Revista de Administração Contemporânea
Journal of Contemporary Administration

ASSOCIAÇÃO NACIONAL DE PÓS-GRADUAÇÃO E PESQUISA EM ADMINISTRAÇÃO

e-ISSN: 1982-7849

Theoretical-empirical Article

Sociobioeconomy and Social Technology in the Amazon Region: An Integrated Framework Proposition

Sociobioeconomia e Tecnologia Social na Amazônia: Uma Proposta de Framework Integrado

Diana Cruz Rodrigues*[1]
Artur da Silva Ribeiro[1]
João Paulo dos Santos da Silva[1]
Cláudia Souza Passador[2]

ABSTRACT

Objective: To propose an analytical framework that integrates the social technology approach into the concept of socio-bioeconomy, as its compatible technological strand, based on the concept of a social technological system. **Theoretical framework:** The concept of socio-bioeconomy is discussed in light of the three predominant visions of bioeconomy (biotechnological, bioresources, and bioecological), proposing a conceptual-analytical framework. The social technological system concept is revised to integrate it, in a cross-cutting way, with the socio-bioeconomy. The framework integrates the dimensions of the social technological system with the dimensions of the socio-bioeconomy. **Methods:** The proposed framework was applied in a case study of a potential social technological system in socio-bioeconomic activities in the rubber production chain in the Amazon. Data collection included documentary research, interviews, and a technical visit. **Results:** the case study presented the integration of three solutions based on social technology, constituting various properties of a social technological system. The social technology system shown was compatible with the dimensions of socio-bioeconomy. Several properties of the framework were evidenced, allowing its initial analytical viability to be considered. **Conclusions:** The framework has advanced in the analytical detailing of socio-bioeconomy, including its technological aspect, by bringing it closer to social technology. The framework can also help with technological development in socio-bioeconomy initiatives.

Keywords: bioeconomy; sociobioeconomy; social technology; social technological system; Amazon

RESUMO

Objetivo: propor um framework analítico que integre na concepção de sociobioeconomia a abordagem de tecnologia social, enquanto sua vertente tecnológica compatível, baseada no conceito de sistema tecnológico social. **Marco teórico:** A concepção de sociobioeconomia é discutida frente as três visões predominantes de bioeconomia (biotecnológica, biorrecursos e bioecológica), com a proposição de um quadro conceitual-analítico. A concepção de sistema tecnológico social é revisada para se integrar, de forma transversal, à sociobioeconomia. O framework integra dimensões do sistema tecnológico social às dimensões equivalentes da sociobioeconomia. **Métodos:** o framework proposto foi aplicado em um estudo de caso de potencial sistema tecnológico social na cadeia produtiva da borracha na Amazônia, atividade da sociobioeconomia. A coleta de dados contemplou pesquisa documental, entrevistas e visita técnica. **Resultados:** o caso em estudo apresentou a integração de três soluções baseadas em tecnologia social, constituindo diversas propriedades de um sistema tecnológico social. O sistema tecnológico social evidenciado mostrou-se compatível com as dimensões de sociobioeconomia. Diversas propriedades do framework foram evidenciadas, permitindo considerar a sua viabilidade analítica inicial. **Conclusões:** O framework avançou no detalhamento analítico-conceitual da sociobioeconomia, incluindo sua vertente tecnológica, pela aproximação com a tecnologia social. O framework também pode auxiliar no desenvolvimento tecnológico em iniciativas da sociobioeconomia.

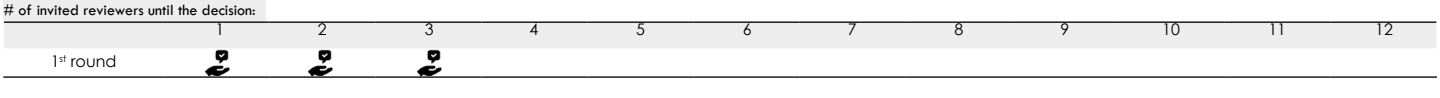
Palavras-chave: bioeconomia; sociobioeconomia; tecnologia social; sistema tecnológico social; Amazônia.

* Corresponding Author.
1. Universidade da Amazônia, Programa de Pós-Graduação em Administração, Belém, PA, Brazil.
2. Universidade de São Paulo, Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto, Ribeirão Preto, SP, Brazil.

Cite as: Rodrigues, D. C., Ribeiro, A. S., Silva, J. P. S., & Passador, C. S. (2024). Sociobioeconomy and social technology in the Amazon region: An integrated framework proposition. *Revista de Administração Contemporânea*, 28(6), e240223. https://doi.org/10.1590/1982-7849rac2024240223.en

JEL Code: Q57

Received: August 05, 2024
Last version received: November 11, 2024
Accepted: November 18, 2024
Published: December 16, 2024



INTRODUCTION

The debate on how the Amazon's biological and cultural diversity can contribute to sustainable regional development through science, technology, and innovation (ST&I) has been ongoing since the 1990s (Becker, 2009; Centro de Gestão e Estudos Estratégicos [CGEE], 2006, 2007; Costa, 2012).Discussions span multiple themes, including the investments and infrastructure required for ST&I in the region (CGEE, 2008; Costa, 2012), economic and business dynamics (Costa, 2009; Costa et al., 2022), and ethical concerns about equitable benefit-sharing with local communities and traditional peoples (Albagli, 2003). These themes remain highly relevant, particularly with the growing prominence of the bioeconomy on public agendas (Lopes & Chiavari, 2022).

The concept of bioeconomy has been polysemic and subject to considerable debate (Bugge et al., 2016; Vivien et al., 2019). Various approaches have emerged in the field, reflecting different perspectives from the Global North and South (Bugge et al., 2016; Costa et al., 2021; Lopes & Chiavari, 2022). These include approaches with well-established trajectories, such as the perspective of biotechnology, and emerging paradigms, like that of the socio-bioeconomy advocated by social movements such as the National Council of Extractive Populations (CNS), the Coordination of Indigenous Organizations of the Brazilian Amazon (COIAB), and the National Coordination of Articulation of *Quilombos* (CONAQ) (COIAB, 2021).

The socio-bioeconomy framework championed by these movements places traditional Amazonian peoples and local communities as key decision-makers and actors in bioeconomy initiatives within their territories. This approach emphasizes empowerment not only in collecting or producing primary inputs but also in acquiring the knowledge and technological capacity necessary for processing and commercializing products and services derived from socio-biodiversity, while respecting traditional ways of life (COIAB, 2021).

In our view, the socio-bioeconomy represents a counter-hegemonic approach to bioeconomy, emerging from the Global South and prioritizing the agency of traditional peoples and local communities. This perspective diverges from biotechnology-oriented approaches (Bugge et al., 2016), which focus on large industries and research and development (R&D) laboratories, and from bioresource-focused approaches (Bugge et al., 2016) that, although serving rural areas, also emphasize mass production of bioinputs for global markets. While socio-bioeconomy aligns somewhat with the bioecology approach (Bugge et al., 2016), it distinctively highlights the role of local social organizations.

However, advancing the socio-bioeconomy requires alignment with a scientific-technological approach that is similarly counter-hegemonic. This means fostering more horizontal and interactive relationships that integrate heterogeneous knowledge (e.g., scientific and traditional) to develop technologies that reflect the values and interests of these communities. In this context, the social technology approach emerges as a promising ally for technological development within socio-bioeconomic initiatives.

Social technology is a counter-hegemonic framework for technological development focused on social inclusion and democratization (Dagnino et al., 2010; Thomas, 2012). Originating in Brazil in the early 2000s, it draws on Latin American perspectives on science, technology, and society, as well as theories of sociotechnical change and technology critique (Bijker, 1995; Dagnino, 2014; Dagnino et al., 2010; Thomas, 2012). The social technology approach's technological development process emphasizes interaction with marginalized social groups or counter-hegemonic organizational arrangements, such as solidarity enterprises and community collectives, to empower these actors (Dagnino, 2014).

