • Fortalecimento de associações e cooperativas locais (como ASPACS – Associação dos Produtores Agroextrativistas da Colônia do Sardinha, em Lábrea). • Capacitação em gestão, comercialização e acesso a políticas públicas. • Governança e inovação • Estruturação de mapeamento nacional de projetos de carbono florestal em parceria com o Instituto Clima e Sociedade (ICS). • Implementação da nova Teoria da Mudança (2022–2026), com quatro frentes estratégicas: estruturação de cadeias, soluções tecnológicas, aceleração de negócios e fortalecimento institucional.	reduzir dependências externas. Diversificação de produtos e inovação As experiências com castanha e cacau mostram que agregar valor localmente (ex.: óleos, chocolates, derivados) é mais eficaz do que aumentar volume de extração bruta. Finanças e mercado de carbono O acesso a créditos de carbono e mecanismos financeiros verdes ainda é limitado, exigindo melhor conexão entre oferta e demanda e adaptação às realidades dos territórios. Abordagem sistêmica O IDESAM evoluiu de uma lógica de projetos isolados para uma estratégia de ecossistemas integrados que articula comunidades, negócios, empresas e investidores.	sociobiodiversidade (PGPM-Bio, PSA, PNAE, PNATER). Monitoramento e transparência Expandir o uso do Painel de Indicadores do IDESAM para comunicação de impactos e fortalecimento da credibilidade perante investidores e sociedade civil.	
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	Melhores ONGs). O IDESAM consolidou-se como uma das principais instituições amazônicas de referência em bioeconomia comunitária, combinando pesquisa aplicada, inovação tecnológica e inclusão social. Sua atuação abrange desde o fortalecimento de cadeias da sociobiodiversidade (castanha, cacau, café) até mecanismos de mercado de carbono e restauração florestal produtiva. Nos últimos anos, o instituto vem transitando de um papel operacional para uma função estratégica de coordenação de ecossistemas regionais de inovação e conservação, com foco na geração de renda, valorização dos territórios e ampliação de parcerias multissetoriais.				
WWF	Criado em 1996, o WWF-Brasil é uma organização da sociedade civil sem fins lucrativos, integrante da Rede WWF (presente em 100 países). Atua em todos os biomas brasileiros — Amazônia, Cerrado, Pantanal, Mata Atlântica, Caatinga e Zona Costeira/Marinha — com foco em quatro pilares: Economia Verde, Justiça Socioambiental, Restauração e Conservação, e	Em 2022: 12 milhões ha apoiados em unidades de conservação; 7.423 ha em restauração (Cerrado, Mata Atlântica e recifes); 260 empreendimentos comunitários apoiados; 10 mil famílias beneficiadas; 12,4 mil t de frutos nativos coletados; 3.300 pessoas treinadas; 58 comunidades quilombolas e indígenas	Abordagem integrada por biomas é essencial: a combinação entre conservação, justiça social e economia local gera maior resiliência comunitária. - Fortalecer guardiões da natureza (IPLCs) é chave para enfrentar o desmatamento e a crise climática.	Consolidar políticas públicas de restauração e sociobiodiversidade, integrando as experiências comunitárias em programas nacionais (ex.: Pacto da Mata Atlântica, Cerrado de Pé). - Ampliar o financiamento climático e privado para negócios comunitários e restauração. - Reforçar a governança ambiental democrática, com participação efetiva de povos indígenas e comunidades tradicionais nas decisões.	

	Sociedade Engajada. Sua missão é “mudar as trajetórias atuais de degradação ambiental e construir um futuro em que as pessoas vivam em harmonia com a natureza”. O WWF mantém parcerias com empresas, governos, povos indígenas, quilombolas e agricultores familiares, além de articulação com redes globais e nacionais (Rede WWF, Coalizão Brasil Clima, PPA, Cerrado Resiliente, etc.). Em 2024 contava com 153 funcionários, 62 projetos ativos e mais de 1.300 filiados. O WWF-Brasil evoluiu de uma ONG ambiental clássica voltada à conservação de ecossistemas para uma organização de transição socioecológica, que combina conservação, justiça social e bioeconomia. Nos últimos anos, o WWF assumiu um papel intermediário e articulador, conectando: Políticas públicas (MMA, ICMBio, Funbio, BNDES, PPCDAm); Empresas privadas (via PPA, Natura, Ambev, Coca-Cola, Carrefour); Redes comunitárias e territoriais (Central do Cerrado, Rede Mulheres de Fibra, COIAB, APIB). Sua atuação recente	apoiadas. Na Amazônia, criou o Observatório Nacional do Garimpo e seus Efeitos Socioambientais, apoiou monitoramento territorial em 22 TIs, e atuou com a DPU e Fiocruz em projetos de saúde e direitos humanos. No Cerrado, fortaleceu cadeias de baru, pequi, buriti, jatobá, macaúba e capim dourado com 67 organizações comunitárias e 4.487 famílias, articulando-se à Central do Cerrado. No Pantanal, treinou 30 brigadas comunitárias e entregou 10 mil equipamentos contra o fogo. Na Mata Atlântica, colaborou no Pacto Trinacional da Restauração (ONU, 2022), com 13 mil ha restaurados e 90 empregos verdes.	- Colaboração multissetorial (sociedade civil, empresas e governos) é necessária, especialmente diante do enfraquecimento das políticas públicas (2019–2022). - Monitoramento participativo e uso de tecnologia (drones, plataformas Smart e SMDK) fortalecem a governança indígena e comunitária. - Restauração produtiva e cadeias de sociobiodiversidade são instrumentos concretos de bioeconomia inclusiva.	- Aprofundar a integração entre conservação e economia, promovendo cadeias locais com certificação, rastreabilidade e acesso a mercados éticos. - Fortalecer o papel do WWF como intermediário entre comunidades e investidores, conectando territórios amazônicos e cerratenses a estratégias globais de mitigação e adaptação.	
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	(2022–2024) consolida o WWF como um dos principais vetores de escalonamento da bioeconomia da sociobiodiversidade, com foco em territórios indígenas, quilombolas e unidades de conservação, e ênfase na restauração produtiva como instrumento de justiça climática.				
FAS	Criada em 2008, a FAS é uma fundação privada sem fins lucrativos com sede em Manaus (AM), nascida de uma parceria entre o Governo do Estado do Amazonas e o Banco Bradesco. Seu objetivo é promover a conservação ambiental e melhorar a qualidade de vida das populações da Amazônia, especialmente em Unidades de Conservação (UCs) e Reservas de Desenvolvimento Sustentável (RDS). Atua como uma das principais intermediárias da bioeconomia amazônica, integrando políticas públicas (REDD+, PSA, PPCDAm) com programas comunitários. Os programas estruturantes são: (i) Bolsa Floresta / Guardiões da Floresta (transferência direta de renda vinculada à conservação); (ii) Floresta em Pé (bioeconomia e	Escala territorial: presença em 802 comunidades e 21 mil famílias (2022), abrangendo 16 UCs. - Impactos ambientais: redução de 12% no desmatamento nas áreas de atuação; monitoramento e controle em 16 RDSs; 243 focos de calor em 2018 (queda de 10% frente a 2017). - Impactos econômicos: entre 2016–2020, R\$ 85 milhões movimentados em cadeias produtivas da bioeconomia (castanha, pirarucu, cacau, copaíba, buriti, óleos vegetais) e R\$ 15 milhões no turismo sustentável. - Floresta em Pé (Fundo Amazônia/BNDES): 17 projetos selecionados entre 188 propostas; R\$ 2,5 mi diretos + R\$ 2,3 mi indiretos, resultando em 127,5 toneladas	Integração socioambiental: a conservação só se sustenta se acompanhada de inclusão social e geração de renda local. - Aglutinação como estratégia: a FAS atuou como aglutinadora de pequenos projetos, permitindo que associações comunitárias e microempreendedores tivessem acesso aos recursos do Fundo Amazônia. - Aprendizados em gestão: desafios na formalização, gestão administrativa e financeira das organizações de base demandaram assistência técnica constante e	Consolidar o Programa Fundo Floresta (KfW) como mecanismo de longo prazo de financiamento a bioeconomia, articulando-o a REDD+ e PSA. - Aprofundar a replicação do modelo Floresta em Pé com novas chamadas regionais, valorizando cadeias comunitárias (pirarucu, cacau, óleos, turismo de base comunitária). - Fortalecer a autonomia organizacional das associações apoiadas, reduzindo dependência técnica da FAS. - Ampliar a mensuração de impacto socioeconômico, incluindo renda per capita, equidade de gênero e indicadores de bem-estar. - Consolidar parcerias público-privadas e internacionais, ampliando a base de doadores (KfW, Fundo Amazônia, Coca-Cola, Samsung, Google, Petrobras). - Formação de jovens e mulheres como liderança na bioeconomia amazônica.	

	turismo de base comunitária); (iii) Educação, Saúde e Cidadania; (iv) Soluções Inovadoras; (v) Gestão e Transparência. Em 2023, a FAS foi selecionada pelo Banco Alemão KfW para executar o Programa Fundo Floresta, com foco em bioeconomia e controle do desmatamento nos estados do Amazonas e Pará, gerindo 31 milhões de euros em parceria com órgãos ambientais estaduais.	de pirarucu e óleo de copaíba (faturamento de R\$ 770 mil em 2018–2019). - Saúde e Educação: 66 pontos de telessaúde em 22 municípios; redução de 84% de jovens sem documentação (2019–2022); 925 estudantes em cursos técnicos nas RDSs. - Reconhecimentos: Prêmio Unesco-Japão de Educação para o Desenvolvimento Sustentável (2019); Melhor ONG do Brasil (2021); Prêmio Calouste Gulbenkian (2020); e 1º lugar no Prêmio IPEA de Excelência em Pesquisa (2022)	padronização de metodologias (guias de gestão e manuais criados pela FAS). - Empoderamento local: fortalecimento do associativismo e cooperativismo foi decisivo para garantir autonomia nas cadeias produtivas. - Abordagem sistêmica: programas articulados (educação, saúde, renda, meio ambiente) são mais eficazes do que ações isoladas.		
Instituto Conexsus	Criada em 2018, a Conexsus (Instituto Conexões Sustentáveis) surgiu com o propósito de ativar ecossistemas de negócios comunitários de impacto socioambiental, conectando cooperativas, associações e comunidades tradicionais a mercados, financiamento e inovação. Tem como objetivo fortalecer Negócios Comunitários de Impacto Socioambiental (NCIS) – empreendimentos formados por comunidades rurais e florestais que utilizam recursos da sociobiodiversidade de forma	Desde 2018, a Conexsus mobilizou mais de 300 negócios comunitários no Brasil, com mapeamento de 57 empreendimentos amazônicos conectados a 181 instituições de apoio (média de 7,5 conexões por negócio). Ecossistemas regionais mapeados (2023) - Baixo Tapajós (PA) – carência de assistência técnica e regularização fundiária. - Baixo Tocantins (PA) – potencial de redes de	A construção de ambientes colaborativos regionais é essencial; não basta fortalecer negócios isoladamente. A governança territorial deve integrar múltiplos atores e serviços. Capacidades institucionais A sustentabilidade dos negócios comunitários depende de organizações intermediárias estáveis e serviços de apoio	Escalar a metodologia da “Iniciativa Amazônia em Conexões” para outros biomas (Cerrado, Caatinga) e consolidar agendas regionais de ativação permanentes. Integração com políticas públicas Alinhar a atuação da Conexsus com instrumentos da Estratégia Nacional de Bioeconomia e Plano Nacional da Sociobioeconomia, atuando como ponte de implementação territorial. Acesso a finanças inclusivas Criar e testar veículos financeiros híbridos (fundos de investimento de impacto, crédito	

	sustentável – e promover condições sistêmicas para seu desenvolvimento. Desenvolveu metodologias próprias de: • Mapeamento de ecossistemas regionais (2022–2023) com oficinas participativas; • Monitor de Soluções (análise de acessibilidade, funcionalidade e perenidade dos serviços de apoio); • Agendas Regionais de Ativação para orientar a atuação coletiva dos atores locais. Territórios de atuação na Amazônia, Cerrado e Caatinga, com ênfase em cinco ecossistemas amazônicos (Baixo Tapajós, Baixo Tocantins, Marajó, Médio Juruá e Médio Xingu). Tem como parceiros institucionais a PPA (Plataforma Parceiros pela Amazônia), USAID, NICFI (Iniciativa Internacional de Clima e Florestas da Noruega), BID-Lab, Fundação CERTI, Conservação Internacional, Memorial Chico Mendes, CNS, APACC, Solidaridad, Projeto Saúde e Alegria. Beneficiários são cooperativas, associações e redes comunitárias envolvidas nas cadeias do açaí, castanha, pirarucu, cacau, guaraná, borracha, óleos vegetais,	comercialização e beneficiamento. - Marajó (PA) – predominância da cadeia do açaí e demanda por crédito adaptado. - Médio Juruá (AM) e Médio Xingu (PA) – ecossistemas com maior número médio de conexões (9,7 e 9,2). Principais achados - Baixa diversidade de atores de apoio e predominância de redes homogêneas. - Setores financeiro e de inovação praticamente ausentes (<5% das conexões). - Assistência técnica e gestão aparecem como soluções mais acessadas, porém pouco perenes. - Intercooperação entre cooperativas ainda limitada. Impactos institucionais Desenvolvimento de um arcabouço metodológico inédito para diagnóstico de ecossistemas de negócios comunitários e forte reconhecimento nacional e internacional (parcerias BID-Lab, PPA, USAID). Inovação e inclusão (2024)	perenes. Projetos pontuais não bastam. Inovação adaptada Há necessidade de tradução e intermediação cultural e técnica entre o ecossistema de inovação (universidades, startups) e as comunidades — superando barreiras de linguagem, tempo e expectativas. Finanças sob medida Persistem entraves de acesso ao crédito convencional. Experiências com blended finance, fundos rotativos e capital paciente mostram-se mais adequadas. Metodologia participativa As oficinas de mapeamento e ativação colocam as cooperativas e associações como protagonistas do diagnóstico, fortalecendo o aprendizado coletivo e a legitimidade das agendas regionais.	solidário, garantias compartilhadas) para negócios comunitários. Conexão com inovação e pesquisa Estruturar programas contínuos de inovação sociotecnológica com ICTs e startups, priorizando demandas dos NCIS; criar laboratórios de experimentação regional. Escala e replicabilidade Adotar abordagem de “ativação em rede” — conectar ecossistemas regionais entre si (Amazônia, Cerrado, Caatinga), gerando um ecossistema nacional de negócios comunitários.	
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	sementes e mel, entre outras. Atua como organização intermediária (meso-nível) entre financiadores e organizações de base, coordenando redes regionais, promovendo inovação e criando mecanismos financeiros adaptados às realidades comunitárias. A partir de 2023–2024), a Conexsus amplia o foco de “apoio a negócios” para a ativação de ecossistemas regionais e a conexão com agentes de inovação (universidades, startups, ICTs). Exemplo: oficina “Inovação e Negócios Comunitários: como aproximar os ecossistemas”, realizada em Manaus (2024).	Ampliação da agenda para conectar ecossistemas de negócios e inovação, integrando comunidades, ICTs, universidades e startups. Oficinas geraram diretrizes de aproximação com foco em escuta ativa, descolonização da linguagem e participação justa nos resultados.			
Parceiros pela Amazônia	Criação e estrutura: A Plataforma Parceiros pela Amazônia (PPA) foi criada em 2017 como uma iniciativa de ação coletiva multissetorial liderada pelo setor privado. É coordenada pela Secretaria Executiva (IDesam) e reúne empresas, fundações, OSCs e agências internacionais para fomentar negócios de impacto socioambiental e conservação da Amazônia. Tem como objetivo construir soluções inovadoras para o desenvolvimento sustentável, fomentar o	Escala e abrangência: Desde 2018, três edições do Programa de Aceleração apoiaram 30 negócios amazônicos, investindo R\$ 7,9 milhões (R\$ 3,8 milhões em capital filantrópico e R\$ 4,1 milhões em capital privado). Impacto territorial: presença em todos os estados da Amazônia Legal, com projetos em cadeias como açaí, castanha, borracha,	Governança colaborativa: a PPA consolidou-se como modelo híbrido entre coalizão empresarial e plataforma multissetorial — envolvendo ONGs, institutos, fundos e atores locais. Integração territorial: o aprendizado central foi a necessidade de associar negócios de impacto à	Consolidação institucional: ampliar a estabilidade da plataforma e de sua Secretaria Executiva, fortalecendo o papel de governança compartilhada entre empresas e organizações locais. Territorialização e escalabilidade: integrar os programas de aceleração e desenvolvimento territorial a políticas públicas e fundos regionais (ex.: Fundo Amazônia, Fundo Clima). Diversificação de mecanismos financeiros: expandir instrumentos de finanças híbridas, como fundos de	

