



CONSTRAINTS ON AN INCLUSIVE BIOECONOMY: A NEO-INSTITUTIONAL ANALYSIS OF THE MURUMURU PRODUCTIVE CHAIN IN THE AMAZON — JURUÁ REGIONAL AREA, ACRE

**RESTRIÇÕES À BIOECONOMIA INCLUSIVA: UMA ANÁLISE
NEOINSTITUCIONAL DA CADEIA PRODUTIVA DO MURUMURU
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ABSTRACT

This article analyzes the constraints to the consolidation of an inclusive bioeconomy in the Amazon, focusing on the murumuru production chain in the Juruá Region, in the state of Acre, Brazil. It is based on the research problem that examines the gap between the theoretical potential of the bioeconomy as a strategy for sustainable regional development and its effective capacity to promote productive inclusion and economic dynamization in local territories. The main objective is to identify the institutional, economic, and territorial factors that shape this gap, based on the role of Coopercintra. The theoretical framework is grounded in the neoinstitutional approach, with emphasis on the contributions of North and Williamson, particularly regarding the role of institutions and transaction costs in coordinating economic activities. Methodologically, the study adopts a qualitative approach, combining documentary analysis of administrative records and public policies with empirical research based on semi-structured interviews and direct observation. The results show that the murumuru production chain is strongly conditioned by high transaction costs, arising from logistical constraints, information asymmetries, institutional weaknesses, and dependence on public subsidies. Although organizational initiatives, such as the cooperative, and territorial assets help mitigate some of these constraints, structural limitations persist, restricting value addition and the economic autonomy of producers. The study concludes that the consolidation of the bioeconomy in the region depends on institutional strengthening, the reduction of transaction costs, and the implementation of integrated and territorially oriented public policies.

Keywords: Inclusive bioeconomy. Neoinstitutionalism. Transaction costs. Regional development. Amazon.

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RESUMO

O presente artigo analisa as restrições à consolidação da bioeconomia inclusiva na Amazônia, com foco na cadeia produtiva do murumuru na Regional do Juruá, no estado do Acre. Parte-se do problema de pesquisa que investiga o descompasso entre o potencial da bioeconomia como estratégia de desenvolvimento regional sustentável e sua efetiva capacidade de gerar inclusão produtiva e dinamização econômica nos territórios. O objetivo central consiste em identificar os fatores institucionais, econômicos e territoriais que condicionam esse descompasso, a partir da atuação da Coopercintra. O referencial teórico fundamenta-se na abordagem neoinstitucional, com ênfase nas contribuições de North e Williamson, especialmente no que se refere ao papel das instituições e dos custos de transação na coordenação das atividades econômicas. Metodologicamente, adota-se uma abordagem qualitativa, combinando análise documental de registros administrativos e políticas públicas com pesquisa empírica baseada em entrevistas semiestruturadas e observação direta. Os resultados evidenciam que a cadeia produtiva do murumuru é fortemente condicionada por elevados custos de transação, decorrentes de limitações logísticas, assimetrias de informação, fragilidades institucionais e dependência de subsídios públicos. Embora iniciativas organizacionais, como a cooperativa, e ativos territoriais contribuam para mitigar parte desses entraves, persistem restrições estruturais que limitam a agregação de valor e a autonomia econômica dos produtores. Conclui-se que a consolidação da bioeconomia na região depende do fortalecimento institucional, da redução dos custos de transação e da implementação de políticas públicas integradas e territorializadas.

Palavras-chave: Bioeconomia Inclusiva, custos de transação, neoinstitucionalismo, desenvolvimento regional e Amazônia

INTRODUCTION

The intensification of natural resource exploitation associated with the expansion of industrial production systems and the scaling up of consumption on a global level has increased pressures on ecosystems and deepened socioeconomic inequalities. Although technological and institutional advances have promoted significant transformations in models of production and accumulation, structural constraints on reconciling economic growth, environmental conservation, and social inclusion persist. In this context, the climate crisis and the accelerated loss of biodiversity have brought back to the forefront the need to devise development strategies capable of articulating environmental sustainability, economic dynamization, and social justice (Sachet, 2026).

In the Amazon, this discussion acquires particular strategic importance due to the ecological relevance of the biome and its prominence in global debates on climate change. In addition to harboring exceptionally high biodiversity, the region plays a fundamental role in climate regulation and in the maintenance of ecosystem services, especially in light of emissions associated with deforestation and land-use change. Given this scenario, the formulation of regional development strategies necessarily requires recognition of the importance of forest conservation and the promotion of economic activities compatible with environmental sustainability (Acre, 2023).