Thus, social technology offers a compatible and supportive approach for traditional Amazonian peoples and local communities seeking technological solutions within the socio-bioeconomy framework. However, conceptual and analytical connections between socio-bioeconomy and social technology must be established. This research addresses this need by proposing an analytical framework that integrates the social technology approach into the socio-bioeconomy concept as its technological dimension.

The proposed framework is based on a literature review of socio-bioeconomy and social technology studies, with a particular focus on the social technological system approach, representing the research's primary contribution. The framework is then applied for initial validation in a case study of the rubber production chain in the Amazon.

SOCIO-BIOECONOMY: PROPOSITION OF AN ANALYTICAL FRAMEWORK

Bioeconomy emerged in the 1990s as an economic alternative leveraging biotechnological advances in industrial contexts. It has been recognized globally as a pathway to address environmental and social challenges through the sustainable management of natural resources (Bugge et al., 2016; Heimann, 2019; Oláh et al., 2023).

Over time, it has evolved into a sustainable economic model based on renewable resources (European Commission, 2005; Oláh et al., 2023).

In the academic field, bioeconomy is a relatively new phenomenon examined across diverse areas of knowledge (Frisvold et al., 2021; Oláh et al., 2023). Three primary visions of bioeconomy have been identified: biotechnology, bioresources, and bioecology (Bugge et al., 2016).

The biotechnology vision emphasizes economic growth and job creation from technological innovation (Staffas et al., 2013). This vision prioritizes the use of technological innovation based on bioeconomy for the growth of the industry, especially global clusters. Value creation is intended for the commercialization of R&D with the application of biotechnological solutions in areas of industrial production, such as the pharmaceutical industry (Hansen, 2014; Morrison & Cornips, 2012).

By focusing on the economic development of large corporations within the scope of central capitalism, the biotechnology vision sidelines socio-environmental sustainability — an idealized principle of the bioeconomy. In territorial terms, central urban regions are the focus of industrial processes and R&D, not prioritizing the sustainability conditions for peripheral and rural regions.

The bioresource-based vision seeks to address the socio-environmental limitations of biotechnology by emphasizing the conversion and improvement of natural resources. Alongside economic growth, it prioritizes environmental sustainability through the development of new sustainable products derived from natural resources (Duchêsne & Wetzel, 2003; Levidow et al., 2012). Its focus extends to land-use optimization, large-scale biofuel and biomass production, and waste management, shifting attention to rural areas and peripheral regions (contrasting with the biotechnology-based view).

Although it is established as an expansion of the biotechnology view, the bioresource-based view is criticized for focusing on economic growth through the large-scale commercialization of products. The bioecological vision establishes a counterpoint to these two visions by focusing directly on sustainability and environmental conservation (Bugge et al., 2016).

The bioecological vision emphasizes socio-biodiversity and ecosystem preservation as objectives for creating value in the bioeconomy. Bioecology focuses on solutions such as biowaste energy production, reduced pesticide use in agriculture, and sustainable production chains (Levidow et al., 2012; McCormick & Kautto, 2013). The bioecological vision also focuses on rural and peripheral regions (Levidow et al., 2012; Marsden, 2012).

Despite the varying perspectives from different major visions of the bioeconomy, there are still gaps, mainly in terms of the analytical focus on the social relations rooted in these processes. Critics highlight issues such as inadequate attention to social and ecological sustainability (McCormick & Kautto, 2013; Peltomaa, 2018), top-down technical solutions that exclude community participation (McCormick & Kautto, 2013) and the perception of bioeconomy as a 'buzzword' rather than a substantive sustainability model (Vivien et al., 2019).

In the Amazon region, the bioeconomy presents both opportunities for sustainable economic development and risks of socio-environmental harm, including deforestation and adverse impacts on traditional and Indigenous communities (Lopes & Chiavari, 2022). Excluding local communities from bioeconomy projects exacerbates exploitation dynamics (Uma Concertação pela Amazônia, 2023). It is crucial to integrate these groups as active participants in developing products and technological solutions for a sustainable bioeconomy model (Uma Concertação pela Amazônia, 2023).

The concept of socio-bioeconomy has emerged in the Global South as a distinct approach, emphasizing the central role of local communities and their knowledge in constructing sustainable development models (Infoamazonia, 2023). The concept of socio-bioeconomy emphasizes the positioning of which actors are (or should be) empowered through the bioeconomy. While the bioecological vision incorporates social relations present in ecological dynamics, the term 'socio-bioeconomy' has been defended by social movements by highlighting the social dimension (including social power relations) in dispute in the field of bioeconomy (COIAB, 2021). Thus, the term points to both a conceptual and a political construction in the field of bioeconomy.

Socio-bioeconomy advocates for the active participation of local populations in creating economic opportunities that generate jobs, income, and quality of life while supporting ecosystem conservation. It positions bioeconomy products and technologies as socially situated constructions that must reflect local needs and values (Bijker, 1995; Thomas, 2012). This socially oriented vision calls for prioritizing the inclusion of local communities as key actors in bioeconomic processes.

As a concept under construction in the Global South, socio-bioeconomy emphasizes the role of local populations and territories in creating sustainable

economic options derived from endogenous foundations rather than external prescriptions. The term has been incorporated into the political demands of traditional and Indigenous peoples in Brazil, particularly in the development of the National Socio-Bioeconomy Plan (Ministério do Meio Ambiente e Mudança do Clima [MMA], 2024) currently under discussion within the framework of the National Bioeconomy Strategy (Decree No. 12,044/2024).

A suitable bioeconomy framework for the Amazon must prioritize the biome's existence as a living system, fostering respectful and harmonious interactions with local societies (Costa et al., 2022). In addition to ensuring the integrity of ecosystems through the conservation and restoration of biodiversity, such a framework must respect sociocultural diversity. This includes recognizing the importance of traditional and Indigenous knowledge in resource use, technological development, and the creation of production chains tied to the territory and oriented toward community well-being. Moreover, establishing infrastructure that supports the sustainable development of socio-bioeconomy initiatives while ensuring quality of life for local populations is a central aspect (Costa et al., 2022).

In this study, we define socio-bioeconomy as the development of economic activities grounded in sustainable socio-biodiversity and driven by the leadership of local communities in Amazonian territories (COIAB, 2021; Infoamazonia, 2023). Indigenous peoples and traditional communities play a pivotal role in this concept, as their struggles and organizational efforts are intrinsically linked to territorial defense and sustainable production (Allegretti, 2008).

The well-being, knowledge, rights, and territorial defense of these communities are priorities in crafting sustainable economic solutions (Garrett et al., 2023). Consequently, socio-bioeconomy should be established as a counter-hegemonic approach within the broader bioeconomy field, reflecting the struggles and rights of these peoples while ensuring their central role in decision-making regarding their territories.

Despite ongoing advancements in defining socio-bioeconomy based on the sociopolitical constructs of traditional communities and the specificities of their territories, existing studies (Costa et al., 2022; Garrett et al., 2023) lack sufficient analytical detail to articulate its dimensions and conceptual properties. This analytical refinement is essential to differentiate this bioeconomy approach from others, particularly in balancing the social dimension (including political and territorial aspects) with the economic and environmental dimensions emphasized in other models. The primary rationale for the emergence of the term 'socio-bioeconomy' lies in its emphasis on the 'social' as a representation of local groups, requiring the establishment of clearly defined analytical properties.

Key questions to guide analyses rooted in socio-bioeconomy include: Do communities act as central actors or merely as support in project implementation? Do traditional populations participate throughout the production chain, or are they limited to collecting and processing final products? Do communities receive equitable benefits from the commercialization of products and services? Does traditional knowledge empower these communities in production processes, or is it appropriated by external entities?