	ecossistema de negócios de impacto e apoiar cadeias de valor da sociobiodiversidade. A PPA representa uma nova geração de programas intermediários, que conectam o setor privado, filantropia e comunidades locais na Amazônia. Sua inovação está em combinar aceleração de negócios de impacto e fortalecimento territorial, integrando empresas e organizações comunitárias na construção da bioeconomia amazônica. A fase recente (2023–2024) marca uma virada territorial, priorizando redes regionais e arranjos multissetoriais — uma evolução em relação ao foco inicial em aceleração empresarial. Programas centrais: (1) Programa de Aceleração e Investimento de Impacto (2018–2021), (2) Tese de Aceleração (2021), (3) Tese de Desenvolvimento Territorial (2023), e (4) Territórios Sustentáveis de Inovação da Sociobioeconomia (2024). Eixos de atuação: (i) negócios de impacto em estágios iniciais e maduros; (ii) restauração e	pirarucu, guaraná, óleos vegetais e sementes nativas. Portfólio 2021–2024: reúne mais de 60 iniciativas, entre elas Aliança Guaraná de Maués (AM), Programa Pesca para Sempre (PA), Revitalização da Cadeia da Borracha (AM), Território Juruá (AC) e Semeando a Sustentabilidade (AP). Resultados qualitativos: fortalecimento de capacidades empresariais e territoriais; articulação de redes regionais; incremento de parcerias entre empresas e negócios comunitários; criação de pipeline de negócios de impacto amazônicos; e construção de métricas de impacto socioambiental (biodiversidade, carbono, inclusão).	governança territorial e bioeconomia da sociobiodiversidade, reconhecendo a diversidade amazônica e seus contextos socioculturais. Customização: os programas precisam ser desenhados “sob medida” para cada território, respeitando o nível de maturidade dos negócios e as dinâmicas locais (ex.: programas específicos por bioma ou cadeia). Capacitação e linguagem: a comunicação deve ser adaptada à realidade local, utilizando mentores e instrutores com legitimidade territorial, para evitar o viés de “importação de soluções” externas. Finanças híbridas: combinar capital semente, doações e crédito paciente foi	investimento de impacto, blended finance e garantias de crédito para negócios comunitários. Integração com a bioeconomia: fortalecer cadeias de sociobiodiversidade e negócios de base florestal como núcleo da bioeconomia amazônica regenerativa. Monitoramento de impacto: desenvolver indicadores de inclusão, gênero, juventude e distribuição territorial de benefícios. Rede PPA 2.0: fortalecer os ecossistemas regionais de inovação comunitária (Territórios Sustentáveis da Sociobioeconomia) como hubs de aprendizado e escalonamento de impacto.	
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	regeneração florestal; (iii) negócios comunitários e de base territorial; (iv) fortalecimento de arranjos multissetoriais e governança territorial. Abordagem metodológica: programas de aceleração realizados via parcerias cofinanciadas (match funding) entre empresas-membro, fundações e implementadores locais; baseiam-se em “teses” orientadoras (aceleração, desenvolvimento territorial, inovação sociobioeconômica).		fundamental para a sustentabilidade dos negócios apoiados.		
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Tipos de intervenções oferecidas por projetos no apoio às associações e cooperativas que atuam em cadeias da sociobiodiversidade

Tipos de intervenção	de	Definição	Palavras-chave
Capacitações fortalecimento institucional	e	Refere-se ao desenvolvimento de habilidades, conhecimentos e estruturas organizacionais para que comunidades e organizações consigam se adaptar, se fortalecer e prosperar. No contexto dos produtos florestais não madeireiros (PFNMs), isso inclui a assistência técnica e extensão rural (ATER), com foco em manejo sustentável, organização social e comercialização. É realizado por meio de oficinas,	Capacitação; capacity building; Capacitados; Trained; Formação; Training / Formation; Seminário; Seminar; Treinamento / Treino; Training / Practice; Oficina; Workshop; Curso; Course; Qualificação – Qualification / Skills training; Workshop; Intercâmbio; Exchange program / Knowledge Exchange; ATER – Technical Assistance and Rural Extension (TARE); Encontro; Meeting / Gathering; assistência técnica; Technical assistance; Extensão rural – Rural extension; Gestão

	cursos e treinamentos voltados à produção, gestão, contabilidade e acesso a políticas públicas.	organizacional; Organizational management; Gestão financeira; Financial management; Gerenciamento; Management; Contabilidade; Accounting; Governança; Governance; Planejamento; Planning; Liderança – Leadership; Fortalecimento institucional – Institutional strengthening; Apoio técnico – Technical support; Educação – Education; Organização social – Social organizations; Aprimoramento – Improvement / Enhancement; Melhoria de práticas – Practice improvement; Manejo sustentável – Sustainable management; environmental management; Boas práticas – Good practices; Suporte técnico – Technical support; Assessoramento – Advisory support / Mentorship; Mentorias – Mentorships / Mentoring; Restauração – Restoration; autonomia; assessoria; fortalecimento; fortalecer; manejo; organização social; protagonismo, associativo; cultivo; sistema de produção; agroecológica; agrofloresta; capacitações; organização; organização popular; capacitando; rede; troca de experiências; temática; valorização; fortalecendo; valorizando; identidade; participação; práticas sustentáveis; qualidade; gestão; discussões; monitoramento; desestimular; Práticas Tradicionais; desenvolver; desenvolvimento; associativismo; cooperativismo; empoderamento; participação social; Articulação; mobilização; transmissão de saberes; inclusão; aprimorando; práticas regenerativas; conversas; mobilização; conscientização; sensibilizar; diagnósticos; capacitações; capacitando; intercâmbios; ferramentas gerenciais; metodologia; mobilizará; difusão de conhecimento; práticas agroecológicas; manual; melhoria da qualidade; envolvidas; envolvimento; Formulação participativa; métodos; recomendações; documento informativo; estimular; identidade; senso coletivo; replicação; fomento; pacotes tecnológicos; técnicas agroecológicas; socialização; empreendedorismo; mobilization; disseminar; adoção de
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		práticas; adequação ambiental; sanitária; Vivenciar; assistência técnica; Resgate; conscientizar; promovendo reflexões; adoção; práticas agroecológicas; troca de saberes; Sistematizar; valorização; práticas agrícolas; estudo; avaliação; aprendizagem
Apoio financeiro e melhorias em infraestrutura	Abrange investimentos em infraestrutura produtiva e logística, como agroindústrias, equipamentos, galpões, barcos e veículos, geralmente por meio de doações ou financiamento híbrido (crédito, doações e capital). O objetivo é superar gargalos nas cadeias de valor e permitir maior participação das comunidades na geração de valor, inclusive com acesso facilitado a crédito subsidiado.	Infraestrutura – Infrastructure; Estrutura física – Physical structure; Galpão – Warehouse / Shed; Unidade de beneficiamento – Processing unit; Agroindústria – Agro-industry / Agro-processing unit; Câmara fria – Cold storage / Refrigerated chamber; Instalação – Installation / Facility; Construção – Construction; Reforma – Renovation / Refurbishment; Máquinas / Maquinário – Machinery / Machines; Equipamentos – Equipment; Embarcações / Barco – Boats / Vessels; Veículo / Caminhão – Vehicle / Truck; Transporte – Transport / Transportation; Beneficiamento / Processamento – Processing; Estrutura de beneficiamento – Processing infrastructure; Aquisição / Compra – Acquisition / Purchase; Insumos – Inputs / Supplies; Doação – Donation; Recurso financeiro – Financial resource / Funding; Apoio financeiro – Financial support; Financiamento – Financing; Crédito – Credit; Capital de giro – Working capital; Microcrédito – Microcredit; Blended finance – Blended finance; Fundo rotativo – Revolving fund; Aporte financeiro – Financial contribution; Investimento – Investment; adquirir; unidade; irrigação; produção; energia; estrutura de produção; fábrica; biodigestores; maquinários; melhorar a estrutura de funcionamento; fortalecer a ação em rede; banco de sementes; instalará; Casa do Mel; produção de polpas e óleos; produção de cabelo biodegradável; cozinha comunitária; viveiro comunitário; viveiros comunitários; revitalizando; engenho comunitário; produção de mudas; inovação biotecnológica; triciclos; escoamento; logística; horta comunitária; fogões ecológicos; indústria; produção de papel reciclado;

		agroindustrialização; combustível; recuperar; recuperação; restaurar; regeneração; restauração; barreiro trincheira; pré-beneficiamento; implementação de roçados; hospedaria ecológica; Implantação do sistema; implementação de sistemas de cultivo; implantar uma guarita; implantará hectares; produção de azeite; extração de óleos; casa de farinha; Unidade Agroextrativista; reestruturará a associação; pasto apícola; baraginhas de contenção; viveiro; roças tradicionais; Confeção de embalagens; desenvolvimento de unidades; Quintais Agroflorestais; quintais produtivos; captação de água; distribuição de água; implantar; sistemas de bioágua; infraestruturas; plantio; construir um centro comunitário; revitalizará a produção; reflorestará; implementará sistemas; implantação de sistema; produzir matrizes; unidades produtivas; revitalizará; limpeza da água; repovoamento de peixes; cozinha comunitária; implementará o Sistema; plantio consorciado; banco de sementes; chalés comunitários; produção de mudas
Acesso a mercados	Ações que visam ampliar as possibilidades de comercialização e geração de renda por meio da aproximação entre produtores e consumidores. As estratégias incluem redução de intermediários, atuação em mercados locais e, conforme o amadurecimento das iniciativas, inserção em mercados regionais, nacionais e internacionais, com ações como certificações, marcas coletivas e posicionamento em nichos que valorizam atributos socioambientais.	Comercialização – Commercialization / Marketing / Sales; Mercado – Market; Venda – Sale; Escoamento da produção – Product outflow / Distribution of production; Feira – Fair / Farmers’ market; Loja – Store / Shop; Restaurante – Restaurant; Supermercado – Supermarket; Cliente – Customer / Client; Acesso ao mercado – Market access; Canais de venda – Sales channels; Pontos de venda – Points of sale; Circuito curto – Short supply chain / Short food circuit; Rede de consumidores – Consumer network; Compra direta / Negociação direta – Direct purchase / Direct negotiation; Comprador – Buyer; Intermediário – Middleman / Intermediary; Encurtamento de cadeia – Value chain shortening / Supply chain reduction; Posicionamento de produto – Product positioning; Marca própria – Own brand / Private label; Marca coletiva – Collective brand; product differentiation / Value proposition; Rastreabilidade –

		Traceability; Certificação – Certification; Selo – Seal / label; Rotulagem – Labeling; Embalagem – Packaging; Marketing; Video; Promotion / Public outreach; Campanha – Campaign; Comunicação – Communication; Catálogo – Catalog; Estratégia de mercado – Market strategy; Branding – Branding; fundo rotativo
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Tipologia adotada segundo Rosenfeld et al., 2024

Rationale for the classification of partners into 17 categories

The categorization of partners into 16 groups was designed to reflect the functional diversity of actors engaged in structuring sociobiodiversity value chains in Brazil. This typology captures differences in institutional roles, levels of formalization, and modes of engagement in governance processes, public policies, and markets. Below is the rationale for each category:

Government

Includes agencies and institutions at federal, state, and municipal levels. They are treated as a separate category due to their central role in regulation, public financing, and policy-making, holding strong leverage over value chains.

Educational and Research Institutions (Universities, Federal Institutes, Technical Schools)

These actors are crucial in the production and dissemination of scientific and technological knowledge, as well as in training professionals. They deserve their own category because of their intensive involvement in research, innovation, and extension programs.

Technical Assistance and Rural Extension

Separated due to their practical function in knowledge transfer and direct support to producers and local communities, often acting as the bridge between science, policies, and everyday practices.

Civil Society Organizations (NGOs, Institutes, Private Foundations)

Grouped as non-state actors that play a key role in social mobilization, project implementation, advocacy, and institutional strengthening of local communities. They differ from universities in their non-academic focus and from unions in not directly representing worker categories.

Workers' Unions

Kept as a distinct category because of their role in labor representation and the defense of social and economic rights, clearly differentiated from producers' associations or social movements due to their formalized institutional structure.

Sistema S (Professional Training and Industry Support System)

Institutions such as SENAI, SENAR, and SEBRAE are unique in providing professional training, technical assistance, and business support, acting in a hybrid position between productive sectors and public policy.

Producers

This category acknowledges individual productive actors (farmers, extractivists, fishers), who, although often articulated in collective organizations, have distinct dynamics when it comes to market participation.

Networks and Articulation Platforms

Created to capture entities that connect multiple organizations at territorial or sectoral scales, facilitating governance, cooperation, and joint strategies.

Commercial and/or Institutional Buyers

A separate category because of their central role in providing markets and securing demand, including both private companies and institutional buyers (e.g., PNAE).

Financial Institutions and Funding Agencies

Distinguished due to their specific role in financing, credit provision, and investment support, which differs from technical or political assistance.

Social Movements

Classified separately because they embody collective grassroots organization and advocacy, distinct from NGOs or unions, emphasizing struggles for social, territorial, and identity rights.

Territorial or Economic Development Agencies and Instances

Recognized as a distinct category due to their role in regional planning, policy integration, and promotion of territorial development, often operating as intermediaries between the State and local communities.

Credit Cooperatives

Kept separate for their function in providing community-based, solidarity-oriented access to credit, which differs from conventional financial institutions.

Sectoral Representation Entities (FIESP, CNA, OCB, UNICAFES, etc.)

A separate category because they serve as sectoral political and institutional representatives at state or national levels, distinct from grassroots organizations.

Second-Tier Cooperatives

Differentiated from first-tier cooperatives due to their federative structure, which articulates multiple local cooperatives into larger, more robust mechanisms for marketing and representation.

Churches and Religious Entities

Included because of their capacity for social and territorial mobilization, often providing cultural, logistical, and political support, distinct from NGOs or social movements.

Collective Brands and Certification Bodies

Maintained as a unique category because of their role in adding symbolic and economic value through certification, collective brands, and origin labels, directly influencing access to differentiated markets.

Maintaining these 17 categories ensures a nuanced understanding of the plurality of actors that contribute, in diverse ways, to the consolidation of a sociobiodiversity-based bioeconomy. This typology recognizes both the state and intermediary institutions as well as the strength of community-based organizations, social movements, and market actors, revealing a complex multi-functional and multi-scalar ecosystem.

Scrip R – Count how many times each of the 17 types of partners appears among the partners listed for the 1,044 community organizations.

Step-by-step analysis

Split the partner column into individual rows

Separate the contents of the partner column so that each partner appears on its own row (based on ; separators).

Standardize the names

Clean and normalize partner names by converting them to lowercase and trimming extra whitespace.

Reshape the typology spreadsheet into long format

Convert the typology data into a two-column format:

partner

functional_type (i.e., the category or typology)

Merge the two datasets

Join the standardized list of partners from the organization spreadsheet with the partner typology, using the partner name as the key.