In this context, the bioeconomy has emerged as one of the leading contemporary paradigms of sustainable development for the Amazon. Grounded in the sustainable use of biodiversity and the valorization of socio-biodiversity assets, the bioeconomy seeks to integrate income generation, environmental conservation, and productive inclusion. However, despite the growing incorporation of this concept into public policies, government programs, and business strategies, empirical evidence from various contexts reveals a mismatch between the expectations associated with the bioeconomy and its actual capacity to promote structural transformations in Amazonian territories (Acre, 2023).

In the field of regional development, this mismatch can be interpreted from a neo-institutional perspective, which emphasizes the role of institutions in coordinating economic activities and reducing the uncertainties inherent in production processes. As North (1990) and Williamson (1985) argue, economic performance depends not only on the availability of natural resources or productive capabilities, but also on formal and informal rules that structure interactions among actors. From this perspective, factors such as high transaction costs, information asymmetries, organizational weaknesses, and low institutional coordination capacity tend to constrain the efficiency and competitiveness of productive chains (Forero, 2017; Williamson, 1985).

In the Amazonian context, these constraints become even more complex due to the spatial dispersion of production, inadequate logistics infrastructure, low institutional density, and dependence on public policies. These characteristics directly affect the capacity to add value, production stability, and the competitiveness of socio-biodiversity productive chains. Therefore, understanding the constraints on the bioeconomy in the Amazon requires an analytical approach that brings together economic, institutional, and territorial dimensions, moving beyond interpretations restricted to productive efficiency or the region's ecological potential.

It is within this context that the present study is situated. This study aims to analyze the factors that explain the mismatch between the potential of the bioeconomy and its actual contribution

to regional development, based on the murumuru¹ productive chain in the Juruá Regional Area², in the State of Acre. The empirical focus is on the activities of the Cooperativa de Produtores da Agricultura Familiar e Economia Solidária de Nova Cintra (*Nova Cintra Cooperative of Family Farming and Solidarity Economy Producers — Coopercintra*), which is responsible for organizing production, processing, and marketing murumuru, playing a strategic role in connecting extractivist communities, public policies, and markets.

The Juruá Regional Area constitutes an emblematic case for this type of analysis, as it exhibits characteristics typical of peripheral Amazonian territories marked by logistical constraints, limited access to services, weak institutional connectivity, and strong dependence on forest resources for the socioeconomic reproduction of local populations. At the same time, it is home to relevant experiences of collective organization linked to socio-biodiversity, allowing for an empirical examination of the relationships among cooperativism, territorial governance, and the bioeconomy.

Methodologically, the research adopts a qualitative, descriptive-analytical approach and was conducted as a case study. The investigation combines a literature review, document analysis, and fieldwork, drawing on data from administrative records, institutional documents, legislation, and materials related to public policies supporting extractivism. In addition, semi-structured interviews and direct observation were conducted, making it possible to capture local practices, perceptions,

1 Murumuru (*Astrocaryum murumuru*) is a palm tree native to the Amazon, found particularly in floodplain areas and wet environments. Its fruits contain seeds from which a vegetable fat known as murumuru butter is extracted, valued for its moisturizing and emollient properties. It is therefore used primarily by the cosmetics and personal care industries in creams, soaps, shampoos, conditioners, and other hair-care products. The murumuru productive chain encompasses the set of activities, actors, institutions, and territorial relationships involved from fruit collection by extractivist communities through processing, transformation, and marketing. Beyond physical and economic flows, this chain incorporates traditional knowledge, forms of collective organization, institutional and market relationships, and mechanisms for the generation, appropriation, and distribution of value, constituting a particularly useful setting for analyzing the possibilities and limitations of the Amazonian territorial bioeconomy.

2 The study area is located in the Juruá Regional Area, one of the development regions used by the State of Acre for territorial planning and organization, in the State's far northwestern corner. It comprises the municipalities of Cruzeiro do Sul, Mâncio Lima, Marechal Thaumaturgo, Porto Walter, and Rodrigues Alves. Together, these municipalities cover an area of 31,948.77 km² (Acre em Números, 2023). The Juruá Regional Area is characterized by an extensive river network that plays a fundamental role in the movement of people, goods, and products, particularly in areas where road infrastructure is limited. BR-364 is the main overland axis connecting the region. Within this territorial context, the empirical focus of the research encompasses the Nova Cintra Settlement and communities located around the processing facility, which form part of Coopercintra's area of operation in the murumuru productive chain. The analysis focuses on this chain, with particular emphasis on the perspectives of extractivist communities and Coopercintra, which is responsible for processing and marketing the product in the region. This particular approach is justified by the cooperative's role as a link between extractivist communities, public policies, and markets, providing a privileged space for analyzing, through the concrete dynamics of the territory, the constraints, potentialities, and contradictions associated with building a territorial bioeconomy in the Amazon.

and dynamics that are often absent from secondary sources.