To address these gaps, we propose an analytical framework (Table 1) structured around three dimensions of socio-bioeconomy — social, bio-territorial, and economic — and their associated properties. This framework establishes criteria for distinguishing socio-bioeconomy activities and enterprises from those aligned with other bioeconomy paradigms. Beyond resolving discursive disputes in the field (Vivien et al., 2019), this framework provides practical guidelines for enterprises and initiatives seeking to adhere to the principles of socio-bioeconomy.

Table 1. Analytical dimensions for socio-bioeconomy.

Dimension	Property
Social	Inclusive and participatory deliberation
	Sociocultural appreciation
	Construction of heterogeneous knowledge networks (connections between traditional, popular, and scientific knowledge)
	Community strengthening
Bio-territorial	Conservation and/or restoration of ecological systems
	Valorization of bioinputs endogenous to the territory
	Environmental sustainability throughout the production chain
	Mitigation and adaptation to climate change
Economic	Collective organization of work
	Promotion and allocation of economic resources
	Fair income generation
	Community productive integration

The social dimension of socio-bioeconomy emphasizes that biodiversity conservation and sustainable economic development are impossible without considering the social groups and communities in the territories (Infoamazonia, 2023). For this dimension, we propose four properties: inclusive and participatory deliberation, sociocultural appreciation, the construction of heterogeneous knowledge networks, and community strengthening.

The properties proposed for the social dimension are related to analyzing the effective participation and empowerment of the local population and communities. 'Inclusive and participatory deliberation' evaluates whether these communities can influence decision-making processes related to (socio)bioeconomic activities (Infoamazonia, 2023). Such incidence is linked to the property of 'sociocultural appreciation' and the possibility of building 'connections between traditional, popular, and scientific knowledge.' The effectiveness of collective deliberative processes generating sociocultural appreciation through these plural knowledge connections is related to the property 'community strengthening' both internally (within the community) and externally (in interactions with other actors in the production chain).

The bio-territorial dimension focuses on ecosystem sustainability, fostering a sense of territory and respect for local communities. The proposed properties for this dimension include the conservation and/or restoration of ecological systems, the valorization of bio-inputs endogenous to the territory, environmental sustainability throughout the production chain, and mitigation and adaptation to climate change.

The properties 'conservation and/or restoration of ecological systems' and 'mitigation and adaptation to climate change' directly dialogue with the bioecological vision that prescribes the use of clean energy, conservation of territories, and a focus on the environment (Bugge et al., 2016). Production processes are observed based on their capacity to be sustainable and contribute to environmental conservation.

The property 'valorization of bio-inputs endogenous to the territory' is connected to the understanding that a proposal for a sustainable economy and biodiversity conservation cannot be separated from the historical processes of availability, cultivation, and use of products in the territory. Biodiversity conservation is not achieved by importing external solutions but by developing locally grounded practices. The property 'environmental sustainability throughout the production chain' also aligns with the bioecological vision, requiring coherence in all stages of production, from extraction to distribution, ensuring that predatory processes do not undermine sustainable practices.

The economic dimension of socio-bioeconomy, as presented in this study, posits that economic development must address community needs (Magno et al., 2022; Mitschein et al., 2013). From a sustainable perspective, economic development is deeply connected to socio-bioeconomy through its focus on enhancing the quality of life of communities and their territories (Mitschein et al., 2013).

The properties of 'collective organization of work' and 'community productive integration' reflect a vision of local economic development that diverges from the market-dominated model. Rather than solely focusing on economic gains, these properties prioritize community empowerment and cohesion through inclusion and organizational efforts (Alves et al., 2016; Magno et al., 2022;). The property of 'fair income generation' aligns with this perspective, ensuring that no exploitation occurs within any link of the production chain and promoting community-wide development (Mitschein et al., 2013).

The property of 'promotion and allocation of economic resources' recognizes the importance of supporting community initiatives through state funding and infrastructure investments. This includes structuring local communities to act as public development agents, particularly in contexts where existing programs and subsidies favor large corporations (González, 2016). Additionally, this property considers solutions such as revolving community funds and microfinance initiatives as essential to fostering local economic sustainability.

In summary, the proposed dimensions and their respective properties aim to characterize socio-bioeconomy initiatives. However, the development and success of socio-bioeconomy ventures in the Amazon require technological advancements tailored to socio-biodiversity. Technological advancement is necessary to make socio-bioeconomy viable and generate development in communities. However, the technological approach must be compatible with the constitutive dimensions of the socio-bioeconomy concept.

SOCIAL TECHNOLOGY AS A TECHNOLOGICAL APPROACH TO SOCIO-BIOECONOMY: PROPOSAL FOR A FRAMEWORK BASED ON THE CONCEPT OF SOCIAL TECHNOLOGICAL SYSTEM

In this section, we explain the concept of social technology as the technological approach most appropriate for socio-bioeconomy, outlining its primary conceptual and analytical properties. We also propose a set of social technology properties that integrate with the

dimensions of socio-bioeconomy, forming a framework that unites the two concepts.

Social technology represents a counter-hegemonic approach to technological development aimed at fostering social inclusion and technological democratization (Dagnino, 2014; Dagnino et al., 2010; Thomas et al., 2015). Grounded in the theoretical perspectives of sociotechnical change and technology critique, this approach posits that technological development is deeply influenced by the values and interests of the social groups involved in its processes (Bijker, 1995; Dagnino, 2014; Dagnino et al., 2010). Consequently, the participation of marginalized social groups, often the primary beneficiaries of technological development, is essential in the social technology approach. These groups can influence technological development through an interactive and horizontal process, aligning them with their social values, interests, and territorial contexts (Dagnino, 2014; Dagnino et al., 2010).

Social technology offers an alternative to the conventional capitalist technological development model, primarily driven by the profit-maximizing interests of large corporations and industries (Dagnino, 2014). For the author Dagnino (2014) conventional technological processes are often characterized by a focus on capital accumulation at the expense of other social and environmental dimensions. This approach has been associated with labor displacement, deskilling, and increased environmental risks or damage. Furthermore, the technological development process tends to impose the interests, values, and lifestyles of dominant groups onto disadvantaged social groups and territories, embedding these priorities into technological artifacts and procedures. As a result, the conventional capitalist model of technological development often perpetuates or exacerbates societal inequalities.

Therefore, the sociotechnical perspective maintains that values and social relations (including power relations) influence scientific-technological processes, rejecting the possibility of value neutrality and technological determinism over society (Bijker, 1995). This perspective requires aligning socio-bioeconomy with a compatible scientific-technological approach. A potential incompatibility can be observed in conventional biotechnology practices typically carried out in large global R&D laboratories. These practices are often inaccessible to traditional peoples or local communities, subordinating their knowledge, values, and interests to those of the dominant industries. In such contexts, traditional communities are frequently relegated to the passive role of recipients of technological solutions developed in vastly different social settings, thereby reinforcing pre-existing social inequalities (Thomas et al., 2015).

SOCIAL TECHNOLOGICAL SYSTEM

Social technology establishes a participatory technological development process aimed at the socio-productive inclusion of disadvantaged groups, fostering technological empowerment and promoting social emancipation (Dagnino, 2014; Dagnino et al., 2010; Freitas & Segatto, 2014; Thomas, 2012). This approach aligns with the concept of socio-bioeconomy. However, equipping enterprises within the (socio)bioeconomy context requires systemic socio-technical solutions that integrate various functions and links in the production chain. To address this need, we explore the concept of a social technological system.

The seminal concept of a technological system, introduced by Hugues (1983) examines large technological systems of the 20th century, such as electrical energy networks, which integrate multiple components and artifacts across generation, distribution, and commercialization. Hugues (1987) defines a technological system as a socially constructed network or structure that connects technical, human, and organizational components operating together to perform specific tasks or solve particular problems.