Count and rank the most frequent partner types

Count the number of times each partner type appears and rank them in descending order of frequency.`library(readxl)`

`library(dplyr)`

`library(tidyr)`

```

library(stringr)
library(janitor)
# Step 1: Upload files
org_parceiros <- read_excel("C:/Users/acms1/OneDrive - Ministério do Meio Ambiente/UFMG/Projeto/organizacoes_parceiros.xlsx")
%>%
clean_names()
tipologia_df <- read_excel("C:/Users/acms1/OneDrive - Ministério do Meio Ambiente/UFMG/Projeto/tipologia_parceiros.xlsx") %>%
clean_names()
# Passo 2: Expandir os parceiros em linhas individuais
org_parceiros_exp <- org_parceiros %>%
separate_rows(parceiro, sep = ";") %>%
mutate(parceiro = str_trim(tolower(parceiro)))
# Passo 3: Transformar a tipologia para formato longo
tipologia_long <- tipologia_df %>%
pivot_longer(cols = everything(), names_to = "tipo_funcional", values_to = "parceiro") %>%
filter(!is.na(parceiro)) %>%
mutate(parceiro = str_trim(tolower(parceiro)))
# Passo 4: Cruzar os dados e contar
resultado <- org_parceiros_exp %>%
inner_join(tipologia_long, by = "parceiro") %>%
count(tipo_funcional, sort = TRUE)
# Visualizar o resultado

```

```

print(resultado, n = 20)
# (opcional) Exportar
write.csv(
resultado,
"C:/Users/acms1/OneDrive - Ministério do Meio Ambiente/Documentos/frequencia_tipos_parceiros.csv",
row.names = FALSE
)

```

Result

Category	Count
Government	2347
Educational and Research Institutions (Universities, Federal Institutes, Technical Schools)	701
Technical Assistance and Rural Extension	669
Civil Society Organizations (NGOs, Institutes, Private Foundations)	613
Workers' Unions	486
Sistema S (Professional Training and Industry Support System)	477
Producers	300
Networks and Articulation Platforms	172
Commercial and/or Institutional Buyers	152
Financial Institutions and Funding Agencies	141
Social Movements	132

Category	Count
Territorial or Economic Development Agencies and Instances	83
Credit Cooperatives	66
Sectoral Representation Entities (FIESP, CNA, OCB, UNICAFES, etc.)	51
Second-Tier Cooperatives	43
Churches and Religious Entities	21
Collective Brands and Certification Bodies	6

Thematic coding Lessons & Recommendations: refers to dominating themes in “Lessons learned” and “recommendations” in each report.

Persistent Institutional Factors Limiting the Consolidation of Sociobiodiversity Value Chains – according to institutional reports

1. Discontinuity and short-term design of funding mechanisms (FUND)

Across nearly all reports, intermediaries highlight **the absence of predictable, long-term financial mechanisms** as the most significant structural limitation.

Despite three decades of programs (PPP-ECOS, Ecoforte, Amazon Fund, etc.), most funding remains project-based, short in duration, and administratively rigid.

- The **FBB/Ecoforte** report explicitly warns that “multi-year predictability is essential; short-term calls do not allow organizational maturation.”

- **Conexsus (2023)** observes that while 422 community enterprises were supported between 2020–2023, “the relationship is not necessarily continuous,” making it difficult to consolidate time-series data and build lasting capacities.
- **ISPN** similarly notes that “long-term and rooted support has more robust effects than punctual interventions,” stressing that sporadic project cycles prevent institutional consolidation.
Even in financial intermediaries like **FUNBIO** and **CAIXA**, the call for *stable, blended finance mechanisms* appears recurrent, revealing a shared recognition that intermittent funding undermines continuity and scale.

Underlying barrier: Brazil’s sociobiodiversity finance still depends on fragmented project grants rather than institutionalized, adaptive funding frameworks.

2. Bureaucratic and administrative rigidity (ADMIN)

Reports converge in diagnosing **excessive bureaucracy and high transaction costs** in public and private funding programs.

- The **IPEA evaluation of Ecoforte** states clearly that “administrative rigidity and excessive control mechanisms hinder innovation and reduce beneficiaries’ protagonism.”
- The **FBB** and **FAS** documents describe the heavy reporting demands imposed by the BNDES and Amazon Fund, which “exclude small organizations unable to meet procedural requirements.”
- The **ISPN** reports also denounce “barriers of access” generated by complex documentation and contracting systems.

These findings reveal a paradox: programs designed to strengthen community autonomy often impose managerial procedures incompatible with small-scale realities.

Efforts at simplification—such as FAS’s “pilot call for small organizations”—are exceptions rather than systemic reforms.

Underlying barrier: centralized and standardized administrative logic incompatible with the diversity of community organizational forms.

3. Weak and fragmented systems of technical assistance and organizational strengthening (TA)

While virtually all intermediaries deliver training or advisory services, they identify **insufficient continuity and coordination** in technical assistance.

- **IEB** highlights that “training, institutional strengthening, and territorial management must be treated as interdependent,” yet notes the difficulty of sustaining such integration after project closure.
- **FAS** points to “gaps in administrative and financial management among grassroots organizations,” while **IDESAM** reports that “the integration between technical assistance and commercialization is decisive for success,” but often not guaranteed.
- **ISPN** adds that without dedicated human and financial resources for long-term accompaniment, the benefits of capacity-building tend to fade.

Underlying barrier: technical assistance remains episodic, dispersed among projects, and seldom institutionalized as a permanent territorial service.

4. Limited market integration and value addition (MARKET)

Despite consistent references to market access, most organizations recognize that **value chains remain weakly integrated into broader markets** and depend on few buyers or programs (such as PAA/PNAE).

- **Conexsus (2023)** finds that “67% of community businesses sell to institutional markets,” while only a minority reach private or differentiated markets.
- **IDESAM** confirms that “organizational arrangements directly determine price and access,” but persistent logistical and regulatory barriers prevent scaling.
- **PPA** acknowledges that “isolated acceleration processes do not guarantee success,” indicating that even impact-investment initiatives struggle to connect enterprises to stable demand.
- The **FAS** and **FBB** programs both emphasize that “value addition and aggregation of knowledge” remain incipient and require sustained support.

Underlying barrier: weak commercial ecosystems, absence of territorial brands or certification schemes, and high logistical costs that limit competitiveness.

5. Fragmented governance and limited policy coordination (GOV)

All reports converge on the persistence of **institutional fragmentation across scales**.

- **Concertação pela Amazônia** stresses that “the construction of local governance arrangements is key for transition to an inclusive bioeconomy,” implicitly acknowledging their absence or fragility.
- **ISPN** and **IEB** highlight the need for “multi-level coordination between local, state, and federal laws,” especially to enforce community rights.
- **FAS** and **Conexsus** both operate within multi-actor partnerships but recognize the challenge of maintaining coordination once project funding ends.
- The **IPEA** evaluation calls for stronger “federal coordination and integration among ministries,” and **FUNBIO (2024)** proposes “synergies between financial mechanisms and bioeconomy initiatives,” underscoring institutional silos between conservation and production agendas.

Underlying barrier: Brazil’s support ecosystem for sociobiodiversity remains dispersed among overlapping programs and agencies, with limited long-term coordination or shared strategic planning.

6. Deficient monitoring, evaluation, and learning systems (MEL)

Although several organizations have advanced in developing monitoring tools, they still highlight **data scarcity and inconsistent methodologies** as key constraints.

- **Conexsus (2023)** admits that “the demonstration of impact evidence faces multiple challenges... businesses are often fragile in generating and managing information.”

- **IEB** stresses that “participatory monitoring mechanisms are essential to consolidate a culture of learning,” but few organizations can maintain them independently.
- **FAS** refers to “knowledge aggregation” as a goal still under construction, while **IPEA** calls for “more territorial impact evaluations.” This persistent weakness limits the ability to demonstrate socio-environmental outcomes and to influence public policy design.

Underlying barrier: absence of standardized, participatory monitoring frameworks that connect project-level data to national policy indicators.

7. Insufficient recognition of local rights and territorial governance (RIGHTS)

Grassroots intermediaries continuously reaffirm that **unresolved land tenure and access issues** remain among the most structural impediments to value-chain consolidation.

- The **ISPN** reports emphasize that “land conflicts and restricted access to palm groves continue to threaten the babassu breakers’ livelihoods.”
- **IEB** and **Concertação** extend this concern to broader territorial governance, linking conservation and traditional knowledge.
- Even within national programs, **Ecoforte** and **FAS** acknowledge that territorial rights recognition is weakly integrated into economic support mechanisms.

Underlying barrier: enduring asymmetry between economic incentives and social-environmental justice — communities generate value but lack secure territorial and decision-making rights.

Institution	Category	Thematic code(s)	Supporting quotation (translated from report)
ISPN	Assessment	RIGHTS, GOV	“The Free Babassu Law is a major achievement that protects the right of babassu breakers to access palm groves and sustain their way of life.”
	Lesson	TA, GOV	“Project monitoring highlighted the importance of institutional strengthening and the participation of grassroots organizations.”
	Recommendation	FUND, TA, RIGHTS	“Funders should consider local specificities, prioritize community-based projects, and invest in institutional strengthening and management training.”
ISPN – PPP-ECOS Effectiveness	Assessment	GOV, RIGHTS	“Project effectiveness is linked to the governance of territorial rights and the articulation of local laws such as the Free Babassu Law.”
	Lesson	GOV	“Aggregating local initiatives under a common support arrangement fosters recognition and mitigates access conflicts.”
	Recommendation	GOV, RIGHTS	“Strengthen local and state legal frameworks and maintain support for grassroots organizations and rights advocacy.”
IEB	Assessment	TA, MEL, GOV	“Over 20 years, IEB supported more than 570 organizations and consolidated participatory transparency and monitoring mechanisms.”
	Lesson	TA, GOV, MEL	“Training, institutional strengthening, and territorial management are interdependent pillars that enhance effectiveness.”
	Recommendation	FUND, MEL, GOV, RIGHTS	“Diversify funding sources and strengthen participatory evaluation instruments that give visibility to social and environmental results.”
FUNBIO	Assessment	FUND, ADMIN, GOV	“The financial governance model has become a national and international reference.”

Institution	Category	Thematic code(s)	Supporting quotation (translated from report)
IDESAM	Lesson	MEL, FUND	“Building local financial management capacity is essential for project sustainability.”
	Recommendation	MEL, FUND, GOV	“Integrate social and biodiversity co-benefit metrics into financial indicators and foster synergies between funding mechanisms.”
	Assessment	TA, MARKET, FUND	“Productive practices and organizational arrangements directly determine product quality, price, and market access.”
	Lesson	TA, MARKET	“Integration between technical assistance and commercialization is decisive for the success of value chains.”
	Recommendation	MARKET, FUND, GOV	“Replicate best practices through territorial networks and adapt financial mechanisms to the agro-extractive cycle.”
SITAWI	Assessment	FUND, MARKET, GOV	“The best-performing initiatives combine financial returns with positive social and environmental impacts.”
	Lesson	FUND, ADMIN	“Hybrid financial instruments and risk-mitigation mechanisms are essential to attract new investors.”
	Recommendation	FUND, GOV, MARKET	“Expand collective-lending platforms and strengthen articulation with public bioeconomy programs.”
PPA (Partners for the Amazon Platform)	Assessment	MARKET, FUND, GOV	“The integration of acceleration, markets, and financing was validated as an effective model for supporting community enterprises.”
	Lesson	MARKET, GOV	“Isolated acceleration processes do not guarantee success; coordination among buyers, investors, and intermediaries is required.”
	Recommendation	FUND, MARKET, GOV	“Strengthen blended-finance instruments and establish permanent multi-sector governance spaces.”

Institution	Category	Thematic code(s)	Supporting quotation (translated from report)
FBB / Ecoforte	Assessment	FUND, TA, MARKET, GOV	“The program was decisive for strengthening family-farming networks and dynamizing local markets.”
	Lesson	ADMIN, GOV, FUND	“Excessive bureaucracy and institutional fragmentation reduce the effectiveness of public funding programs.”
	Recommendation	ADMIN, FUND, TA, MARKET	“Simplify administrative processes, integrate technical assistance and market strategies, and ensure multi-year funding predictability.”
CAIXA / Socio-Environmental Fund	Assessment	FUND, GOV	“The Socio-Environmental Fund supports projects with well-defined eligibility and governance criteria.”
	Lesson	MEL, GOV	“Monitoring and governance criteria strengthen the fund’s credibility and partner trust.”
	Recommendation	MEL, FUND, GOV	“Increase transparency, expand communication of results, and include social and environmental impact metrics in performance assessments.”
FAS (Standing Forest Program)	Assessment	FUND, GOV, MARKET	“The call for proposals reached small organizations that struggled to meet BNDES and Amazon Fund administrative requirements.”
	Lesson	TA, GOV, MEL	“Administrative and financial management, associative practices, and production were the main learning themes.”
	Recommendation	MARKET, TA, MEL, GOV	“Innovate in grant management, strengthen training, and promote value-addition and market access.”
Concertação pela Amazônia	Assessment	GOV, RIGHTS, MARKET	“Building local governance arrangements is key for the transition to an inclusive and sustainable bioeconomy.”
	Lesson	GOV, RIGHTS	“Successful experiences combine economic diversification, traditional knowledge valorization, and multi-actor coordination.”

Institution	Category	Thematic code(s)	Supporting quotation (translated from report)
IPEA (Evaluation of FBB's Ecoforte Program)	Recommendation	FUND, GOV	“Strengthen territorial innovation ecosystems and ensure continuous, decentralized funding.”
	Assessment	GOV, ADMIN, FUND	“Ecoforte showed high public relevance but faces administrative hurdles and budget limitations.”
	Lesson	GOV, ADMIN, RIGHTS	“Territorial participatory councils are essential to offset bureaucratic rigidity.”
	Recommendation	ADMIN, FUND, GOV, MEL	“Simplify requirements, strengthen participatory councils, and conduct more territorial impact evaluations.”

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APPENDIX C – Supplementary information of Chapter 4

Methodological process

Global case studies' literature review

We conducted a systematic review to identify and evaluate how IP&LC knowledge and stewardship practices are valued across the globe. This method involves a rigorous and comprehensive search strategy to capture the full range of available research literature. Through our systematic approach, we assess each article's relevance and quality to determine inclusion and exclusion criteria, ensuring that only the most pertinent studies contribute to our synthesis. This process provides clear evidence of the effectiveness of integrating IP&LC practices within sustainable development frameworks, guiding future research and policy-making initiatives (Grant & Booth, 2009). In conducting our literature review, we utilized keywords such as "people", "nature", "people-nature interactions", and "bioeconomy", along with related terms (Table 1).

Table 1. Description of keywords and search string adopted in this study.

Variable/term	Description	Search string
People	Users affecting and being affected by nature, including, but not restricted to, stakeholders, traditional and Indigenous communities' members, policymakers, citizens, etc.	("Indig*" OR "Native people*" OR "IPLC" OR "First Nation*" OR "IP&LC" OR "Aboriginal*" OR "Original inhabitant*" OR "Tribal community*" OR "Native community*" OR "Traditional community*" OR "Ethnic minority*" OR "Local commun*" OR "Customar*" OR "traditional people*" OR "riverine*" OR "settler*" OR "Small-scale" OR "local users" OR "small farmers" OR "family farmers" OR "small landowner")
Nature	Comprise all forms of nature's diversity of organisms, processes and ecosystems that co-evolved with cultural practices and diversity.	("Natur*" OR "biodivers*" OR "territory*" OR "land*" OR "environment*" OR "ecosystem*" OR "genetic heritage" OR "non-timber forest product*")
People-nature interactions	Comprised of all positive and negative contributions between nature and people, including NPC (Nature Contribution to People) and PCN (People Contribution to Nature), knowledges (traditional, Indigenous, and scientific) and stewardship practices	("stewardship practice*" OR "socio-ecological system*" OR "ecological knowledge*" OR "community-based management" OR "environmental knowledge*")
Bioeconomy	Composed of activities related to producing goods and services supported by people's and nature's interactions.	("Economic Value*" OR "Market Value" OR "Inherent Value" OR "Competitiveness" OR "Job Creation" OR "Utilitarian Benefits" OR "Instrumental Value") OR ("Environmental Value*" OR "Sustainability" OR "Ecosystem Service*" OR "Climate Mitigation" OR

		"Climate Adaptation" OR "Intrinsic Value" OR "Nature's Inherent Worth") OR ("Social Value*" OR "Equity" OR "Local Development" OR "Cultural Acceptability" OR "Relational Value*" OR "Human-Nature Relationship*" OR "Sense of Place") OR ("Technological Value*" OR "Innovation Value*" OR "Flexibility" OR "Adaptability" OR "Circular Economy" OR "Industrial Ecology" OR "Integrated Systems") OR ("Governance Value*" OR "Policy Support" OR "Stakeholder Collaboration" OR "Sustainability Metrics" OR "Justice" OR "Intergenerational Equity") ("Cultural Value*" OR "Cultural Heritage" OR "Cultural Intellectual Heritage")
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This comprehensive search spanned two databases, including Scopus (558 items) and EBSCOHost (396 items). Our search focused on studies published between 2014 and 2025. On Scopus, we narrowed our search to the following subject areas: “Environmental Science”, “Social Sciences”, “Agricultural and Biological Sciences”, “Earth and Planetary Sciences”, and “Multidisciplinary”. We included the “Environmental Complete” database on EBSCOHost without selecting any search filters. Search results were managed using Covidence, leading to the initial identification of 954 entries. We removed 201 duplicates, ultimately considering 753 articles for further evaluation. Title and abstract screening followed by full-text reviews were performed by the entire team, using clearly defined criteria concerning the study’s core themes of type of natural resource, type of study, language and geographic region as outlined in Table 2.