By bringing together empirical evidence and the neo-institutional framework, this article provides a critical interpretation of the potential of the bioeconomy as a strategy for sustainable regional development and its actual capacity to promote productive inclusion and economic dynamization in territories, thereby contributing to the formulation of more inclusive and sustainable regional development strategies.

In addition to this introduction, the article comprises five sections. The first presents the theoretical framework underpinning the analysis, addressing debates on the bioeconomy, inclusive bioeconomy, regional development, territory, and the neo-institutional perspective. The second section describes the methodological procedures adopted, detailing the research design, study area, data collection strategies, and analytical framework used to interpret the findings. The third section characterizes the Juruá Regional Area and the murumuru productive chain, highlighting their organizational and institutional aspects. The fourth section presents and discusses the research findings in light of the theoretical framework, emphasizing the relationships among institutions, transaction costs, organizational capabilities, inclusive bioeconomy, and regional development. Finally, concluding remarks revisit the main findings and present the study's limitations and prospects for future research on the bioeconomy, extractivism, and regional development in the Amazon.

THEORETICAL PERSPECTIVES OF THE BIOECONOMY

The bioeconomy is neither a homogeneous nor a consensual concept; rather, it constitutes a field marked by conceptual disputes and distinct theoretical and political interpretations. To a large extent, approaches developed in countries of the Global North tend to prioritize technological and industrial dimensions, such as biotechnology and bio-based inputs, often detached from the socio-environmental specificities of territories. This orientation tends to shift attention away from environmental conservation, the valorization of traditional knowledge, and social inclusion, which are central aspects of the Amazonian reality. In this sense, the conceptual debate becomes essential to avoid reproducing exogenous models that, instead of addressing historical inequalities, may deepen them (Barabinot, 2025; Padovezi; Munhoz; Goulart, 2024).



Despite these divergences, it is possible to identify points of convergence among different theoretical currents, even as distinctions related to analytical foundations, implementation strategies, and scales of action remain evident. Georgescu-Roegen's perspective emphasizes the ecological limits of the economic system by recognizing that natural resources are finite and undergo degradation throughout the production process (Silva, 2023). This interpretation is consistent with the guidelines of the German Bioeconomy Summit (GBS, 2018), which emphasize the need to reduce environmental impacts, promote the sustainable use of biological resources, and expand technological solutions oriented toward sustainability. Although they stem from different intellectual traditions — one rooted in the biophysical critique of economics and the other oriented by innovation and global policy agendas — both converge in advocating environmentally responsible production models.

Bugge and Hansen (2016) deepen this debate by proposing a typology of the bioeconomy structured around three approaches: biotechnology, bio-resources, and bio-ecology. The biotechnology approach emphasizes the application of advanced biotechnologies for the development of products such as pharmaceuticals and biofuels; the bio-resources approach focuses on replacing fossil resources with renewable raw materials through the organization of biomass-based productive chains; and the bio-ecology approach values sustainable production systems that are strongly rooted in the territory and oriented toward the conservation of biodiversity and local identity.

Whereas the biotechnology and bio-resources approaches are aligned with the GBS (2018) guidelines in emphasizing technological innovation and the substitution of fossil resources, the bio-ecology approach is closer to the perspective presented by Silva (2023), as it values territorialized, sustainable production systems grounded in biodiversity. This differentiation reveals a significant contrast between models oriented by technological expansion and industrial scale and proposals that prioritize environmental conservation, territorial identity, and local ways of life.

According to Pamplona, Salarini, and Kadri (2021), the bioeconomy has become one of the central themes in the contemporary debate on sustainable development, particularly because of its potential to promote economic growth, technological innovation, and environmental conservation. In recent years, discussions concerning its meanings and its actual capacity to foster sustainable development in the Amazon have intensified. Although different interpretations coexist regarding its modalities and

dimensions, particular emphasis has been placed on the conception of a bioeconomy committed to environmental conservation and social inclusion, linking biodiversity, traditional knowledge, science, and technological innovation to production and resource-management processes (Porro, 2025).

Moreover, within the global agenda, the bioeconomy has been presented as a strategic alternative for reducing environmental impacts and addressing climate change. This model is grounded in the valorization of renewable biological resources, the mitigation of environmental degradation, the reuse of waste, and the advancement of scientific research in biological technologies, thereby strengthening sustainable production processes and broadening opportunities for innovation (GBS, 2018).

In this context, the Amazon stands out internationally due to its vast biological diversity and the ecosystem services it provides on a global scale, making it a strategic territory for the consolidation of the bioeconomy. The sustainable use of natural resources represents a relevant alternative for promoting sustainable regional development, particularly through the economic valorization of non-timber forest products (such as fruits, seeds, and vegetable oils), thereby reconciling income generation, environmental conservation, and the strengthening of local economies (Pamplona; Salarini; Kadri, 2021).