Based on the original notion of the technological system, Dagnino (2014) highlights the need to coordinate and integrate the diverse elements involved in social technology development. For the author, stabilizing social technology requires connecting sociotechnical elements such as materials, inputs, artifacts, construction methods, production processes, and participant values (Dagnino, 2014). An illustrative example is the implementation of water collection and storage systems using cement slab cisterns in Brazil's semi-arid region. This initiative, grounded in social technology, involves a range of components, including community organization for collective cistern construction, the necessary materials (e.g., pipes, cement), water management processes, and trained community members who operate the system (Dias, 2013).

Extending the technological system concept to social technology gives rise to the notion of a social technological system (Thomas, 2012; Thomas et al., 2015). This system involves designing, implementing, and managing technologies aimed at inclusive and sustainable development (Juárez, 2020; Thomas, 2012). It is a heterogeneous sociotechnical system composed of social actors, technological artifacts, organizations, and regulations (similar to Hughes' concept of a

technological system) but focuses on empowering co-producers and users, democratizing decision-making, and promoting the socialization of goods and services (Juárez, 2020; Picabea, 2017). Central to this concept is the co-construction of technological solutions by the groups that will ultimately operate and benefit from them.

A social technological system presents relevant analytical concepts, such as sociotechnical alliance and trajectory (Thomas, 2012; Juárez & Becerra, 2012). sociotechnical alliance represents the network of relationships between actors and technological artifacts at a specific time and place, determining the system's functionality (or lack thereof) (Thomas, 2012; Picabea, 2017). Thus, the sociotechnical alliance represents the structure of the relationships of the multiple components in the development of a social technological system in a given time and space, based on which actors can identify its functioning (or lack thereof) and reset the use of technological solutions according to the process of dialogue and collective decisions.

This structure of component alignment and coordination may consider local production dynamics, including production processes, interactions between actors at different scales, and economic activities that affect a given community or production chain (Thomas et al., 2015). Applied to socio-bioeconomy chains, the concept of sociotechnical alliance allows for a broad and systemic view of the multiple components (actors, artifacts, and organizations) that must be connected in the community context (and in its relations with other scales) for the proper operation of a social technological system in a given production chain.

On the other hand, the sociotechnical trajectory refers to the dynamic process by which social groups collectively deliberate and understand the functioning (and malfunctioning) of a social technological system (Thomas, 2012; Picabea, 2017). It encompasses changes in productive and organizational processes, product and service design, learning experiences, problem-solving relationships, and the institutions and actors that constitute the system's sociotechnical alliances.

The concept of social technological systems implies the integration of diverse sociotechnical solutions as part of systemic interventions to address socio-productive challenges (Picabea, 2017). Implementing these combinatorial solutions is critical to tackling multidimensional issues, such as those inherent in socio-bioeconomy contexts(Jesus & Bagattolli, 2013; Thomas, 2012).

A key aspect of systemic thinking in social technology integration is the synergy of learning and strengthening of participatory processes. The knowledge derived from implementing sociotechnical solutions fosters stability and informs future applications. Communities can build on their own experiences to identify local potential, reflect on challenges, and co-evolve collective responses to socio-historically situated problems (Thomas, 2012).

PROPOSAL FOR A FRAMEWORK FOR INTEGRATING THE SOCIAL TECHNOLOGICAL SYSTEM INTO A SOCIO-BIOECONOMY SYSTEM

Thomas (2012) discusses the concept of a social technological system as a potential driver of new local techno-productive dynamics. The author identifies three levels of action for establishing these systems: socioeconomic, sociopolitical, and sociocognitive.

The socioeconomic level focuses on identifying local potential and developing sociotechnical solutions through the participation of community members. These solutions aim to enable the "differentiation of products, the adaptation and improvement of production processes, the development of new forms of organization, and the incorporation of added value" (Thomas, 2012, p. 15). Such actions emphasize intensifying the technical-cognitive content of products and processes, a crucial factor for transforming communities' productive profiles and improving quality of life.

This transformation aligns with co-evolutionary techno-economic dynamics within sociotechnical trajectories shaping the social technological system (Thomas, 2012). Operating costs must align with the scale (family, collective, community, etc.) and scope (production chain links) of operations at a given time, leveraging local comparative advantages. The notion of sociotechnical trajectory must consider, over time, economic and social integration processes through strategies of complementation, densification, and intertwining of production chains between communities to strengthen community enterprises in a logic of cooperation and solidarity (Dagnino, 2014).

Thomas (2012) emphasizes the connection between sociopolitical and socioeconomic actions to ensure the viability of the latter. Many socioeconomic challenges relate to public policy issues, such as social inclusion, government legitimacy and visibility, and access to rights in areas like food, health, housing, and energy (Juárez, 2020). The processes of social

and political organization — democratic participation in collective decision-making — to create solutions based on social technology also refer to actions aiming at community empowerment and territorial development.

Learning and sociocognitive actions serve as the foundation for both socioeconomic and sociopolitical actions (Thomas, 2012). Sociotechnical constructs and technologies influence social change by affecting production costs, access to rights and goods, economic distribution structures, and social positioning while also producing social and environmental impacts (both positive and negative). Therefore, the development process entails sociocognitive advancements.

Therefore, within the social technology proposal, technological development must be implemented as an interactive and horizontal process between local communities or other social groups and researchers or experts to allow knowledge sharing that generates sociotechnical solutions appropriate to the social context while empowering them technologically (Dagnino, 2014; Thomas, 2012). The goal is to establish a technological project rooted in the territorial context, enabling increasing sociotechnical autonomy (Thomas, 2012).

Drawing from the levels of action within the social technological system, we adapted their composition into dimensions for developing social technological systems within the socio-bioeconomy. Table 2 presents the proposed framework, integrating the conceptual-analytical foundation of socio-bioeconomy outlined in the previous section (Table 1) with the addition of the dimensions of the social technological system as its technological axis.

Table 2. Socio-bioeconomy framework integrated into the cross-cutting technological axis, based on the concept of a social technological system.

Socio-bioeconomy			
Dimension	Property	Cross-cutting axis: Social technological system	
		Dimension	Property
Social	Inclusive and participatory deliberation	Sociopolitical-cognitive	Social construction of the interactive and horizontal problem-solution
	Sociocultural appreciation		Technological projects endogenous to the territory
	Construction of heterogeneous knowledge networks (connections between traditional, popular, and scientific knowledge)		Establishment of a network of heterogeneous knowledge
	Community strengthening		Co-construction of technological solutions with a focus on increasing autonomy
Bio-territorial	Conservation and/or restoration of ecological systems	Territorial sustainability	Promoting environmental conservation combined with cultural values
	Valorization of bioinputs endogenous to the territory		Sociotechnical adaptation of inputs and products to the territory
	Environmental sustainability throughout the production chain		Sustainable technological construction and operations
	Mitigation and adaptation to climate change		Technological development agenda based on the territory
Economic	Collective organization of work	Socioeconomic	Establishing sociotechnical alliances in the production chain
	Promotion and allocation of economic resources		Management of costs conditioned by the scale and scope of operations, taking advantage of comparative advantages
	Fair income generation		Promoting economic and social integration
	Community productive integration		Complementation, consolidation, and intertwining of production chains

Aligned with the social dimension of socio-bioeconomy, we integrate sociopolitical and sociocognitive properties for sociotechnical development. For an endogenous technological project that respects the ways of life in the territories, the social construction of problem-solving must be a participatory and horizontal process rooted in the interpretative flexibility of diverse knowledge systems (Juárez, 2020; Thomas, 2012). This requires forming a network of heterogeneous knowledge, involving local members alongside researchers, engineers, and specialists to collaboratively develop technological solutions to enhance community autonomy (Dagnino, 2014; Thomas, 2012).

In addition to the bio-territorial dimension, we propose a set of properties for technological development focused on territorial sustainability. It is important to note that while sustainability concerns are often highlighted in social technology development (Dagnino, 2014; Freitas & Segatto, 2014), aspects specifically related to environmental sustainability have received limited analytical attention in the field. Therefore, aligning the social technology approach with the socio-bioeconomic framework presents an opportunity for cross-learning and advancing studies at this intersection.