During the title and abstract screening phase, each study was reviewed independently by at least two team members. A third evaluation was conducted in cases of disagreement regarding whether a study should be advanced to the next phase or deemed irrelevant. This additional review involved two team members who collaboratively determined the study's inclusion or exclusion.

Table 2. Inclusion and exclusion criteria for document selection.

Particulars	Inclusion	Exclusion
Type of natural resource	Cultivated, collected or wild, such as cultural keystone species	Synthetic
Type of study	Scientific papers, policy briefs, laws, regulations, agendas, book’s chapter	Books
Language	English	All other
Geographic region	All countries	

We screened 753 studies’ titles and abstracts, determining that 464 items did not align with

our research objectives. Following a thorough review of the articles, we identified 38 studies that explicitly describe concrete cases of recognition of stewardship practice. The findings presented in this study are based exclusively on the analysis of these included items.

To establish a rigorous data extraction process, we formulated a data extraction sheet designed to log publication details such as social group, stewardship practices, recognition and/or compensation, and nature contribution to people (benefits from nature), as well as the dimensions and scope of the studies related to bioeconomy. Throughout the data extraction phase, all studies were independently coded by the entire team. Table 3 outlines the variables examined to identify and evaluate how IP&LC knowledge and stewardship are valued for sustainable development.

Table 3. Categories used for coding the selected literature

Variable	Description
ID	Continuous numerical order of papers analyzed
Included? (Yes/No/Maybe)	Whether the paper is included (yes), excluded (no), or may be included (yes) in this analysis
Title	Full paper's title
Authors	Full name of first author (et al. if necessary) separated by commas
Year	Date of publication (in year format YYYY)
Link	URL or DOI to find the paper. Please prioritize DOI for papers that have it
Country	National political borders the study was held in stated in the paper (e.g. study areas)
Geographical area	Any mention to place/territory that is not country stated in the paper (e.g. province or city stated in the study areas)
Social group	Comprises the social groups targeted at the papers (e.g., Indigenous peoples, riverine communities, coastal traditional people, peasants, etc.). These groups can be defined by cultural, geographic, economic, or social characteristics.
Species/products/resources	Comprises the natural resource being used by the social groups described above
Stewardship practices	Stewardship practices are the “actions taken by individuals, groups or networks of actors, with various motivations and levels of capacity, to protect, care for or responsibly use the environment in pursuit of environmental and social outcomes in diverse social-ecological contexts”
Any kind of rewarding/valued/compensation?	Binary category if the study mentions a valuing initiative for the people's contributions to nature (yes) or not (no). Please note: If no value is provided, consider excluding the paper (does not fit our research question) and add it to the "excluded literature" tab.
Kind of recognition/compensation	Description of recognition of contributions of and compensations to people that might integrate economic, environmental, social, technological, and governance dimensions to promote sustainable development. Economic values highlight the balance between market profitability and intrinsic benefits, fostering competitiveness, job creation, and territorial development. Environmental values emphasize

	sustainability through resource preservation, ecosystem services, and climate resilience. Social values focus on equity, local development, and cultural acceptability, ensuring inclusive and participatory processes. Technological and innovation values prioritize adaptability, circularity, and systemic optimization for efficiency and waste reduction. Governance and policy values underscore the critical role of public support, collaborative frameworks, and robust metrics to harmonize diverse interests and evaluate progress.
Recommendation of recognition/compensation	Refers to the recommendations or claims made by the authors or within the papers regarding any form of recompensation or rewarding towards stewardship practices.
Nature Contribution to People (benefits from nature)	IPBES (2019) definition: "All the contributions, both positive and negative, of living nature (diversity of organisms, ecosystems, and their associated ecological and evolutionary processes) to people's quality of life." IPBES (2023) definition: "The ways nature contributes to the realization of a good quality of life, emphasizing the dynamic interlinkages between nature and societies."
Note	Any information you think is important for analysis that was not included in previous variables.

Within each paper, we looked for ways of recognition of stewardship practices. Stewardship practices were identified and classified following Mattalia et al. forthcoming. Nature's contributions to people were identified and classified according to Diaz et al. 2018. IP&LC were identified according to their language following the ISO639 code reported in Glottolog. Later, we used an inductive qualitative approach grounded in the systematic analysis of global case studies in which environmental stewardship practices were explicitly recognized or rewarded. The aim was to identify and classify the diverse forms of recognition that link local practices of environmental care to broader policy, market, and institutional frameworks. Rather than starting from a predefined typology, the categories emerged progressively from the empirical material through an iterative process of coding, comparison, and conceptual consolidation, typical of qualitative content analysis and grounded theory procedures (Charmaz, 2014; Glaser & Strauss, 1967). This approach was selected because it allows theoretical categories to arise from patterns observed in real-world cases, minimizing normative bias and capturing the multidimensional nature of recognition.

Coding and analytical procedure for types of recognition

To classify the forms of recognition embedded in project interventions, we conducted an iterative inductive coding process combining two complementary data sources:

- (1) excerpts from 38 international case studies that describe concrete examples of stewardship recognition. For a detailed description of this see citation of the previous review and
 (2) the Brazilian project database (citing the work).

The analytical procedure followed three main stages:

Stage 1 – Open coding and initial clustering

All textual excerpts describing how local actors were rewarded, supported, or legitimized for their stewardship were coded using in vivo terms directly derived from the original descriptions. Codes such as cash transfers, subsidies, infrastructure support, legal recognition, council participation, cultural festivals, and use of local knowledge in governance were generated. This stage aimed to capture the full variety of recognition practices observed in both global and Brazilian contexts.

The emerging codes were then grouped into conceptual clusters that represented broader modes of recognition. Through iterative comparison across cases, four distinct yet complementary patterns emerged, encompassing both material and non-material dimensions. These categories were defined inductively, based on the nature of the benefits, the institutional actors involved, and the degree of formalization of recognition mechanisms.

The resulting typology included five categories, presented below (based on the document Coding Typology for Different Kinds of Recognition of Stewardship Practices):

Typology for different kinds of recognition of stewardship practices				
	Code	Type	Definition / When to Apply	Example (from the excerpts in the papers)
Material	Monetary and Non-Monetary Economic Distribution (Material recognition)	Inductive	I Refers to tangible benefits that directly impact positively the income or improve the material well-being of individuals, families, or communities as a result of their stewardship practices. These include both monetary (cash transfers, wages, subsidies, PES schemes, price premiums, revenue-sharing) and non-monetary benefits (in-kind support such as equipment, infrastructure, food, or services).	“PES implementation has provided economic income to all community members, and income generated at the family level has been able to mitigate the current crisis of coffee production. Similarly, external stakeholders note that PES has supported San Antonio’s income. It facilitates community management, contributes to cushioning low coffee production, generates jobs (activities financed by the common fund) and promotes productive activities.” (Mexico).

Non material recognition	Legal and Institutional Recognition	Inductive	Formal acknowledgment of stewardship practices by legal frameworks, government policies, or institutional arrangements. This category includes rights to land and resources, official recognition of stewardship practices, legal instruments that guarantee benefit-sharing, and institutional mechanisms that integrate stewardship into policy.	“Formal state recognition: The Kibber community is officially recognized as a Scheduled Tribe under Article 342 of the Indian Constitution... The Panchayats (Extension to Scheduled Areas) Act – PESA (1996) formally acknowledges the traditional rights of indigenous communities over land, water, and forests.” (India).
	Symbolic and Cultural Recognition	Inductive	Acknowledgment of stewardship practices through symbolic, cultural, or reputational means that elevate their social value. These forms of recognition reinforce cultural identity, prestige, and legitimacy, but do not necessarily involve direct material or legal benefits.	“The community’s traditional canoe regatta was supported by researchers and public institutions, and later became a symbolic event reinforcing caiçara cultural identity and stewardship practices. A documentary film ‘Pulsating: a film about Araçá Bay’ was produced to highlight caiçara stewardship...” (Brazil).
	Participatory and Governance Recognition	Inductive	Recognition expressed through the inclusion of communities and their knowledge in decision-making, governance structures, and co-management arrangements. This includes both practical involvement (training, formal seats in councils) and epistemic recognition (valuing local knowledge as expert input).	“Restoration projects by the Thai government and by NGOs... applying Community-Based Ecological Mangrove Restoration (CBEMR) methods, explicitly involving local communities in conservation and restoration activities.” (Thailand).
Question: if participation/governance	Legal and Institutional Recognition: Refers to the formal, legal, or organizational acknowledgment of stewardship practices. The core criterion is: rights, status, or official frameworks granted through laws, policies, or external institutions. Participatory and Governance Recognition:			

rnance is institutionalized, as in the case of "institutional support for Indigenous leadership in environmental restoration", in which type should we include it?	Refers to the practical acknowledgment of communities as active decision-makers. The core criterion is: inclusion as participants or co-managers in governance arrangements (e.g., seats in councils, co-production of knowledge, community assemblies). So, in this case, we have both.
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These categories were refined through continuous iteration and cross-validation between the global corpus and the Brazilian project dataset. Rather than a predefined classification, the typology emerged empirically from patterns repeatedly observed across multiple contexts. Each project could exhibit more than one form of recognition, reflecting the multidimensional nature of sociobiodiversity governance.

Qualitative analytical procedure for classifying types of recognition according to Arnstein's Ladder of Citizen Participation

The analysis followed a qualitative content analysis approach combining inductive and deductive coding (Glaser & Strauss, 1967; Charmaz, 2014). First, all textual descriptions of interventions and outcomes were extracted from the Brazilian project database — specifically the fields “Resumo do Projeto” and “Resultados/Avaliação” — because these two fields were the only ones that systematically described what communities actually did (stewardship practices) and what kinds of support or recognition they received. In parallel, the 38 global case studies were processed in the same way, extracting only the passages that explicitly mentioned (i) practices of environmental care, use, or management carried out by IP&LC and (ii) some form of valuation, support, or institutional recognition of these practices.

In the first cycle of coding (open coding), we used *in vivo* codes — i.e. terms taken verbatim from the original descriptions, such as “construction of processing unit”, “participation in state law on pequi”, “community fire management”, “agroforestry recovery”, “inclusion in PAA/PNAE”, “creation of local association”, “participation in territorial council”, “indigenous environmental agents trained”, “legalization of the cooperative”, “public act to regulate seed banks”. This step was intentionally expansive to capture the diversity of

recognition forms typical of sociobiodiversity projects, which often combine productive, environmental, and political components in the same intervention.

In the second cycle (axial / clustering), these *in vivo* codes were grouped into higher-order semantic clusters that represented the main modes of recognition already identified in the literature and in your previous coding scheme (economic/monetary; legal/institutional; participatory/governance; cultural/symbolic). This clustering was done by constant comparison across Brazilian and international cases to check whether a code referred only to transfer of resources (e.g. equipment, processing unit, working capital, credit access) or whether it also implied power sharing (e.g. sitting in a council, co-designing a management plan, influencing a state law, managing a collective brand). At this stage we also removed duplicates, merged semantically equivalent codes (e.g. “infra-estrutura” and “equipment provision”), and kept ambiguous cases tagged for a second review.

In the third cycle (directed / deductive coding), we mapped each cluster against the eight rungs of Arnstein’s Ladder of Citizen Participation (manipulation, therapy, informing, consultation, placation, partnership, delegated power, citizen control). Because most Brazilian sociobiodiversity projects are project-based and externally funded, we adopted a four-level operational version of Arnstein (non-participation; tokenism; partnership; delegated power/citizen control), previously discussed in the manuscript, to reduce classification noise. The rule was:

- if the project only informed, trained, equipped, or legalized the group, with decisions remaining in the funding or implementing organization → Tokenism;
- if the project created or strengthened arenas where the community co-decided (councils, territorial forums, co-management of RESEX, participatory fire management with Naturatins, elaboration of PGTA with indigenous associations) → Partnership;
- if the community achieved binding decisions or long-term control (approval of a municipal law on pequi; consolidation of “associações-mães” in the Bolsa Floresta; indigenous environmental agents managing 285,000 ha; networks like Rede Jalapão renegotiating fire rules with the state) → Delegated power / Citizen control;
- if the action was essentially awareness-raising or visibility with no room for community voice → Non-participation.

To increase analytical rigor, ambiguous or border cases — for example, projects that both built an agroindustry (typically tokenism) and, at the same time, ensured the group’s seat in a territorial council (partnership) — were double-coded and resolved by consensual adjudication: two researchers independently proposed a ladder level based on the strongest participatory element present in the description, and discrepancies were resolved in a joint

session by applying the following priority rule: when in doubt, classify according to the highest level of actual decision-making power evidenced in the text. This procedure is equivalent to a light form of intercoder reliability for qualitative data when the source texts are heterogeneous and short.

The final list is:

Type of Recognition	Typical mechanisms (examples)	Expected level of participation (Arnstein's Ladder)	Interpretation
Monetary recognition	Cash transfers, wages, subsidies, price premiums, PES schemes, revenue-sharing	Tokenism (informing, consultation, centralized placation) — occasionally partnership when co-managed funds	Monetary transfers tend to improve material conditions but usually preserve decision-making power, as allocation criteria and remain externally defined. In rare cases (e.g., community-managed PES funds), they can reach partnership level.
Non-monetary recognition	Provision of equipment, infrastructure, processing units, food, or technical services	Tokenism (most frequent) → Partnership (when controlled. When accompanied by co-participatory governance or management or long-term cooperative governance arrangements) evolve toward shared power (partnership).	In-kind support generally strengthens production capacity but remains externally linked to participatory governance or cooperative management, it can evolve toward shared power (partnership).
Non-material: legal and institutional recognition	Inclusion in policies, benefit-sharing frameworks, land or use rights	Partnership → Delegated Power	When communities gain legal status or access rights, they move beyond consultation toward shared or delegated authority, especially when laws formalize their role in decision-making.
Non-material: participatory and	Participation in councils, co-management committees, participatory planning	Partnership → Delegated Power / Citizen Control	Direct involvement in governance spaces represents a transfer of decision power and institutional voice, especially

Type of Recognition	Typical mechanisms (examples)	Expected level of participation (Arnstein's Ladder)	Interpretation
governance recognition			when communities influence agendas, manage funds, or define local rules.
Non-material: cultural and recognition	Non-cultural brands, symbolic awards, campaigns	Collective storytelling, visibility	Symbolic and visibility-based recognitions often increase social legitimacy and external visibility but rarely alter power relations or decision structures. They may, however, reinforce other types of recognition indirectly.
		Non-participation Tokenism	→

Non-participation (*citizens are informed or manipulated, with little real power*)

Manipulation / Therapy

- Awareness campaigns
- Visibility or dissemination actions
- Awards or symbolic prizes

Tokenism (*citizens are consulted or informed but decision power remains centralized*)

Informing / Consultation / Placation

- Training and capacity building
- Technical assistance
- Public policy inclusion (without shared decision power)
- Consultation or participation in isolated events
- Knowledge exchange activities
- Education programs
- Restoration or environmental rehabilitation led externally
- Legalization or registration support (e.g., CNPJ, licenses)
- Incentives or credit access mechanisms

- Funding or project-based support
- Certification (ISO, organic, fair trade)
- Infrastructure or equipment provision
- Processing units or agroindustry installation
- Fairs and exhibitions to promote products
- Branding and marketing visibility (collective brand, labels)
- Institutional strengthening guided by external agents

Partnership (*citizens share power and responsibilities with external institutions*)

- Governance strengthening
- Formation of networks and partnerships
- Participation in policy councils or committees
- Co-management arrangements
- Market access initiatives with shared management
- Inclusion in territorial or public procurement programs
- Support for women's and youth leaderships (as recognized actors)
- Collective income generation with participatory management