Drawing from the alignment between sociotechnical and socio-bioeconomic approaches, we posit that the technological development process must promote environmental conservation, including ecosystem restoration, when necessary. This involves conducting community-driven diagnoses that respect sociocultural values tied to the notions of nature and local landscapes (Garrett et al., 2023). The production process should align with the sociotechnical adequacy of the territory's material resources (such as bioinputs and bioproducts), incorporating sustainable construction practices and technological operations (Thomas, 2012). Furthermore, the technological development agenda must account for systemic interactions (Thomas, 2012), by incorporating measures to address environmental changes, including mitigation and adaptation strategies for climate change.

Aligned with the economic dimension of socio-bioeconomy, we highlight the socioeconomic properties of social technological systems. This dimension emphasizes the formation of sociotechnical alliances among community action chains, with construction and operational costs adjusted to the scale and scope of operations, leveraging local comparative advantages (Thomas, 2012). These sociotechnical alliances must prioritize economic and social integration arrangements to ensure that technological solutions in production processes foster cohesion among workers rather than competitiveness.

Finally, we draw upon Dagnino (2014). to outline the properties of complementarity, densification, and intertwining of production chains. To empower local communities within the socio-bioeconomy, the sociotechnical trajectories of their social technological systems should aim to link production through complementary sociotechnical processes (verticalization), often upstream in the chain, as many of these communities engage in extractive activities.

Another opportunity lies in densification, which refers to cross-cutting integration where inputs previously sourced externally are now produced locally. This could include packaging materials, accessory services, or other production necessities developed through sociotechnical advances (Dagnino, 2014). The intertwining of chains corresponds to prioritizing commercial agreements between community or solidarity enterprises to intertwine different chains in which they operate (Dagnino, 2014). Intertwining production chains involves prioritizing commercial agreements among community or solidarity enterprises, creating synergies between distinct chains in which they operate. For instance, food production cooperatives offering delivery services could prioritize partnerships with community-based or cooperative enterprises in information and communication technology or transportation.

METHODOLOGICAL APPROACH

After developing the proposed framework for integrating socio-bioeconomy and social technology through literature reviews in the preceding sections, it was applied to a case study to validate its dimensions and properties. This stage, characterized as theoretical-empirical research, is aimed at the preliminary validation of the framework. The case study involved applying the basic analytical concepts of the research — social technological system and socio-bioeconomic production chain in the Amazon — to a specific empirical case (Platt, 1992; Ragin, 1992).

The process of identifying potential cases began with a survey of social technology experiences on the Transforma! platform of the Banco do Brasil Foundation (https://transforma.fbb.org.br/) (Fundação Banco do Brasil [FBB], 2024a, 2024b, 2024c). The survey included experiences registered between 2001 and 2023 across all states in the Legal Amazon. Two sets of criteria were used as filters: experiences associated with both 'income generation' and 'environment' (32 experiences identified) and those linked to the UN social

development goals 'decent work and economic growth' (SDG8) and 'climate action' (SDG13) (31 experiences identified).

Among these experiences, only two proponents — Justa Trama and Poloprobio — had more than one certified social technology with integration across the same production chain. Poloprobio's experiences were chosen for analysis as a potential social technological system because the majority of its production processes occur within the Amazon region, the territorial focus of this research. Although Justa Trama also utilizes Amazonian bioinputs and is recognized as a potential social technological system, its production processes are primarily located in other regions of Brazil.

The selected case involved the integrated application of three social technology solutions — *Cernambi Virgem Ecológico* (type of sustainable rubber), *Encauchados de Vegetais* (plant-based rubber sealing), and *Metodologia para Construir e Reaplicar uma Tecnologia Social na Agricultura Familiar* (methodology for building and reapplying a social technology in family farming) — in the natural rubber production chain within local communities in Pará, in the Brazilian Amazon. This integration formed a sociotechnical alliance comprising various actors (civil society organizations, state development organizations, local communities, and marketing partners), artifacts (practical and methodological instruments, inputs), and constructed rules, which together constitute a social technological system (FBB, 2024a, 2024b, 2024c).

The productive activities within this social technological system include latex and natural rubber extraction for biojewelry and other decorative products, as well as the production of bioinputs for footwear manufacturing. Historically, the extraction and commercialization of natural rubber in the Amazon have seen peak periods during the 19th and 20th centuries and are recognized as foundational to the Amazonian bioeconomy (Rosenfeld & Poschen, 2024).

This case aligns with the research's two guiding concepts: the social technological system, defined as the integration of multiple social technology solutions for socio-productive inclusion, and the socio-bioeconomy chain, characterized by the actions of local communities with traditional expertise in rubber extraction. Using the proposed framework, the case was analyzed based on its dimensions and properties (Table 2), with a detailed discussion presented in the following section.

Data collection for this analysis included documentary research, semi-structured interviews, and technical visits conducted in 2024. Documentary research involved accessing public records related to the social technology solutions in the case, along with books, training materials (manuals and booklets), and regulatory documents on bioeconomy. Semi-structured interviews were conducted with two managers from Poloprobio, the focal civil society organization, and a design and biojewelry specialist partnering with the organization. Additionally, technical visits were made to the organization's headquarters and the manufacturing facility for products and intermediate inputs.

INTEGRATION OF SOCIAL TECHNOLOGY SYSTEMS INTO SOCIO-BIOECONOMY: A CASE STUDY OF THE NATURAL RUBBER PRODUCTION CHAIN IN THE AMAZON

The case study examines the development of three social technology-based solutions in the natural rubber production chain, applied within local communities in Pará, Brazilian Amazon. These solutions aim to enhance productivity by complementing and densifying the natural rubber chain in Amazonian communities. Initially, we describe the three identified social technology experiences. Subsequently, we analyze their alignments and limitations in relation to the concept of a social technological system integrated with the socio-bioeconomy, based on the analytical dimensions proposed in the framework.

The first solution, developed by Poloprobio, is *Encauchados de Vegetais da Amazônia* (Amazonian plant-based rubber sealing). This initiative seeks to create alternative sources of work and income for extractive communities while revitalizing native rubber plantations and contributing to forest conservation and sustainable management (FBB, 2024a). The sociotechnical process involves pre-vulcanizing native latex, stabilizing it without toxic industrial inputs. The stabilized latex is then mixed with plant fibers and natural dyes and dehydrated at room temperature in the field for vulcanization (FBB, 2024a).

This plant-based rubber sealing can be crafted into various artisanal products, such as storage boxes, placemats, rugs, fabric-painted items, rubber-sealed bags, and purses (FBB, 2024a). Additionally, there is an ongoing effort to train artisans in producing biojewelry and decorative pieces due to their potential for higher income returns, though other community-driven uses are not excluded (information from Interviewee 1).

The second social technology, methodology for building and reapplying a social technology in family farming, supports community and family organizations in

establishing handicraft production units using plant-based rubber (FBB, 2024b). This methodological approach aims to structure production units by promoting, equipping, and training participants in two critical stages of the chain: latex extraction and handicraft production (FBB, 2024b).

Thus, in this second social technology, it is possible to identify an effort to integrate different activities in the chain by recognizing their interdependencies between the extraction of inputs (rubber) and handicraft production, which are characteristics of systemic thinking. Therefore, we interpret that the first configuration of the sociotechnical alliance of plant-based rubber workers was focused on providing a training structure for production and adaptation of production processes to each community's interests and cultural traits. However, stabilizing production processes for consistent income generation required improved organization and alignment between latex extraction (rubber tappers) and craft production (artisans). The methodological and organizational emphasis of this solution fostered a new sociotechnical alliance, incorporating additional components to adapt operations effectively.

The third social technology, Ecological Virgin Cernambi (which is a type of sustainable rubber), enhances natural rubber production by refining extraction practices and introducing primary processing methods (FBB, 2024c). This approach produces a cleaner rubber clot with reduced moisture content, creating an ecological bioinput suitable for direct use in footwear manufacturing without polluting industrial processes. This innovation not only improves the quality of rubber but also increases its market value, providing higher returns for rubber tappers (FBB, 2024c).

Integrating this third solution into the local rubber chain established a new sociotechnical alliance with additional components. A key positive outcome was the generation of greater economic incentives for rubber tappers, who now add value to their production by selling higher-quality rubber directly. This economic benefit also balanced financial outcomes between rubber tappers and artisans, as the frequent extraction of latex — a critical input for artisans — became a more lucrative activity (information from Interviewee 1). Consequently, both groups within the community benefited from the aggregation of value in rubber production.

ANALYSIS OF THE APPLICATION OF THE FRAMEWORK TO THE CASE

The social technological system analyzed encompasses activities within the rubber production chain in extractive communities. In the social dimension, it was observed that latex extraction and rubber production were traditionally male-dominated activities conducted in forest settings. However, the introduction of handicraft production, including vegetable rubber products and biojewelry, has enabled the socio-productive inclusion of women in this chain. The added value generated across these activities, both extractive and artisanal, has revitalized rubber plantations, fostered the sociocultural appreciation of the rubber tree's identity, and provided incentives for conserving native forests with rubber trees (Interviewee 1).

A significant aspect of this social dimension within the socio-bioeconomy is its strong commitment to local communities. The case study centers on the economic activities of extractive communities in a sector with deep historical roots in the region (the rubber chain), which has experienced devaluation cycles. The focus on these community groups highlights the following:

> Within the Poloprobio project, focusing on latex and rubber, we only work in communities with a history, a tradition, an extractive tradition; they [the communities] must have rubber trails around them, in their territory (I2).

Regarding the development and implementation of technology in interaction with community members and the formation of the network of heterogeneous knowledge, we highlight the format of collaboration exposed by Interviewee 1:

> I only do the theoretical part. For the practical part, I call a rubber tapper from the community, someone with expertise in having a light hand to draw the design to make a suitable panel, and I encourage them to do it. Then, I correct the deficiencies in the panel. I don't draw the design, but I know that the panel has to be a certain size. The design can't be a certain depth; it has to have the right angle (I1).

The co-construction of activities is also evidenced by Interviewee 2 regarding the craftsmanship process:

> How do I work in the collective? We work more like creative directors because all artisans have their own creative process, and we must respect and encourage its development. So, we give them some creative tools and encourage them to feel free to create during the training, and we help them solve the assembly issue (I2).

As for the bio-territorial and sustainability dimensions, the activities have a clear historical identity

in the territories, combined with the conservation of forests with native rubber trees. In addition, the technological solutions focus on natural and sustainable inputs (bioinputs) throughout all the activities, as well as improving the sustainability of processes upstream in the chain:

> [About the use of bioinputs for biojewelry] In the case of biojewelry, the main material is latex, which is extracted there, and it is a biomaterial that is latex mixed with plant fiber; we work with sawdust powder, which is also obtained locally … These resources are there, easy to find, [easy] for them to work with. They won't be dependent on the city (I2).

> [About mitigating the impact of Cernambi Ecológico's production] It takes 20 liters of water to wash one kilo of rubber. It generates effluents and waste. That dirty, rotten water that washed the rubber has to go to tanks to treat this water because the water is very [dirty], it can't go to the water cycle immediately, so they have to have impermeable tanks, usually three tanks. In the third tank, they can put a fish there and return this water to the environment clean. So we eliminate this step … making the rubber cleaner (I1).

In the economic dimension, including the socioeconomic interface of technological development, it was also possible to identify several properties. Regarding fair income generation, Interviewee 1 highlights:

> So he [the rubber tapper] receives almost 5 reais less, but we were not happy with that, because I thought 7.41 was too little to make him go into the forest to extract rubber. So we gave him a bonus, but this bonus has to be for a reason. … So we paid him 10 reais more than the 7.41 for him to take care of the forest and environmental service; each kilo of rubber generates 10 reais more in bonus.

Economic and social integration was evident in the socio-technical trajectory of the social technology solutions within the chain. The implementation of these solutions aimed to align extractive and artisanal activities while generating greater added value at each link. It is important to note that this economic integration is closely tied to social integration processes, including the valorization of work traditionally performed by men and the socio-productive inclusion of women.

One noteworthy aspect is the dynamic of complementarity within the chain (Dagnino, 2014), For example, the *Encauchados de Vegetais* (plant-based rubber sealing) complemented the downstream latex extraction activity. Similarly, the Cernambi Virgem Ecológico strengthened latex extraction for crafts while also creating opportunities for interaction with the footwear industry, which predominantly uses synthetic rubber but seeks to increase the use of natural rubber.

In summary, the case study demonstrated that the constitution of a social technological system aligns well with the development of the socio-bioeconomy. Moreover, it identified several properties within the proposed dimensions, suggesting that the framework holds strong analytical viability in this initial application.

FINAL CONSIDERATIONS

The proposed framework for integrating socio-bioeconomy and social technology in this research advances in two key directions: it provides analytical detail (dimensions and properties) to the concept of socio-bioeconomy, and it incorporates a technological component — social technology — into the socio-bioeconomic concept. By aligning the concept of social technology, particularly through the approach of a social technological system, with socio-bioeconomy, the framework acknowledges the interfaces among development, economy, and technology. At the same time, it reinforces the need for a technological development process that aligns with the socio-bioeconomic concept, emphasizing the leadership of traditional peoples and local communities.

The detailed dimensions and properties of the social technological system, as aligned with socio-bioeconomy, offer an analytical structure that fosters cross-learning between the fields of socio-bioeconomy and social technology. This structure is a foundation for further research to deepen the intersections between these two fields.

The initial application of the framework to a case study involving the natural rubber chain in the Amazon — characterized as a social technological system — revealed the presence of multiple proposed properties (though not all), with an analytical synthesis presented for each dimension. While the framework's initial application was limited to a single case, this developmental stage lays the groundwork for more comprehensive and detailed applications in future theoretical and empirical studies.

REFERENCES

Albagli, S. (2003). Interesse global no saber local: A geopolítica da biodiversidade. In Seminário Saber Local/Interesse Global: Propriedade intelectual, biodiversidade, e conhecimento tradicional na Amazônia, Belém, PA, Brasil. https://ridi.ibict.br/handle/123456789/96

Allegretti, M. (2008). A construção social de políticas públicas. Chico Mendes e o movimento dos seringueiros. *Desenvolvimento e Meio Ambiente*, *18*, 39–59. https://doi.org/10.5380/dma.v18i0.13423

Alves, J. N., Flaviano, V., klein, L. L., Löbler, M. L., & Pereira, B. A. D. (2016). A Economia Solidária no Centro das Discussões: Um trabalho bibliométrico de estudos brasileiros. *Cadernos EBAPE.BR*, *14*(2), 243-257. https://periodicos.fgv.br/cadernosebape/article/view/20257

Becker, B. K. (2009). Uma visão de futuro para o coração florestal da Amazônia. In *Centro de Gestão e Estudos Estratégicos – CGEE. Um Projeto Para a Amazônia no Século 21: desafios e contribuições*. CGEE.

Bijker, W. (1995). *Of bicycles, bakelites and bulbs*. MIT Press.

Bugge, M. M., Bugge, M. M., Hansen, T., Hansen, T., Klitkou, A., & Klitkou, A. (2016). What Is the Bioeconomy? A Review of the Literature. *Sustainability, 8*(7), 691. https://doi.org/10.3390/su8070691

Centro de Gestão e Estudos Estratégicos. (2006). *Rede de Inovação da Biodiversidade da Amazônia*. CGEE.

Centro de Gestão e Estudos Estratégicos. (2007). *Sub-rede de Dermocosméticos na Amazônia a partir do uso sustentável de sua biodiversidade com enfoques para as cadeias produtivas da: Castanha-do-pará e dos óleos de andiroba e copaíba*. CGEE.