Delegated Power & Citizen Control (*citizens or communities hold decision-making authority and control resources*)

- Policy influence or legal recognition achieved through advocacy
- Law or regulation creation influenced by community organizations
- Community-led governance structures (councils, associations)
- Institutionalized representation and decision power
- Community networks managing resources or brands autonomously
- Full economic autonomy (income increase, employment, market inclusion led by the group)

Results

Nos projetos brasileiros foram encontrados: 8 citizen control, 36 consultation, 36 delegated power, 224 informing, 66 partnership, 4 placation

Forms of recognition - global	Arnstein Level
Economic (Economic outcomes In the community, only men give tequio, so when the benefi	Informing
Economic (incl fair trade) Since 2007, Shiga has been promoting low environmental impact a	Informing
In this policy shift toward a sustainable society, the term satoyama was increasingly integrat	Partnership
Karen communities have established village funds for sustainable CFM following the PES pai	Delegated Power
Economic Values: Maharashtra: Revenue generation through bamboo sales in Menda-Lekh;	Delegated Power
Continuous financial resources from U.S. public utilities to mitigate salmon losses caused by	Informing
sustainable harvest quotas for arapaima, a high-value fish species, as part of community-ba	Informing
Legal Framework: The Indian Biological Diversity Act (2002) ensures equitable sharing of ber	Delegated Power
Economic Values: Amazon (Tapajós-Arapiuns): Income generation from açai and Brazil nut (	Informing
The Government of India (GoI) has taken various legislative and administrative initiatives to	Informing
Official designations: The Isobe area, with wild cherry trees, was designated as a National Pl	Informing
Formal state recognition: The Kibber community is officially recognized as a Scheduled Tribe	Citizen Control
Restoration projects by the Thai government and by NGOs (notably the Mangrove Action Pr	Informing
Benefit-sharing: direct monetary compensation for land use by extractive industries; legal re	Delegated Power
policy makers and scientists recognize the importance of TK for environmental management	Informing
Families participating in the participatory research project were able to access resources fro	Manipulation
Seed collection, preparation and storage techniques were adapted or developed considerin	Delegated Power
The caiçara people are officially safeguarded under the National Policy for Traditional Peopl	Informing
Residents who assist in the scientific process by contributing their LEK compensated for thei	Informing
Support from environmental NGOs and local government agencies. Public funding via an off	Informing
Traditional knowledge recognized as valuable as scientific knowledge. At the request of Heilt	Informing
A mechanism for co-management that exists within U.S. law is the Indian Self-Determinatio	Delegated Power
Joint international fisheries management for the river Minho by Portuguese and Spanish na	Informing
Monthly wages for fieldwork. Free technical training on invasive alien plant identification an	Delegated Power
Formal incorporation of TEK into government-supported fire management programs. Creat	Informing
Multi-partnered tribal intern program (initiated 2015), offering Paiute youth practical fieldw	Informing
In the Ko Te Pukākī Program (Māori-led) case): Paid employment for 14 community membe	Partnership
Symbolic recognition: Municipal Law 033/2018 prohibits fishing gear that could cause dolph	Delegated Power
Transhumant pastoralism contributes significantly to the economy of the Kinnaura commur	Informing
Costa Rica is already considering how to respect Indigenous Peoples' right to autonomous ir	Citizen Control
Access and rights to use resources formalized: Throughout the 20th century, especially in the	Partnership
These traditions and their revival in the 21st Century has made the Pacific Island region a w	Informing
the government policy of devolving environmental stewardship to local control (Dale et al.,	Partnership
POLICY that includes, in general, but see figure 1: The basic principles included, five large grc	Partnership
Monetary incentives: Fishers in San Felipe and Golfo de Santa Clara received financial comp	Manipulation
The government of Ghana in the year 2000 introduced a policy for Collaborative Community	Partnership
Formal legal recognition: VEAs were formally recognized by Normative Instruction IBAMA N	Delegated Power
Ecological jobs as direct financial compensation: Local Tibetan households were offered pos	Informing

APPENDIX D – Supplementary information of Chapter 5

List of final selected papers in the literature review

In Brazil

Title	Author	Year	Publisher
Innovation Perspectives for the Bioeconomy of Non-Timber Forest Products in Brazil	Sandra Regina Afonso	2022	Forest
Business, biodiversity, and innovation in Brazil	Anna C. F. Aguiar, Fabio R. Scarano, Reinaldo L. Bozelli, Paulo D. Branco, Paula Ceotto, Vinicius F. Farjalla, Rafael Loyola, José Maria C. da Silva	2023	Perspectives in Ecology and Conservation
Bioeconomy in the Amazon: Lessons and gaps from thirty years of non-timber forest products research	Emmanoella Costa Guaraná Araujo, Thiago Cardoso Silva, Ernandes Macedo da Cunha Neto, José Augusto Spiazzi Favarin, Joana Keila da Silva Gomes, Kyvia Pontes Teixeira das Chagas, Elaine Cosma Fiorelli, Artur Falqueto Sonsin, Emanuel Maia	2024	Journal of Environmental Management
Potential of native palms from the Brazilian Amazon for bioeconomy: a network analysis of scientific and technological production	Antonio Jorge Barbosa da Silva, Elison de Souza Sevalho, Ires Paula de Andrade Miranda	2021	Ciência Florestal
Corporate Power in the Bioeconomy Transition: The Policies and Politics of Conservative Ecological Modernization in Brazil	Mairon G. Bastos Lima	2021	Sustainability
Just transition towards a bioeconomy: Four dimensions in Brazil, India and Indonesia	Mairon G. Bastos Lima	2022	Forest Policy and Economics
Bioeconomy and local value-chain development as a hedge against deforestation in Brazil's Cerrado	Mairon G. Bastos Lima	2024	Emerald Publishing
The Bioeconomy–Biodiversity Nexus: Enhancing or Undermining Nature's Contributions to People?	Mairon G. Bastos Lima and Ulrika Palme	2022	Conservation

Meeting Brazilian challenges for a bio-based economy: the case of alcohols and carboxylic acids	Melissa Braga et al.	2024	Biomass Conversion and Biorefinery
Bioeconomy in Brazil: Opportunities and Guidelines for Research and Public Policy for Regional Development	Sergio A. M. Carbonell, Luis Augusto Barbosa Cortez, Luis F. C. Madi, Lilian C. Anefalos, Ricardo Baldassin Junior, Rodrigo L. V. Leal	2021	Biofuels, Bioproducts and Biorefining
Opportunities of the Nagoya Protocol to Nurture the Use of Native Species in Brazil	Sônia Carvalho Ribeiro, Britaldo Soares Filho	2022	Environmental Science and Policy
Bioeconomic markets based on the use of native species in Brazil	Sônia Carvalho Ribeiro et al.	2024	Ecological Economics
Brazilian biorefineries from second-generation biomass: critical insights for sustainable bioeconomy	Ashok Pandey, Anuj Kumar Chandel, Edgard Gnansounou, Carlos Ricardo Soccol	2021	Renewable Energy
Challenges for a Brazilian Amazonian bioeconomy based on forest foods	Charles R. Clement, Henrique dos Santos Pereira, Ima Celia Guimarães Vieira, Alfredo Kingo Oyama Homma	2024	Trees, Forests and People
Biorefinery concepts in the transition to the bioeconomy: A Q-analysis from the Brazilian experts' perspectives	Conteratto, C., Artuzo, F.D., Benedetti Santos, O.I., Talamini, E.	2022	Biofuels, Bioproducts and Biorefining (Biofpr)
New Forms of Land Grabbing Due to the Bioeconomy: The Case of Brazil	Eva Cudlínová, Valny Giacomelli Sobrinho, Miloslav Lapka, Luca Salvati	2020	Sustainability
Bioeconomy and the Nagoya Protocol	Danielle Mendes Thame Denny	2022	Revista de Direito Internacional / Brazilian Journal of International Law
Bioeconomia no Brasil e no Mundo: Panorama Atual e Perspectivas	Rodnei Fagundes Dias, Carlos Alberto Aragão de Carvalho Filho	2017	Revista Virtual de Química
Brazilian Biodiversity as a Source of Power and Sustainable Development: A Neglected Opportunity	Joel Henrique Ellwanger, Carlos Afonso Nobre, José Artur Bogo Chies	2023	Sustainability
A lack of clarity on the bioeconomy concept might be harmful for Amazonian ecosystems and its people	Joice Ferreira, Emilie Coudel, Ricardo Abramovay, Jos Barlow, Rachael Garrett, Alexander C. Lees, Marie-Gabrielle Piketty, Roberto Porro, Ima Vieira, Kieran Daniel Withey	2024	Ecological Economics

Transformative changes are needed to support socio-bioeconomies for people and ecosystems in the Amazon.	Rachael Garrett, Joice Ferreira, Ricardo Abramovay, Joyce Brandão, Eduardo Brondizio, Ana Euler, Danny Pinedo, Roberto Porro, Emiliano Cabrera Rocha, Oscar Sampaio, Marianne Schmink, Bolier Torres, Mariana Varese.	2024	Nature Ecology & Evolution.
Indigenous Knowledge in the Amazon's Bioeconomy: Unveiling Bioepistemicide through the case of Kambo Medicine	Maria Fernanda Gebara, Sabaheta Ramcilovic-Suominen, Michael Franz Schmidlehner	2023	Forest Policy and Economics
Sugar-Cane Bioelectricity in Brazil: Reinforcing a Socio-Technical Regime or Supporting Energy Transition?	Susana Herrera e John Wilkinson	2021	Capítulo de livro no volume "Bioeconomy and Global Inequalities"
Bioeconomy and biofuels: the case of sugarcane ethanol in Brazil	Susan G. Karp, Jesus D. C. Medina, Luiz A. J. Letti, Adenise L. Woiciechowski, Júlio C. de Carvalho, Caroline C. Schmitt, Rafaela de Oliveira Penha, Gabriel S. Kumlehn, Carlos R. Soccol.	2021	Biofuels, Bioproducts and Biorefining
Bioeconomy: Different Countries, Different Strategies, Multiple Benefits	Pramod Khandekar e Prasanta Kumar Ghosh	2023	Asian Biotechnology and Development Review
Macrobioeconomia: PIB da bioeconomia (2010-2023)	Cícero Zanetti de Lima	2024	Observatório de Bioeconomia - FGV Agro
Herbal medicine promotion for a restorative bioeconomy in tropical forests: A reality check on the Brazilian Amazon	Klara Lindberg, Amanda Martvall, Mairon G. Bastos Lima, Caroline S.S. Franca	2023	Forest Policy and Economics
Brazilian Forest-Based Sector Perceptions and Contributions to the Sustainable Development Goals (SDGs)—Developing Strategies Using the Strategic Options Development and Analysis (SODA) Approach	Renata Aguayo Lopes da Silva, Leandro Duarte dos Santos, Renato Cesar Gonçalves Robert, Thomas Purfürst	2024	Forests
Biobased economy for Brazil: Impacts and strategies for maximizing socioeconomic benefits	P.G. Machado, M. Cunha, A. Walter, A. Faaij, J.J.M. Guilhoto	2021	Renewable and Sustainable Energy Reviews
Modeling and Analysis: GHG emissions in a Brazilian bioeconomy	P.G. Machado, M. Cunha, A. Walter, A. Faaij, J.J.M. Guilhoto	2020	Biofuels, Bioproducts and Biorefining

Forest Bioeconomy in Brazil: Potential Innovative Products from the Forest Sector	Yasmin Imparato Maximo, Mariana Hassegawa, Pieter Johannes Verkerk, André Luiz Missio	2022	Land
Separating the two faces of “bioeconomy”: Plantation economy and sociobiodiverse economy in Brazil	Ossi I. Ollinaho, Markus Kröger	2023	Forest Policy and Economics
Disputing the bioeconomy-biodiversity nexus in Brazil: Coalitions, discourses and policies	Guilherme de Queiroz-Stein, Fernanda S. Martinelli, Thomas Dietz, Karen M. Siegel	2024	Forest Policy and Economics
The Bioeconomy in Emerging Economies: A Study of the Critical Success Factors Based on Life Cycle Assessment and Delphi and Fuzzy-Delphi Methods	Izabela Simon Rampasso, Osvaldo L. G. Quelhas, Rosley Anholon, Diogo A. L. Silva, André Teixeira Pontes, Jocimar D A Miranda, Janice O. Dias	2021	The International Journal of Life Cycle Assessment
Bioeconomy based on non-timber forest products for development and forest conservation – untapped potential or false hope? A systematic review for the Brazilian Amazon	Tomas Rosenfeld, Benno Pokorny, Jacques Marcovitch, Peter Poschen	2024a	Forest Policy and Economics
Local Development Based on Non-Timber Forest Products: Evidence from a Mapping of Initiatives in the Brazilian Amazon since Rio 1992	Tomas Rosenfeld, Benno Pokorny, Jacques Marcovitch, Peter Poschen	2024b	Sustainability
Potencial de oleaginosas nativas no desenvolvimento de cadeias produtivas da biodiversidade brasileira	Oscar Zalla Sampaio Neto, Eduardo Augusto Caldas Batista, Antônio José de Almeida Meirelles	2020	Desenvolvimento e Meio Ambiente
From commodity-based value chains to biomass-based value webs: The case of sugarcane in Brazil’s bioeconomy	Lilli Scheiterle; Alina Ulmer; Regina Birner; Andreas Pyka	2018	Journal of Cleaner Production
Fostering Transitions Towards Sustainability? The Politics of Bioeconomy Development in Argentina, Uruguay, and Brazil	Karen M. Siegel; Melisa Deciancio; Daniel Kefeli; Guilherme de Queiroz-Stein; Thomas Dietz	2022	Bulletin of Latin American Research
The Potential Contribution of Natural Products from Brazilian Biodiversity to Bioeconomy	Marilia Valli; Helena M. Russo; Vanderlan S. Bolzani	2018	Anais da Academia Brasileira de Ciências
Beyond Sugar and Ethanol: The Future of Sugarcane Biorefineries in Brazil	L.P.S. Vandenberghe; K.K. Valladares-Diestra; G.A. Bittencourt; L.A. Zevallos Torres; S. Vieira; S.G. Karp;	2022	Renewable and Sustainable Energy Reviews

	E.B. Sydney; J.C. de Carvalho; V. Thomaz Soccol; C.R. Soccol		
Understanding the bioeconomy through its instruments: standardizing sustainability, neoliberalizing bioeconomies?	Thomas Vogelpohl	2023	Sustainability Science
Challenges Faced by the Chemical Industry in Strengthening the Bioeconomy in Brazil	Fernando Zanatta, Vinícius Eduardo Ferrari, Denise Helena Lombardo Ferreira	2024	Revista de Gestão Social e Ambiental
Bioeconomia no Brasil e no Mundo: Boletim Temático	Centro de Gestão e Estudos Estratégicos (CGEE)	2021	Centro de Gestão e Estudos Estratégicos (CGEE)
Amazonia Bioeconomy Country Profiles	Yves Lesenfants, Adam Veprinsky Mehl, Robert Muggah, Katherine Aguirre, Peter Smith	2024	Banco Interamericano de Desenvolvimento (IDB), Unidade de Coordenação da Amazônia
Alimentos e Bebidas da Amazônia: Oportunidades e Apelos Globais	Augusto Souto Pestana, Igor Isquierdo Celeste, João Ulisses Rabelo Pimenta, Gustavo Ferreira Ribeiro	2022	Agência Brasileira de Promoção de Exportações e Investimentos (ApexBrasil)
Bioeconomia e a Indústria Brasileira	Gonçalo Pereira	2020	Confederação Nacional da Indústria (CNI)
Bioeconomia – Oportunidades para Fomento da Agenda Climática e Desenvolvimento Socioeconômico	Vitor Paiva, Maria Rita Vilella	2023	Partnerships for Forests (P4F)
Bioeconomia da Restauração na Amazônia	Aurélio Padovezi, Fabiana Munhoz, Alexandre Goulart	2024	Aliança pela Restauração na Amazônia
Bioeconomia no Novo Governo Lula: Avanços Regulatórios e Institucionais	Cristina Leme Lopes, Ana Flávia Corleto, Joana Chiavari	2024	Amazônia 2030
A Bioeconomia Brasileira em Números	Martim Francisco de Oliveira e Silva, Felipe dos Santos Pereira, José Vitor Bomtempo Martins	2018	BNDES Setorial 47
Experiências Recentes da União Europeia e dos Estados Unidos em Bioeconomia e Oportunidades para o Brasil	Adriana Mesquita Corrêa Bueno, Danielle Alencar Parente Torres	2022	Revista Tempo do Mundo
Financiamento para a Bioeconomia no Brasil: Fontes e Destinação dos Recursos	Joana Chiavari, Miguel Motta, Cristina Leme Lopes, Ana Flávia Corleto	2024	Climate Policy Initiative

Bioeconomia da Sociobiodiversidade no Estado do Pará	Costa. F. A., Ciasca, B.S., Castro, E.C.C., Barreiros, R.M.M., Folhes, R.T., Bergamini, L.L., Solyno Sobrinho, S.A., Cruz, A., Costa, J. A., Simões, J., Almeida, J.S., Souza, H.M.	2021	The Nature Conservancy (TNC), Banco Interamericano de Desenvolvimento (BID) e Natura
BIOECONOMIA: Oportunidades para o Setor Agropecuário e para o Brasil	Danielle Alencar Parente Torres, Adriana Mesquita Corrêa Bueno, Áurea Fabiana Apolinário de Albuquerque Gerum, Bruno dos Santos Alves Figueiredo Brasil, Clenilson Martins Rodrigues, João Ricardo Moreira de Almeida, Gilmar Souza Santos, Marcelo do Amaral Santana, Patrícia Verardi Abdelnur, Richardson Silva Lima	2022	Embrapa
Estado do Financiamento para a Bioeconomia no Brasil: Estado Atual e Desafios	Marcos Aurélio Da-Ré; Janice Maciel; Gisele Garcia Alarcon; Vitor Guimarães	2021	Programa das Nações Unidas para o Desenvolvimento (PNUD) e a Fundação CERTI.
Bioeconomia e Infraestrutura na Amazônia: Análise do Estado da Arte e Estudo de Casos sobre Infraestrutura no Brasil	Monzoni, Mario, et al.	2022	Centro de Estudos em Sustentabilidade. Escola de Administração de Empresas de São Paulo. (FGVces)
Identificação das Oportunidades e o Potencial do Impacto da Bioeconomia para a Descarbonização do Brasil: Novos Cenários	ALVES, A. A. et al.	2024	ABBI
A Sociobiodiversidade no Contexto da Reforma Tributária	Márcio Fontes Hirata	2023	projeto Bioeconomia e Cadeias de Valor
Bioeconomy lessons from the local scale	Patricia F. Pinho; Joyce Brandão; Joice Nunes Ferreira; Rafael Moraes Chiaravalloti; Claudio Valladares-Padua; Rayna Benzeev	2024	One Earth
Potencial da Bioeconomia para o Desenvolvimento Sustentável da Amazônia e Possibilidades para a Atuação do BNDES	Pamplona, P. P.; Farinaci, J. S.; Nogueira, O. M.; Boff, S.; Vendemiatti, A.	2021	Banco Nacional de Desenvolvimento Econômico e Social (BNDES).
A global view of bio-based industries: benchmarking and monitoring their economic importance and future developments	Claudia Parisi & Tévécia Ronzon	2016	Joint Research Centre (JRC) - European Commission

Destravando a Agenda da Bioeconomia: Recursos Genéticos e Conhecimento Tradicional no Brasil	Kohlmann, G., et al.	2021	Instituto Escolhas
A sociobiodiversidade amazônica em busca de mercados internacionais	Ana Margarida Castro Euler, Catherine Aubertin e Nathalie Cialdella	2023	Estudos de Sociologia

In the Netherlands

Title	Author	Year	Publisher
Accelerating innovation for the Dutch bioeconomy transition: the case of biobased asphalt	Maged Elsamny, Alberto Gianoli	2023	Journal of Environmental Planning and Management
The Dutch Green Deals Policy and Its Applicability to Circular Economy Policies	Sven Kevin van Langen, Renato Passaro	2021	Sustainability
Circular Economy Implementation in Dutch Agriculture: Assessing Sustainable Practices and Economic Impact	Abraham Van de Vliert, Jochem Van Peij	2024	Paradigm Academic Press
Towards a Circular Economy: The Role of Dutch Logistics Industries and Governments	Nicole van Buren, Marjolein Demmers, Rob van der Heijden, Frank Witlox	2016	Sustainability
Transition Governance towards a Bioeconomy: A Comparison of Finland and The Netherlands	Rick Bosman, Jan Rotmans	2016	Sustainability
The Dutch Green Deals Policy and Its Applicability to Circular Economy Policies	Sven Kevin van Langen, Renato Passaro	2021	Sustainability
The transformative potential of circular agriculture initiatives in the North of the Netherlands	A.G. Hoogstra, J. Silvius, E.M. de Olde, J.J.L. Candel, C.J.A.M. Termeer, M.K. van Ittersum, I.J.M. de Boer	2024	Agricultural Systems
More than peanuts: Transformation towards a circular economy through a small-wins governance framework	C.J.A.M. Termeer, T.A.P. Metze	2019	Journal of Cleaner Production
Strategic Biomass Vision for the Netherlands towards 2030	Ministry of Economic Affairs	2016	Ministry of Economic Affairs

Hearing, listening, and learning: how bioeconomy triple helix clusters deal with uninvited societal input	Jan R. Starke, Tamara A. P. Metze, Jeroen J. L. Candel, Katrien J. A. M. Termeer	2024	Sustainability Science
What does it take to close the loop? Lessons from a successful citrus waste valorisation business	Madhura Rao, Lea Bilic, Aalt Bast, Alie de Boer	2024	British Food Journal
Assessing the contribution of bioeconomy to the total economy: A review of national frameworks	Bracco, Stefania, Ozgul Calicioglu, Marta Gomez San Juan, and Alessandro Flammini	2018	Sustainability
Getting the ball rolling: an exploration of the drivers and barriers towards the implementation of bottom-up circular economy initiatives in Amsterdam and Rotterdam	Max Russell, Alberto. Gianoli, Stelios. Grafakos	2019	Journal of Environmental Planning and Management
Circular economy: The silver bullet for emissions?	Khalid Khan, Chi Wei Su, Adnan Khurshid	2022	Journal of Cleaner Production
Measuring the circular economy in Europe: Big differences among countries, great opportunities to converge	Gloria Claudio-Quiroga, Carlos Poza	2023	Sustainable Development
Towards a framework for corporate disclosure of circular economy: Company perspectives and recommendations	Katelin Opferkuch, Anna M. Walker, Erik Roos Lindgreen, Sandra Caeiro, Roberta Salomone, Tomás B. Ramos	2023	Corporate Social Responsibility and Environmental Management
Environmental awareness and sustainable behavior of respondents in Germany, the Netherlands and Poland: A qualitative focus group study	Diana D. Boermans, Agnieszka Jagoda, David Lemiski, Jana Wegener, Malgorzata Krzywonos	2024	Journal of Environmental Management
Consumer perception of bio-based products—An exploratory study in 5 European countries	Siet J. Sijtsema, Marleen C. Onwezen, Machiel J. Reinders, Hans Dagevos, Asta Partanen, Marieke Meeusen	2016	NJAS - Wageningen Journal of Life Sciences
Assessing the social sustainability of circular economy practices: Industry perspectives from Italy and the Netherlands	Anna M. Walker, Katelin Opferkuch, Erik Roos Lindgreen, Alberto Simboli, Walter J.V. Vermeulen, Andrea Raggi	2021	Sustainable Production and Consumption
A comparative analysis of the circular economy performances for European Union countries	Ewa Mazur-Wierzbicka	2021	Resources

Monitoring van circulariteitsstrategieën: Uitgangspunten voor toepassing bij het PBL	Maikel Kishna, Anne Gerdien Prins	2024	PBL Planbureau voor de Leefomgeving
Integral Circular Economy Report 2021: Assessment for the Netherlands	Aldert Hanemaaijer, Maikel Kishna	2021	PBL Netherlands Environmental Assessment Agency
Circular economy: Measuring innovation in the product chain	José Potting, Marko Hekkert, Ernst Worrell, Aldert Hanemaaijer	2017	PBL Netherlands Environmental Assessment Agency
Opportunities for a circular economy in the Netherlands	Ton Bastein, Elsbeth Roelofs, Elmer Rietveld, Alwin Hoogendoorn	2013	The Netherlands Organisation for Applied Scientific Research (TNO)
The biobased economy and the bioeconomy in the Netherlands	J.W.A. Langeveld, K.P.H. Meesters, M.S. Breure	2016	Biomass Research
Circular economy: advancement of European Union countries	Ewa Mazur-Wierzbicka	2021	Environmental Sciences Europe
Breaking the Barriers to the Circular Economy	Julian Kirchherr, Marko Hekkert, Ruben Bour, Anne Huibrechtse-Truijens, Erica Kostense-Smit, Jennifer Muller	2017	Utrecht University
Characterizing Circular Agriculture Initiatives in the North of the Netherlands through a Small Wins Perspective	A. G. Hoogstraal, J. Silvius, E.M. de Olde, J.J.L. Candel, C.J.A.M. Termeer, I.J.M de Boer	2022	Wageningen University & Research
Circulaire Atlas Noord-Brabant	Jan Bart Jutte, Iris Pronk, Guido Israels, Kelly Hartholt	2020	Royal HaskoningDHV
A typology of circular start-ups: An Analysis of 128 circular business models	Marvin Henry, Thomas Bauwens, Marko Hekkert, Julian Kirchherr	2020	Journal of Cleaner Production
Integral Circular Economy Report 2021: Assessment for the Netherlands	Aldert Hanemaaijer, Maikel Kishna	2023	PBL Netherlands Environmental Assessment Agency
External implications of the circular economy transition of the Netherlands and the EU	Nadia Ashraf, Daniel Adeniyi and Jeske van Seters	2024	ECDPM
From pea soup to water factories: wastewater paradigms in India and the Netherlands	Sumit Vij, Eddy Moors, Katarzyna Kujawa-Roeleveld, Ralph E.F. Lindeboom, Tanya Singh, Merle K. de Kreuk	2021	Environmental Science and Policy
Building a Circular Future	Jacqueline Cramer	2022	Vormgeving Counter Creatives

How Network Governance Powers the Circular Economy	Jacqueline Cramer	2020	Vormgeving Counter Creatives
The Function of Transition Brokers in the Regional Governance of Implementing Circular Economy—A Comparative Case Study of Six Dutch Regions	Jacqueline Cramer	2020	Sustainability
Transition to Circular Economy in Practice Through Network Governance in Conjunction with Public Governance; Comparative Longitudinal Action Research on Mattresses, Concrete, and Textile in The Netherlands	Jacqueline Cramer	2023	Advances in Environmental and Engineering Research
City level circular transitions: Barriers and limits in Amsterdam, Utrecht and The Hague	Kieran Campbell-Johnston, Joey ten Cate, Maja Elfering-Petrovic, Joyeeta Gupta	2019	Journal of Cleaner Production
Transition to a Regional Circular Society: The case of Haarlemmermeer	Sybren Bosch	2015	Utrecht University
Biobased economy: State-of-the-art assessment	Peter Nowicki, Martin Banse, Christiaan Bolck, Harriëtte Bos, Elinor Scott	2008	Agricultural Economics Research Institute
Worldwide Research on Circular Economy and Environment: A Bibliometric Analysis	Ruiz-Real, José Luis, Juan Uribe-Toril, Jaime De Pablo Valenciano, and Juan Carlos Gázquez-Abad	2018	Environmental Research and Public Health
The Energy & Raw Materials Factory: Role and Potential Contribution to the Circular Economy of the Netherlands	Kees van Leeuwen, Eli de Vries, Stef Koop, Kees Roest	2018	Environmental Management
Sustainable biofuel economy: A mapping through bibliometric research	Morshadul Hasan, Mohammad Zoynul Abedin, Mohamamd Bin Ami, Md. Nekmahmud, Judit Oláh	2023	Journal of Environmental Management
‘Small stories of closing loops’: social circularity and the everyday circular economy	Kersty Hobson	2020	Climatic Change
Environmental concerns in political bioeconomy discourses	D. Kleinschmit, B. Artsb, A. Giurca, I. Mustalahti, A. Sergeant, H. Pülzl	2017	International Forestry Review
Biobased economy – Exploring the opportunities for the Netherlands	Christien Enzing, Annelieke van der Giessen	2008	TNO Quality of Life

Constructing the Public in Roadmapping the Transition to a Bioeconomy: A Case Study from the Netherlands	Lynch, Durwin H.J., Pim Klaassen, Lan van Wassenae, and Jacqueline E.W. Broerse	2020	Sustainability
Understanding Consumer Perspectives of Bio-Based Products—A Comparative Case Study from Ireland and The Netherlands	Gaffey, James, Helena McMahon, Emily Marsh, Kaisa Vehmas, Tiina Kymäläinen, and John Vos	2021	Sustainability
The Contribution of the Bioeconomy to Sustainable Development	Justus Wesseler, Mengshuai Zhu	2024	Engineering
A global and comparative assessment of the level of economic circularity in the EU	María Magdalena Martínez Moreno, Eva M Buitrago Esquinas, Rocío Yñiguez, Miguel Puig-Cabrera	2023	Journal of Cleaner Production
Renewal of forest-based manufacturing towards a sustainable circular bioeconomy	Riina Antikainen, Carl Dalhammar, Mikael Hildén, Jáchym Judl, Tiina Jääskeläinen, Petrus Kautto, Sirkka Koskela, Mika Kuisma, David Lazarevic, Ilmo Mäenpää, Jukka-Pekka Ovaska, Philip Peck, Håkan Rodhe, Armi Temmes, Åke Thidell	2017	Finnish Environment Institute
What Is the Relation between Circular Economy and Sustainability? Answers from Frontrunner Companies Engaged with Circular Economy Practices	Anna M. Walker, Katelin Opferkuch, Erik Roos Lindgreen, Andrea Raggi, Alberto Simboli, Walter J.V. Vermeulen, Sandra Caeiro & Roberta Salomone	2021	Circular Economy and Sustainability
From Circular Economy to Circular Society: Analyzing Circularity Discourses and Policies and Their Sustainability Implications	Martin Calisto Friant	2022	Utrecht University
The Impact of Managers and Network Interactions on the Integration of Circularity in Business Strategy	Manon Eikelenboom, Gjalt de Jong	2022	Organization & Environment
Transition to a Sustainable Circular Plastics Economy in The Netherlands: Discourse and Policy Analysis	Calisto Friant, Martin, Dirkjan Lakerveld, Walter J. V. Vermeulen, and Roberta Salomone	2022	Sustainability
Are technology innovation and circular economy remedy for emissions? Evidence from the Netherlands	Khalid Khan, Adnan Khurshid	2024	Environment, Development and Sustainability

A transition in the Dutch wastewater system? The struggle between discourses and with lock-ins	Kasper Ampe, Erik Paredis, Lotte Asveld, Patricia Osseweijer, Thomas Block	2020	Journal of Environmental Policy and Planning
How and when do purchasers successfully contribute to the implementation of circular purchasing: A comparative case-study	Petra C.M. Neessen, Marjolein C.J. Caniëls, Bart Vos, Jeroen P. de Jong	2021	Journal of Purchasing and Supply Management
A circular economy in the Netherlands		2016	The Ministry of Infrastructure and the Environment and the Ministry of Economic Affairs, also on behalf of the Ministry of Foreign Affairs and the Ministry of the Interior and Kingdom Relations
Biobased en Groene Chemie Provincie Noord-Brabant	Veerle Bastiaanssen, Erwin Karsten, Erika van der Linden, Jasper van Dijk, Geert van der Veen	2021	Technopolis Group
Biobased economy: an in-depth overview of the biobased sector in Brabant	Peije Bruil, Paul Kleijne, Henry de Vaan	2022	Brabant Development Agency (BOM),
Analyse biobased-ecosysteem in Noord-Brabant	Kees Joosten, Lotte Bernards, Eva Loopik	2022	Bax & Company
People at the heart of circularity: A mixed methods study about trade-offs, synergies, and strategies related to circular and social organizing	Katinka J.P. Quintelier, Koen van Bommel, Amba Maria van Erkelens, Johan Wempe	2023	Journal of Cleaner Production
Energizing a transformation to a circular bioeconomy: mechanisms to spread, deepen and broaden initiatives	O. M. Schagen, T. A. P. Metze, E. M. de Olde, C. J. A. M. Termeer	2022	Sustainability Science
Briefing: Governments as drivers for a circular economy	Arthur ten Wolde	2016	Proceedings of the Institution of Civil Engineers - Waste and Resource Management
Identifying practices of inclusive biobased value chains: Lessons from corn stover in Iowa, sugar cane in Jamaica, and sugar beet in the Netherlands	Zoë Robaey, Lotte Asveld, Kinsuk M. Sinha, Emiel Wubben, Patricia Osseweijer	2022	Cleaner and Circular Bioeconomy