Centro de Gestão e Estudos Estratégicos. (2008). *Mapeamento e diagnóstico das instituições de ensino e pesquisa, e empresas existentes na região norte e suas competências em C,T&I, para implantação da Sub-rede de Inovação de Dermocosméticos*. CGEE.

Coordenação das Organizações Indígenas da Amazônia Brasileira. (2021) *Carta da Amazônia 2021: Aos Participantes da 26a Conferência das Nações Unidas sobre Mudanças Climáticas (cop26)*. Belém.

Costa, F. A. (2009). Desenvolvimento agrário sustentável na Amazônia: Trajetórias tecnológicas, estrutura fundiária e institucionalidade. In *Centro de Gestão e Estudos Estratégicos – CGEE. Um Projeto Para a Amazônia no Século 21: desafios e contribuições.* CGEE.

Costa, F. A. (2012). *Ciência, tecnologia e sociedade na Amazônia: Questões para o desenvolvimento sustentável*. NAEA.

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). *Bioeconomia da sociobiodiversidade no estado do Pará* Brasília. DF: The Nature Conservancy (TNC Brasil). Banco Interamericano de Desenvolvimento (BID). Natura.

Costa, F. A., Nobre, C., Genin, C., Medeiros Rocha Frasson, C., Araújo Fernandes, D., Silva, H., Vicente, I., Takaes Santos, I., Feltran-Barbieri, R., Ventura R. Neto, & Folhes, R. (2022). Uma bioeconomia inovadora para a Amazônia: conceitos, limites e tendências para uma definição apropriada ao bioma floresta tropical. https://concertacaoamazonia.com.br/estudos/uma-bioeconomia-inovadora-para-a-amazonia-conceitos-limites-e-tendencias-para-uma-definicao-apropriada-ao-bioma-floresta-tropical/?gad_source=1&gclid=CjwKCAiA6aW6BhBqEiwA6KzDc_ZpkbmH_pl-jc-ElpJSLHpz7sV7DGVKqgO7OHgDdV5wY0wM5JeDbxoCM3sQAvD_BwE

Dagnino, R., Brandão, F. C., & Novaes, H. T. (2010). Sobre o marco analítico-conceitual da tecnologia social. In R. Dagnino (Org.), Tecnologia social: Ferramenta para construir outra sociedade (2nd. ed.). Komedi.

Dagnino, R. (2014). Tecnologia Social: Contribuições conceituais e metodológicas. Eduepb.

Dias, R. B. (2013). Tecnologia social e desenvolvimento local: Reflexões a partir da análise do Programa Um Milhão de Cisternas. *Revista Brasileira de Desenvolvimento Regional, 1*(2), 173–189. https://www.resbr.net.br/tecnologia-social-e-desenvolvimento-local-reflexoes-a-partir-da-analise-do-programa-um-milhao-de-cisternas/?srsltid=AfmBOooIGLbtoyjrnwg7yxPoEkys4-twCAmEe8m2X7Mj5Sa2obx_AZO_q

Duchêsne, L. C., & Wetzel, S. (2003). The bioeconomy and the forestry sector: Changing markets and new opportunities. *Forestry Chronicle*, *79*, 860–864. https://api.semanticscholar.org/CorpusID:85290929

European Commission. (2005). New Perspectives on the Knowledge-Based Bioeconomy: Conference Report. *European Commission*. https://www.normalesup.org/~adanchin/lectures/kbbe_conferencereport.pdf

Freitas, C. C. G., & Segatto, A. P. (2014). Ciência, tecnologia e sociedade pelo olhar da Tecnologia Social: Um estudo a partir da Teoria Crítica da Tecnologia. *Cadernos EBAPE.BR*, *12*(2), 302-320. http://doi.org/10.1590/1679-39517420

Frisvold, G. B., Moss, S. M., Hodgson, A., & Maxon, M. E. (2021). Understanding the U.S. bioeconomy: A new definition and landscape. *Sustainability, 13*(4), 1–24. http://doi.org/10.3390/su13041627

Fundação Banco do Brasil. (2024a). Encauchados de Vegetais da Amazônia. Disponível em: https://transforma.fbb.org.br/tecnologia-social/encauchados-de-vegetais-da-amazonia

Fundação Banco do Brasil. (2024b). Cernambi Virgem Ecológico. Disponível em: https://transforma.fbb.org.br/tecnologia-social/cernambi-virgem-ecologico

Fundação Banco do Brasil. (2024c). Metodologia para Construir e Reaplicar uma Tecnologia Social na Agricultura Familiar. https://transforma.fbb.org.br/tecnologia-social/metodologia-para-construir-e-reaplicar-uma-tecnol-social-na-agricultura-familiar

Garrett, R., Ferreira, J., Abramovay, R., Brandão, J., Brondizio, E., Euler, A., Pinedo, D., Porro, R., Rocha, E. C., Sampaio, O., Schmink, M., Torres, B., & Varese, M. (2023). Apoiando Sociobioeconomias de Saudáveis Florestas em Pé e Rios Fluindo na Amazônia. https://acervo.socioambiental.org/acervo/documentos/apoiando-sociobioeconomias-de-florestas-em-pe-e-rios-fluindo-saudaveis-na

González, R. R. (2016). Similitudes y diferencias de los programas de Desarrollo Local en Europa y América Latina. ¿Es posible establecer comparaciones? *Interações (Campo Grande)*, *1*(1). https://doi.org/10.20435/interações.v1i1.609

Hansen, J. (2014). The Danish Biofuel Debate: Coupling Scientific and Politico-Economic Claims. *Science as Culture*, *23*(1), 73–97. https://doi.org/10.1080/09505431.2013.808619

Heimann, T. (2019). Bioeconomy and SDGs: Does the Bioeconomy Support the Achievement of the SDGs? *Earth's Future, 7*(1), 43–57. https://doi.org/10.1029/2018EF001014

Hughes, T. (1983). Networks of Power. Johns Hopkins University Press eBooks.

Hughes, T. (1987). The Evolution of Large Technological Systems. In W. E. Bijker, T. P. Hughes, & T. J. Pinch (Eds.), *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (pp. 51-82). MIT Press.

Infoamazonia. (2023). Sociobioeconomia se transforma na Amazônia e reconhece papel central de populações tradicionais para desenvolvimento sustentável. https://infoamazonia.org/2023/09/05/sociobioeconomia-se-transforma-na-amazonia-e-reconhece-papel-central-de-/populacoes-tradicionais-para-desenvolvimento-sustentavel/

Jesus, V. M. B. de., & Bagattolli, C. (2013). Integração de tecnologias sociais: Reflexões sobre práticas iniciais. In A. B. Costa (Org.), Tecnologia social políticas públicas (pp. 207-222). Instituto Pólis Fundação Banco do Brasil Gapi/Unicamp São Paulo.

Juárez, P. (2020). Hacia la construcción de Sistemas Tecnológicos Sociales: ¿cómo se transforman "conceptos" en "praxis" para el desarrollo inclusivo sustentable? In H. E. Thomas et al. (Orgs.), Tecnologías públicas: estrategias políticas para el desarrollo inclusivo sustentable (1. ed., pp. 101-139). Universidad Nacional de Quilmes.

Juárez, P., & Becerra, L. (2012). Alianzas socio-técnicas, estrategias y políticas para el desarrollo inclusivo y sustentable. In 6º Congreso de ALACIP. La investigación política en América Latina, Quito, Ecuador.