Power struggles in policy feedback processes: incremental steps towards a circular economy within Dutch wastewater policy	Kasper Ampe, Erik Paredis, Lotte Asveld, Patricia Osseweijer, Thomas Block	2021	Policy Sciences
Lost in Transition? Market Failure in the Implementation of the Circular Economy. A Comparative Analysis of the Netherlands and Poland	Jagoda Adamus, Jacek Chądzyński, Justyna Trippner-Hrabi	2024	Comparative Economic Research. Central and Eastern Europe
Building innovation ecosystems for circularity: start-up business models in the food and construction sectors in the Netherlands	Thomas Bauwensa, Kris Hartleyb, Marko Hekkerta, Julian Kirchherr	2024	Journal of Cleaner Production
Regime-Niche' Actors as Catalysts in the Transition to a Circular Economy	Rachel Greer	2023	Routledge
Inter-connected challenges: an overview of bioeconomy in Europe	Piergiuseppe Morone, Idiano D'Adamo and Mattia Cianfroni	2022	Environmental Research Letters

List of interviewees and list of questions from the semi-structured questionnaire in the Dutch and Brazilian cases

List of interviewees

Interviewee	Sector	Code
The Netherlands		
Representative from Avans University of Applied Science	Academia	NL01
Representative from Wageningen University & Research	Academia	NL02
Representative from Cosun	Cooperative	NL03
Representative from Midpoint Brabant	Regional economic development organization	NL04

Representative from Gemeente Breda	Local government	NL05
Representative from Waterschap De Dommel	Regional government	NL06
Representative from Rewin	Regional economic development organization	NL07
Representative from Kleine Aarde in Boxtel	Non-profit foundation	NL08
Representative from Natural Plastics Int	Company	NL09
Representative from Peel Pioneers	Company	NL10
Brazil		
Representative from Instituto Peabirú	Non-profit foundation	BR01
Representative from Ministry of Environment	Federal Government	BR02
Representative from Cooperativa Grande Sertão	Cooperative	BR03
Representative from 100% Amazônia	Company	BR04
Representative from Universidade Federal do Amazonas	Academia	BR05
Representative from Núcleo do Pequi	Non-profit foundation	BR06
Representative from Ministry of Integration and Regional Development	Federal Government	BR07
Representative from University of São Paulo	Academia	BR08
Representative from Cooperuaçu	Cooperative	BR09
Representative from Peabiru Produtos da Floresta	Company	BR10
Representative from CooperRiachão	Cooperative	BR11
Representative from Assusbac	Cooperative	BR12

List of questions from the semi-structured questionnaire in the Dutch and Brazilian cases

In the Dutch case

Introduction (about the organization and the interviewer)

Could you tell me about your organization and what it does?

What is your role within it?

What do you understand by “bioeconomy” and “circular economy”?

Motivation and context

What led your organization to work with the bioeconomy or circular economy?

What are the main opportunities and challenges for the sector today?

What are the main barriers to implementing the circular or bioeconomy? How did your organization deal with them?

What incentives exist to encourage conventional practices to shift toward circular economy?

External influences

Which policies, laws, or societal changes have the greatest impact on your work?

How does circular bioeconomy policy interact with other agendas (bioeconomy, green growth, waste management, climate change, etc)?

Are there environmental or sustainability goals that influence your decisions?

Actors and partnerships

Who are your main partners (companies, government, universities, NGOs)?

How does collaboration between these different actors happen?

What is the role of government in implementing circular or bio-based economy strategies?

Who are the key investors? What strategies were used to attract them?

Innovations and practices

Can you give examples of innovative solutions, products, or processes you have developed?

What helped or hindered bringing these innovations to market?

How do bio-based products enter the market and what challenges arise?

Social and environmental impact

Are there social or economic values associated with bio-based or circular products?

Do you use environmental labels or certifications or other ways to show that your product is sustainable?

Learning and perspectives

What advice would you give to someone starting a similar enterprise?

What other successful examples do you know of circular or bio-based companies?

What lessons could be useful for other regions or countries?

What could the Netherlands learn from experiences in other contexts, such as Brazil?

In the Brazilian case

Introduction (about the organization and the interviewer)

Could you tell me about your organization and what it does?

What is your role within it?

What do you understand by “bioeconomy” and “sociobiodiversity”?

Motivation and context

What led your organization to work with sociobiodiversity products?

What are the main opportunities and challenges for the sector today?

What are the main barriers to implementing the bioeconomy? How did your organization deal with them?

What incentives exist to encourage conventional practices to shift toward more sustainable practices?

External influences

Which policies, laws, or societal changes have the greatest impact on your work?

How does bioeconomy policy interact with other agendas (waste management, climate change, etc)?

Have there been recent changes in public policies or in how biodiversity products are valued?

Actors and partnerships

Who are your main partners (companies, government, universities, NGOs)?

How does collaboration between these different actors happen?

What is the role of government in implementing sociobiodiversity bioeconomy strategies?

Do the government, companies, or other institutions support your work? In what ways (policies, projects, technical assistance, funding)?

What are the main difficulties or barriers you face in developing your work?

Do public agencies, companies, universities, and associations work well together? Could you give an example?

Do you participate in councils, meetings, or forums where decisions are made? Do they work well?

How can small producers, traditional peoples, or communities take part in decision-making about this type of policy or project?

Innovations and practices

What are the main species collected? What kind of products do you produce (derive) from these species?

In your daily work, how do you carry out activities such as collection, planting, processing, and sales?

What techniques or knowledge do you use for managing, producing, or processing natural products?

What kind of technical support or training have you received?

Where do you sell your products?

How is your product received in the market? What difficulties do you face in selling it?

How did the idea of working with a specific product or practice come about?

Were these skills learned from other people, organizations, or developed by you?

What helped or hindered bringing these innovations to market?

Social and environmental impact

Do consumers value the origin or sustainability of your products?

What social, cultural, or environmental values do you see in your work?

Do you use environmental labels or certifications or other ways to show that your product is sustainable?

Learning and perspectives

How do you imagine the future of your work in your region?

What changes would be needed for your work to grow and improve?

Bioeconomy-related policies in Brazil and in the Netherlands

In Brazil

ID	Legal / Policy Instrument	Objective	Link to bioeconomy	Responsible Government Body	Governance instance
1	National Bioeconomy Strategy (Decree No. 12,044/2024)	Adding value to products, processes, and services; strengthening the competitiveness of national bio-based production; promoting innovation and scientific knowledge; and proposing financial and economic instruments to foster development, among other actions.	It defines guidelines to integrate biodiversity, innovation, and sustainability into economic development	Ministry of Development, Industry, Trade and Services (MDIC), Ministry of the Environment and Climate Change (MMA), and Ministry of Finance (MF)	National Bioeconomy Commission
2	National Energy Transition Policy – PNTE (Resolution No. 5/2024 of the National Council for Energy Policy – CNPE)	To transform Brazil's energy matrix into a more sustainable economy that is less dependent on fossil fuels.	It promotes the use of renewable sources derived from biomass and encourages biofuels	Ministry of Mines and Energy (MEE)	National Council for Energy Policy (CNPE)

3	New Industry Brazil Program	To boost Brazilian industry by increasing its competitiveness and innovation, directing investments toward agribusiness, health, urban infrastructure, information technology, the bioeconomy, and defense.	It promotes the bioeconomy as a driver of sustainable reindustrialization and green innovation.	Ministry of Development, Industry, Trade and Services (MDIC)	National Council for Industrial Development (CNDI)
4	Ecological Transformation Plan	To promote a shift in economic, technological, and cultural paradigms in favor of development based on sustainable relations with nature and its biomes, enabling the generation of wealth and its fair and shared distribution, while improving the quality of life of present and future generations	It guides the Brazilian economy toward sustainable and bioeconomy-based models.	Ministry of Finance (MF)	
5	Pact for Ecological Transformation (Decree No. 12,223/2024)	A commitment among the Executive, Legislative, and Judiciary branches to act in a harmonious and integrated manner to promote ecological transformation through legislative, administrative, and judicial measures.	It fosters cross-sectoral commitments for the ecological transition, including bioeconomic value chains	The Three Branches of the Brazilian State (Executive, Legislative, and Judiciary)	Interinstitutional Management Committee
6	National Solid Waste Policy (Law No. 12,305/2010)	To promote integrated management and sustainable handling of solid waste, with reduction, reuse, recycling, and shared responsibility.	It encourages the circular economy and the use of organic waste as input for bioproducts.	Ministry of the Environment and Climate Change (MMA)	Interministerial Policy Committee
7	National Environmental Policy (Law No. 6,938/1981)	To preserve, improve, and restore environmental quality in order to ensure sustainable development and quality of life.	It establishes the foundations of environmental conservation, an essential basis for the sustainable use of biological resources in the bioeconomy	Ministry of the Environment and Climate Change (MMA)	National Environmental Council (CONAMA)
8	National Water Resources Policy (Law No. 9,433/1997)	To ensure the sustainable and integrated use of water resources, giving priority to human consumption and animal watering, while guaranteeing the availability of water in adequate quality and quantity	It ensures sustainable access to water, an essential input for agro-industrial bioeconomy value chains.	National Water and Basic Sanitation Agency (ANA)	National Water Resources Council (CNRH)
9	“National Environmental Education Policy (Law No. 9,795/1999)	To promote environmental education as a continuous and integrated practice at all levels of education and within society, aiming at	It fosters awareness of the sustainable use of biodiversity, facilitating the	Ministry of Education (MEC) and Ministry of the	Managing Body of the National Environmental

		building citizenship oriented toward sustainability.	social acceptance of bioeconomic practices.	Environment and Climate Change (MMA)	Education Policy (PNEA)
10	National System of Protected Areas – SNUC (Law No. 9,985/2000)	To ensure the conservation of biodiversity through the creation and management of Protected Areas, guaranteeing the protection of natural ecosystems and the sustainable use of their resources.	It protects areas of importance for biodiversity, which can generate environmental products and services linked to the bioeconomy	Ministry of the Environment and Climate Change (MMA) / Chico Mendes Institute for Biodiversity Conservation (ICMBio)	
11	Green Seal Brazil Program (Decree No. 12,063/2024)	To standardize and certify products and services of sustainable origin, ensuring the competitiveness and market access of Brazilian products in the international market.	It certifies products based on socio-environmental criteria, adding value to bioeconomic value chains.	Ministry of Development, Industry, Trade and Services (MDIC) / Brazilian Association of Technical Standards (ABNT)	
12	Amazon Seal Program (Decree No. 12,285/2024)	To certify industrialized products and services demonstrably produced in the Legal Amazon, using raw materials and inputs from the Amazon biome's biodiversity, in compliance with environmental, economic, and social sustainability requirements.	It values the region's biological and cultural assets, boosting markets for sociobiodiversity products — one of the central pillars of the Amazonian bioeconomy.	Ministry of Development, Industry, Trade and Services (MDIC) / Brazilian Association of Technical Standards (ABNT)	
13	National Intellectual Property Strategy (Decree No. 10,886/2021)	To encourage creativity, investment in innovation, and access to knowledge, with a view to increasing competitiveness and fostering Brazil's economic and social development	It strengthens the intellectual property system, which is important for adding value to bioeconomic innovations.	Secretariat for Competitiveness and Regulatory Policy of the Ministry of Development, Industry, Trade and Services (SCPR/MDIC)	Interministerial Group on Intellectual Property (GIPI)
14	National Circular Economy Strategy (Decree No. 12,082/2024)	To promote the economic transition from the current linear model to the logic of a circular economy.	It fosters the reuse of resources and waste in bioeconomic value chains.	Ministry of Development, Industry, Trade and Services (MDIC)	Nacional Forum on Circular Economy
15	Science, Technology and Innovation Law (Law No. 13,243/2016)	To encourage innovation and scientific and technological research in the productive sector, aiming at technological capacity-building, the achievement of technological autonomy, and the development of the	It facilitates partnerships and research in sustainable technologies and bioinnovation.	Ministry of Science, Technology and Innovation (MCTI)	

		country's national and regional productive system.			
16	National Innovation Policy (Decree No. 10,534/2020)	To stimulate increased productivity and competitiveness of companies and other institutions that generate innovation in the country.	It establishes guidelines for innovation in strategic sectors such as the bioeconomy.	Ministry of Science, Technology and Innovation (MCTI)	Innovation Chamber
17	Science, Technology and Innovation Action Plan for the Bioeconomy (PACTI Bioeconomy)	To produce and apply scientific and technological knowledge, fostering innovation and providing conditions for the strategic inclusion of the Brazilian bioeconomy in the global arena.	It coordinates research, innovation, and development actions in bioeconomy.	Ministry of Science, Technology and Innovation (MCTI)	Center for Strategic Studies and Management (CGEE) / General Coordination of Science for Bioeconomy (CGBE)."
18	Biodiversity Law (Law No. 13,123/2015) and Decree No. 8,772/2016	To regulate research and the development of products derived from Brazilian biodiversity, as well as to define criteria for the sharing of the benefits generated.	It regulates access to genetic resources and benefit-sharing, one of the pillars of the sociobiodiversity-based bioeconomy.	Ministry of the Environment and Climate Change (MMA)	Genetic Heritage Management Council (CGEN)
19	National Biofuels Policy – RenovaBio (Law No. 13,576/2017)	To expand the production and use of biofuels in the Brazilian energy matrix.	It promotes the use of biofuels as a sustainable alternative to petroleum.	Ministry of Mines and Energy (MME)	RenovaBio Committee
20	Social Biofuel Seal (Decree No. 10,527/2020)	To promote the participation of family farming in biodiesel production and to encourage social sustainability.	It values biofuels produced with the inclusion of family farming.	Ministry of Mines and Energy (MME) and Ministry of Agrarian Development and Family Farming (MDA)	
21	Plant Variety Protection Law (Law No. 9,456/1997)	To strengthen and standardize the intellectual property rights of plant breeders over their new varieties.	It protects innovations in cultivated plants, which are fundamental for bioeconomic agriculture.	Ministry of Agriculture and Livestock (MAPA)	
22	Biosafety Law (Law No. 11,105/2005)	To regulate all aspects related to the development and adoption of Genetically Modified Organisms (GMOs) in the country, including contained research, field testing,	It regulates the use of genetically modified organisms, which are essential for biotechnological innovation in the bioeconomy.	Ministry of Science, Technology and Innovation (MCTI)	National Biosafety Council – CNBS and National

		transport, import, export, production, and storage.			Technical Biosafety Commission – CTNBio
23	National Bioinputs Program (Decree No. 10,375/2020)	To harness the potential of Brazilian biodiversity for the production of bio-based agricultural inputs, reducing dependence on imported inputs and expanding the supply of raw materials for the sector.	It encourages the production and use of bioinputs, reducing dependence on chemical products and promoting sustainable practices.	Ministry of Agriculture and Livestock (MAPA)	Strategic Council of the National Bioinputs Program
24	Forest Code (Law No. 12,651/2012)	The main public policy instrument for protecting native vegetation on private lands, it aims to preserve Brazil's native vegetation, regulate forest exploitation, and prevent fires.	It regulates the sustainable use of native vegetation, which is fundamental for extractive value chains and agroforestry systems within the bioeconomy.	Brazilian Forest Service (SFB) and Ministry of the Environment and Climate Change (MMA)	
25	National Policy for Environmental Regularization of Rural Properties – RegularizaAgro (Decree No. 11,015/2022)	It aims to environmentally regularize rural properties in order to comply with the Forest Code.	It facilitates environmental regularization and encourages sustainable production practices in rural areas.	Ministry of Agriculture and Livestock (MAPA)	Managing Committee of RegularizaAgro
26	National Policy on Genetic Resources for Food, Agriculture, and Livestock – RGen+Sustainable (Decree No. 12,097/2024)	It proposes strategies and projects that will contribute to agricultural and forestry innovation, developing actions for the conservation and efficient use of genetic resources in order to promote food, energy, and climate security.	It promotes the conservation and sustainable use of genetic resources, which are fundamental for the agricultural bioeconomy.	Ministry of Agriculture and Livestock (MAPA), Ministry of Agrarian Development and Family Farming (MDA), and Ministry of the Environment and Climate Change (MMA)	Managing Committee of the Policy
27	Priority Bioeconomy Program of the Manaus Free Trade Zone – PPBio (Law No. 13,674/2018)	To attract resources from mandatory R&D investments (Informatics Law) for the creation of new products, services, and businesses for the Amazon Bioeconomy.	It fosters innovation and sustainable value chains in the Amazon, integrating conservation and development.	Brazil's Ministry of Development, Industry, Commerce and Services (MDIC) / Superintendence of the	Institute for the Conservation and Sustainable Development of the Amazon (IDESAM)

				Manaus Free Trade Zone (SUFRAMA)	
28	Startups Law (Complementary Law No. 182/2021)	To facilitate business opportunities for small companies and their contracting by public administration, while also reducing bureaucracy and increasing legal certainty for entrepreneurs and the investors behind these businesses.	It creates a favorable environment for innovation, including bioeconomic technological solutions.	Ministry of Science, Technology and Innovation (MCTI)	
29	Good Law (Law No. 11,196/2005)	Considered the main instrument for fostering R&D&I activities in Brazilian companies, it offers them the possibility of using certain tax incentives, covering all sectors of the economy and regions of the country.	It grants tax incentives to companies that invest in research and innovation, including in the bioeconomy	Ministry of Science, Technology and Innovation (MCTI)	
30	Brazilian Sustainable Taxonomy	To mobilize and redirect capital flows toward the investments needed to address the climate crisis. It consists of a classification system that clearly, objectively, and scientifically defines activities, assets, and/or categories of projects that contribute to climate, environmental, and/or social objectives through specific criteria	It aims to classify sustainable economic activities, including sectors of the bioeconomy.	Ministry of Finance (MF)	Interministerial Committee
31	Program for External Private Capital Mobilization and Exchange Rate Protection – EcoInvest Brazil (Law No. 14,995/2024)	To boost green foreign investments in the country, enabling capital market operations for companies and investors based in Brazil to raise funds abroad.	It supports green investments and the raising of international funds for sustainable activities.	Ministry of Finance (MF) and Ministry of the Environment and Climate Change (MMA)	Executive Committee of the Program
32	Believe in the First Step Program (Law No. 14,995/2024)	To create opportunities for productive inclusion, income generation through work, improved quality of life, and social participation for families in situations of socioeconomic vulnerability. It focuses on territories with high socioeconomic vulnerability and prioritizes actions directed at	It supports micro and small entrepreneurs, including businesses linked to the community bioeconomy.	Ministry of Social Development, Family, and Fight Against Hunger (MDS)	

		persons with disabilities, women, youth, Black populations, and members of traditional and riverine communities.			
33	National Policy for Crop-Livestock-Forest Integration (Law No. 12,805/2013)	To improve the productivity, quality, and income of agriculture and livestock in a sustainable way, as well as to promote the recovery of degraded pasture areas by integrating different production systems within the same property.	It promotes integrated and sustainable production systems, aligned with the bioeconomy.	Ministry of Agriculture and Livestock (MAPA)	
34	Agricultural Policy for Planted Forests – PAFF (Decree No. 8,375/2014)	To increase the productivity and sustainable use of cultivated forests, reduce pressure on native forests, improve rural income, and promote integration between producers and the timber agroindustry.	It fosters the sustainable use of planted forests, contributing to bioeconomic value chains.	Ministry of Agriculture and Livestock (MAPA)	
35	Public Forest Management Law (Law No. 11,284/2006)	It allows granting Legal Entities, including companies, cooperatives, and associations of local communities, permission to carry out sustainable forest management to extract timber and non-timber products and to provide tourism services.	It allows sustainable forest concessions that integrate production and conservation, forming the basis of the forest bioeconomy.	Brazilian Forest Service (SFB)	
36	National Policy for the Recovery of Native Vegetation – Proveg (Decree No. 8,872/2017)	To restore Brazil's native vegetation (12 million hectares by 2030), promoting the environmental regularization of rural properties.	It promotes ecological restoration, creating opportunities for productive uses of native species and bioactive compounds.	Ministry of Finance, Ministry of the Environment and Climate Change (MMA), Ministry of Agriculture and Livestock (MAPA), and Ministry of Education (ME)	National Commission for the Recovery of Native Vegetation (Conaveg)
37	National Policy for Territorial and Environmental Management of Indigenous Lands – PNGATI (Decree No. 7,747/2012)	To ensure and promote the protection, restoration, conservation, and sustainable use of natural resources in Indigenous lands and territories.	It values traditional environmental management practices, which are essential for the sociobiodiversity bioeconomy.	Ministry of Indigenous Peoples (MPI) and Ministry of the Environment and Climate Change (MMA)	Managing Committee of PNGATI

38	National Policy for Quilombola Territorial and Environmental Management (Decree No. 11,786/2023)	To support the territorial and environmental management practices developed by Quilombola communities in their territories.	It strengthens territorial management, traditional knowledge, and sustainable productive activities developed by Quilombola communities.	Ministry of Racial Equality	Managing Committee of the Policy
39	National Policy for the Sustainable Development of Traditional Peoples and Communities – PNPCT (Decree No. 6,040/2007)	To promote the sustainable development of Traditional Peoples and Communities, ensuring their rights and valuing their identity, organization, and culture.	To foster the sustainable development of Traditional Peoples and Communities, while safeguarding their rights and enhancing the value of their identity, social organization, and culture.	Ministry of the Environment and Climate Change (MMA)	National Commission for the Sustainable Development of Traditional Peoples and Communities - CNPCT
40	National Policy for the Sustainable Development of Aquaculture and Fisheries (Law No. 11,959/2009)	To promote the sustainable development of fisheries and aquaculture, reconciling income and food generation with environmental conservation.	It stimulates sustainable fisheries and aquaculture value chains.	Ministry of Fisheries and Aquaculture	National Council for Aquaculture and Fisheries (CONAPE)
41	Minimum Price Guarantee Policy for Sociobiodiversity Products – PGPM-Bio (Interministerial Ordinance MAPA/ME No. 25/2021)	To support extractivists and traditional communities through direct subsidies when market prices fall below the minimum levels set by the federal government.	It guarantees minimum prices for extractivist products, fostering bioeconomy value chains.	National Supply Company (Conab) / Ministry of Agrarian Development and Family Farming (MDA)	
42	Food Acquisition Program – PAA (Law No. 10,696/2003)	To promote access to food and encourage family farming through the institutional purchase of food produced by family farmers, traditional peoples, and communities, with exemption from public bidding.	It strengthens sustainable value chains based on local biodiversity, promotes the valorization of sociobiodiversity products, and encourages agroecological and extractivist practices, contributing to an inclusive, community-based bioeconomy.	Ministry of Social Development, Family, and Fight Against Hunger	Program Managing Group
43	National School Feeding Program (PNAE)	To ensure school meals and food and nutrition education actions for students in public basic education, with at least 30% of the resources	It stimulates sustainable local markets and values foods produced in agroecological, traditional, and	National Education Development Fund (FNDE)	School Feeding Council

		allocated to direct purchases from family farming.	biodiverse ways, contributing to the principles of the sociobiodiversity bioeconomy.		
44	National Policy on Agroecology and Organic Production – PNAPO (Decree No. 7,794/2012)	To promote agroecology and organic production, contributing to the supply and consumption of healthy food, the conservation of natural resources, and the strengthening of family farming as well as traditional peoples and communities.	It fosters sustainable production systems, aligned with the ecological bioeconomy.	Ministry of Agrarian Development and Family Farming (MDA) e Office of the Chief of Staff of the Presidency	National Commission on Agroecology and Organic Production (CNAPO) and Interministerial Chamber on Agroecology and Organic Production (CIAPO)
45	Organic Agriculture Law (Law No. 10,831/2003)	It establishes regulations for the production and commercialization of organic products in Brazil.	It establishes principles for organic production, with a focus on sustainability and environmental valorization.	Ministry of Agriculture and Livestock (MAPA)	
46	National Program for Strengthening Family Farming – Pronaf (Decree No. 1,946/1996)	To promote the sustainable development of the rural segment made up of family farmers, in order to increase their productive capacity, generate jobs, and improve income.	It finances sustainable activities in family farming units, including bioeconomic value chains.	Ministry of Agrarian Development and Family Farming (MDA)	
47	Program for the Reduction of Greenhouse Gas Emissions in Agriculture – ABC Program (Central Bank Resolution No. 3,896/2010)	To promote the reduction of greenhouse gas emissions from agricultural activities and contribute to reducing deforestation.	It finances low-emission technologies in agriculture, such as Crop-Livestock-Forest Integration	Ministry of Agriculture and Livestock (MAPA)	
48	National Policy on Payment for Environmental Services – PNPSA (Law No. 14,119/2021)	To encourage conservation and environmental restoration by providing remuneration to those who deliver ecosystem services	It promotes sustainable practices and remunerates environmental services provided by farmers, extractivists, and traditional communities.	Ministry of the Environment and Climate Change (MMA)	

49	National Policy on Climate Change – PNMC (Law No. 12,187/2009)	To promote the reduction of greenhouse gas emissions and the adaptation of the country to the impacts of climate change, contributing to sustainable development and the protection of the climate system.	It promotes the transition to a low-carbon economy, in which the bioeconomy plays a role by fostering sustainable value chains.	Ministry of the Environment and Climate Change (MMA)	Interministerial Committee on Climate Change (CIM)
50	National Biodiversity Policy (Decree No. 4,339/2002)	To conserve Brazil's biodiversity, promote its sustainable use, and ensure the fair and equitable sharing of benefits derived from the use of genetic resources.	It provides the basis for the economic valorization of biodiversity, regulates its sustainable use, and creates conditions for the development of value chains and innovations based on biological resources — core elements of the bioeconomy.	Ministry of the Environment and Climate Change (MMA)	National Biodiversity Commission (Conabio)
51	National Regional Development Policy – PNDR (Decree No. 6,047/2007)	To reduce economic and social inequalities among Brazilian regions, promoting sustainable growth, income generation, and improved quality of life for the population.	It reduces regional inequalities and stimulates value chains based on local resources.	Ministry of Integration and Regional Development (MIDR)	Deliberative Council of Sudene (Condell), Sudam (Condell/Sudam), and Sudeco (Condell/Sudeco), depending on the region
52	Intermediary Cities for Regional Development Program (Executive Committee/MIDR Resolution No. 4/2024)	To decentralize Brazil's economic and social growth by strengthening medium-sized cities — referred to as 'vector municipalities' — as regional development hubs.	It values hub cities that articulate regional bioeconomic value chains.	Ministry of Integration and Regional Development (MIDR)	
53	Program for Productive Inclusion and Sustainable Development – National Integration Routes (MIN Ordinance No. 162/2014)	To promote productive inclusion and sustainable development in Brazil's less developed regions by structuring networks of Local Productive Arrangements (APLs) associated with strategic value chains	It fosters strategic local productive arrangements for the regional bioeconomy	Ministry of Integration and Regional Development (MIDR)	
54	Citizenship Territories Program (Decree without number of 02/25/2008)	To promote sustainable territorial development and reduce social inequalities in	It strengthens sustainable, community-based value chains in rural and traditional territories.	Ministry of Agrarian Development and Family Farming (MDA)	

		rural areas through the integration of public policies and social participation			
55	Environmental Conservation Support Program – Bolsa Verde Program (Law No. 12,512/2011)	To provide financial support to low-income families living in environmentally protected areas, encouraging environmental conservation and social inclusion.	Valoriza práticas sustentáveis de uso da biodiversidade, como o extrativismo e a agroecologia, fortalecendo cadeias produtivas da sociobiodiversidade e promovendo uma bioeconomia de base comunitária.	Ministry of the Environment and Climate Change (MMA)	

In The Netherlands

ID	Legal / Policy Instrument	Objective	Link to Bioeconomy	Responsible Government Body	Governance Instance
1	Government Vision on the Biobased Economy (2007)	Introduce national strategy for transition to a biobased economy	Establishes initial direction for using biomass and biotechnology in energy and materials	Ministry of Economic Affairs and Climate Policy (EZK)	Inter-ministerial coordination, private–public consultation
2	Framework on the Biobased Economy (2012)	Provide a structured mid/long-term roadmap	Aligns biobased economy with innovation and industrial development policies	Ministry of Economic Affairs and Climate Policy (EZK); Ministry of Agriculture, Nature and Food Quality (LNV)	Policy framework, expert working groups
3	Green Growth: From Biomass to Business (2012) / For a Strong, Sustainable Economy (2013)	Operational “business plans” for green growth	Strengthens biomass use and connects to market opportunities	Ministry of Economic Affairs and Climate Policy (EZK); Ministry of Agriculture, Nature and Food Quality (LNV)	Public–private platforms, sectoral councils
4	Circular Economy by 2050 (2016) & Raw Materials Reduction Target (2030)	Achieve full circular economy by 2050; reduce 50% use of primary raw materials by 2030	Bioeconomy embedded in circularity, especially biomass & food	Ministry of Economic Affairs and Climate Policy (EZK); Ministry of Agriculture, Nature and Food Quality (LNV); Ministry of Infrastructure	“Transition Agendas” (Biomass & Food, Plastics, etc.), national monitoring system

				and Water Management (IenW)	
5	Transition Agendas (sectoral roadmaps, 2017–)	Define pathways in key sectors: biomass & food, plastics, construction, manufacturing, consumer goods	Specifies measures for bio-based innovation and circular use	Ministry of Economic Affairs and Climate Policy (EZK); Ministry of Agriculture, Nature and Food Quality (LNV); Ministry of Infrastructure and Water Management (IenW) with regional governments	Transition Teams (multi-stakeholder governance arenas)
6	Green Deals (since 2011)	Remove systemic barriers through voluntary agreements	Instrument for collaborative innovation in bioeconomy and circular economy	National government in partnership with companies, NGOs, universities	Flexible governance through Green Deal coalitions
7	SDE+ Subsidy Scheme (Stimulating Sustainable Energy Production)	Support renewable energy production	Provides financial incentives for bioenergy and biogas projects	Ministry of Economic Affairs and Climate Policy (EZK)	National subsidy program, monitored by Netherlands Enterprise Agency (RVO)
8	Energy Agreement for Sustainable Growth (2013)	Comprehensive framework for sustainable energy and climate	Embeds bio-based energy solutions within national climate policy	Ministry of Economic Affairs and Climate Policy (EZK); Ministry of Agriculture, Nature and Food Quality (LNV); Ministry of Infrastructure and Water Management (IenW)	Multi-actor negotiation platform
9	Climate Agenda (2013)	Long-term GHG reduction (95% by 2050)	Encourages biomass and bio-based energy as part of mitigation	Ministry of Economic Affairs and Climate Policy (EZK); Ministry of Infrastructure and Water Management (IenW)	National Climate Policy framework

10	Strategic Biomass Vision 2030 (2020)	Provide guidelines for sustainable biomass use	Defines priority uses: high-value applications, materials, chemicals	Ministry of Economic Affairs and Climate Policy (EZK); Ministry of Agriculture, Nature and Food Quality (LNV)	Advisory councils, interministerial consultation
11	Environment and Planning Act – <i>Omgevingswet</i> (effective 2024)	Consolidate environmental and spatial planning laws	Facilitates permitting and spatial planning for bio-based projects	Ministry of the Interior and Kingdom Relations (BZK)	Municipal and regional planning bodies
12	National Biotechnology Strategy 2040 (2022)	Position the Netherlands as a leader in biotechnology	Promotes biotech innovation and regulatory adaptation for bio-based industries	Ministry of Economic Affairs and Climate Policy (EZK); Ministry of Agriculture, Nature and Food Quality (LNV); Ministry of Health (WS), other ministries	National biotechnology council, multi-ministerial governance