Levidow, L., Birch, K., & Papaioannou, T. (2012). Divergent Paradigms of European Agro-Food Innovation: The Knowledge-Based Bio-Economy (KBBE) as an R&D Agenda. *Science, Technology, & Human Values*, *38*(1), 94–125. https://doi.org/10.1177/0162243912438143

Lopes, C. L., & Chiavari, J. (2022). Bioeconomia na Amazônia: Análise Conceitual, Regulatória e Institucional. *Projeto Amazônia 2030*. https://amazonia2030.org.br/wp-content/uploads/2022/09/Bioeconomia-na-Amazonia-1.pdf

Magno, T. S. do C, Albuquerque Vasconcellos, A. M., Barros , J. N., & Arroyo, J. C. T. (2022). Economia solidária como estratégia para o desenvolvimento local. *P2P e Inovação*, *8*(2), 15-34. https://doi.org/10.21721/p2p.2022v8n2.p15-34

Marsden, T. (2012). Towards a real sustainable agri-food security and food policy: Beyond the Ecological Fallacies? *Political Quarterly*, *83*(1), 139–145. https://doi.org/10.1111/j.1467-923X.2012.02242.x

McCormick, K., & Kautto, N. (2013). The Bioeconomy in Europe: An Overview. *Sustainability, 5*(6), 2589–2608. https://doi.org/10.3390/su5062589

Ministério do Meio Ambiente e Mudança do Clima. (2024). *Diálogos do Plano Nacional da Sociobioeconomia*. https://www.gov.br/mma/pt-br/composicao/sbc/dialogos-do-plano-nacional-da-sociobioeconomia.

Mitschein, T. A., Rocha, G. de M., & Vasconcellos, M. Sobrinho (2013). *Desenvolvimento Local e o Direito à Cidade na Floresta Amazônica*. NUMA/UFPA.

Morrison, M., & Cornips, L. (2012). Exploring the role of dedicated online biotechnology news providers in the innovation economy. *Science, Technology, & Human Values*, *37*(3), 262–285. http://www.jstor.org/stable/41511174

Oláh, J., Chuluunbaatar, E., Balázs, E., & Popp, J. (2023). The socio-environmental challenges in the transition to sustainable bioeconomy: A review. *Acta Montanistica Slovaca, 28*(1), 98–112. https://10.46544/AMS.v28i1.09

Peltomaa, J. (2018). Drumming the *Barrels of H*ope? Bioeconomy narratives in the media. *Sustainability, 10*(11). https://doi.org/10.3390/su10114278

Picabea, F. (2017). *Los sistemas tecnológicos sociales como herramienta para orientar procesos inclusivos de innovación y desarrollo en América Latina Universidad de Buenos Aires*. Facultad de Arquitectura, Diseño y Urbanismo. Centro de Hábitat Inclusivo. http://www.habitatinclusivo.com.ar/revista/sistemas-tecnologicos-sociales-como-herramienta-para-orientar-procesos-inclusivos/

Platt, J. (1992). Cases of cases … of cases. In: Ragin, C. C.; Becker, H. S. (Eds.), *What is a case?* Cambridge University Press.

Ragin, C. C. (1992). "Casing" and the process of social inquiry. In C. C. Ragin, & H. S. Becker (Eds.), *What is a case?* Cambridge University Press.

Rosenfeld, T., & Poschen, P. (2024). Conceitos e Desafios da Bioeconomia dos Produtos Florestais Não Madeireiros. In J. Marcovitch, & A. Val (2024). *Bioeconomia para quem? Bases para um desenvolvimento sustentável na Amazônia*. Com-Arte.

Staffas, L., Gustavsson, M., & McCormick, K. (2013). Strategies and policies for the bioeconomy and bio-based economy: An analysis of official national approaches. *Sustainability*, *5*(6), 2751–2769. https://doi.org/10.3390/su5062751

Thomas, H. E. (2012). Tecnologías para la inclusión social en América Latina: De las tecnologías apropiadas a los sistemas tecnológicos sociales. In H. E. Thomas (Org.), *Tecnología, desarrollo y democracia: nueve estudios sobre dinámicas socio-técnicas de exclusión/inclusión social* (pp. 25-78). Ministerio de Ciencia, Tecnología e Innovación Productiva.

Thomas, H. E., Juarez, P., & Picabea, F. (2015). *Tecnología y Desarrollo ¿Qué son las tecnologías para la inclusión social?* (1st. ed.). Red de Tecnologías para la Inclusión Social; Universidad Nacional de Quilmes.

Uma Concertação pela Amazônia (Org.) (2023). *Bioeconomia: A evolução do debate e repercussões nas Amazônias*. (Cadernos da Concertação, 2).

Vivien, F. D., Nieddu, M., Befort, N., Debref, R., & Giampietro, M. (2019). The Hijacking of the Bioeconomy. *Ecological Economics, 159*, 189–197. https://doi.org/10.1016/j.ecolecon.2019.01.027

Authorship

Diana Cruz Rodrigues*

Universidade da Amazônia, Programa de Pós-Graduação em Administração

Av. Alcindo Cacela, n. 287, Umarizal, CEP 66060-902, Belém, PA, Brazil

E-mail: dicruzrodrigues@gmail.com

https://orcid.org/0000-0001-6670-8907

Artur da Silva Ribeiro

Universidade da Amazônia, Programa de Pós-Graduação em Administração

Av. Alcindo Cacela, n. 287, Umarizal, CEP 66060-902, Belém, PA, Brazil

E-mail: arthurribeiro@museu-goeldi.br

https://orcid.org/0000-0002-4971-6873

João Paulo dos Santos da Silva

Universidade da Amazônia, Programa de Pós-Graduação em Administração

Av. Alcindo Cacela, n. 287, Umarizal, CEP 66060-902, Belém, PA, Brazil

E-mail: joaopssilva803@gmail.com

https://orcid.org/0000-0002-6096-4544

Cláudia Souza Passador

Universidade de São Paulo, Faculdade de Economia, Administração e Contabilidade de Ribeirão Preto

Av. Bandeirantes, n. 3900, Vila Monte Alegre, CEP 14040-905, Ribeirão Preto, SP, Brazil

E-mail: cspassador@usp.br

https://orcid.org/0000-0002-9333-563X

* Corresponding Author

Authors' Contributions

1st author: conceptualization (lead), formal analysis (equal), investigation (lead), methodology (lead), writing - original draft (lead), writing - review & editing (lead).

2nd author: formal analysis (equal), data curation (equal), investigation (supporting), writing - original draft (supporting).

3rd author: conceptualization (supporting), investigation (equal), writing - original draft (supporting), writing - review & editing (supporting).

4th author: supervision (lead), writing – review & editing (equal), data curation (equal), resources (lead).

Copyrights

Funding

The authors thank the Coordination for the Improvement of Higher Education Personnel (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior [CNPq])(código de financiamento 001) for the financial support.

Conflict of Interests

The author informed that there is no conflict of interests.

Plagiarism Check

RAC maintains the practice of submitting all documents approved for publication to the plagiarism check, using specific tools, e.g.: iThenticate.

Peer Review Method

This content was evaluated using the double-blind peer review process. The disclosure of the reviewers' information on the first page, as well as the Peer Review Report, is made only after concluding the evaluation process, and with the voluntary consent of the respective reviewers and authors.

Data Availability

The authors claim that all data used in the research have been made publicly available, and can be accessed via the Harvard Dataverse platform:

Rodrigues, Diana Cruz; Ribeiro, Artur da Silva; Silva, João Paulo dos Santos da; Passador, Cláudia Souza, 2024, "Replication Data for: Sociobioeconomy and social technology in the Amazon region: An integrated framework proposition published by RAC-Revista de Administração Contemporânea", Harvard Dataverse, V1. https://doi.org/10.7910/DVN/SKBWIX

RAC encourages data sharing but, in compliance with ethical principles, it does not demand the disclosure of any means of identifying research subjects, preserving the privacy of research subjects. The practice of open data is to enable the reproducibility of results, and to ensure the unrestricted transparency of the results of the published research, without requiring the identity of research subjects.

RAC is a member of, and subscribes to the principles of the Committee on Publication Ethics (COPE) for scholarly publication

COPE Member since 2020 JM14878