At the national level, the inclusive bioeconomy — also referred to as the socio-bioeconomy — constitutes one of the central pillars of the National Bioeconomy Strategy, established in 2024 and aimed at enhancing forest and socio-biodiversity economies. According to Decree No. 12,044/2024, the bioeconomy is a model of economic and productive development based on the sustainable use, regeneration, and conservation of biodiversity, connecting scientific and traditional knowledge, innovation, and technology to generate value, employment, income, and climate balance (Brasil, 2024).

Given this context, the formulation of public policies and multisectoral actions points to the need to strengthen productive systems capable of addressing the climate crisis while simultaneously promoting sustainable livelihoods for local communities. Thus, inclusive bioeconomies are of strategic importance, particularly in recognizing the key role of Indigenous peoples, traditional communities, and family farmers in natural resource management and market access, thereby contributing to regional development with greater social equity, environmental conservation, and improved living conditions (Porro, 2025).

Pinsky, Marcovitch, and Val (2024), however, observe that the Amazonian bioeconomy still has an incipient institutional structure and is characterized by limitations in coordination, a lack of integrated

metrics, and difficulties in coordination among different levels of government. The authors emphasize that decentralized governance can foster the participation of local actors and broaden the distribution of power in public policy implementation processes.

From this perspective, multilevel governance emerges as an essential element in building an inclusive and sustainable bioeconomy. According to Pinsky, Marcovitch, and Val (2024), public policies aimed at the bioeconomy should be grounded in vertical alignment across different institutional scales, integration among sectoral policies, and a clear allocation of responsibilities between the state and non-state actors. This framework is presented as an indispensable condition for promoting socioeconomic development alongside environmental conservation (Pinsky; Marcovitch; Val, 2024).

NEO-INSTITUTIONAL FOUNDATIONS

As Plein and Filippi (2010) demonstrate, the neo-institutional approach, developed by Douglass North (1994), represents a critical departure from traditional neoclassical theory by questioning central assumptions such as full rationality, equilibrium, and the absence of transaction costs. By operating with the notion of a static and frictionless economic system, neoclassical theory proves insufficient to explain development processes that are, by definition, dynamic, historical, and evolutionary. In contrast, North (1994) places institutions at the center of the analysis, understanding them as the set of formal and informal rules that structure human interactions and shape economic incentives, thereby conditioning the performance of economies.

Along the same lines, Forero (1997) argues that real economic systems are permeated by tensions between individual and collective interests, while also being characterized by uncertainties and informational constraints that directly affect actors' decisions. Unlike the neoclassical perspective, neo-institutionalism recognizes that transaction costs are inherent in economic interactions, as these involve negotiation, contract drafting and monitoring, as well as coordination mechanisms. In this context, institutions cease to occupy a secondary position and assume a central role in economic analysis, being regarded as structures that organize, regulate, and condition actors' behavior. These institutions, both formal and informal, are endogenous to the economic system; that is, they are historically constructed and evolve in response to social, political, and economic dynamics.



Complementing this perspective, Forero (2017) emphasizes that the neo-institutional approach directs analysis toward concrete problems faced by economic actors, such as the high costs associated with drafting and enforcing contracts, weak property rights, the presence of risks and uncertainties, and information imperfections. These factors become particularly evident in peripheral regions, such as the State of Acre, where institutional fragility undermines coordination among actors and limits the prospects for economic development. Furthermore, this approach emphasizes that economic dysfunctions do not result exclusively from market failures, but may also stem from unstable or poorly designed public policies that increase inefficiencies and raise costs. Williamson (1985) contributes by demonstrating that, faced with behavioral limitations and the presence of transaction costs, firms emerge as specific institutional arrangements for economizing on such costs.

Therefore, neo-institutional principles indicate that economic efficiency does not depend solely on technological advances, but is deeply associated with the quality of institutions and governance mechanisms. Reducing transaction costs and strengthening the rules of the game are, in this sense, essential conditions for building a more inclusive, resilient, and sustainable bioeconomy (North, 1990; Williamson, 1985).

METHODOLOGICAL PROCEDURES

The research adopts a qualitative, descriptive-analytical approach, using a case study of the murumuru productive chain in the Juruá Regional Area, Acre. The case was selected because it represents a relevant bioeconomy experience based on Amazonian socio-biodiversity and allows for an analysis of the relationships among institutions, markets, and regional development.

Data collection drew on three sources: documentary research (legislation, institutional reports, Coopercintra documents, and government data), semi-structured interviews with actors involved in the productive chain, and direct observation of collection, processing, and marketing activities. The data were analyzed using thematic content analysis organized into four categories derived from the theoretical framework: (a) institutions and governance; (b) transaction costs; (c) coordination and cooperation strategies; and (d) contributions to and constraints on regional development.



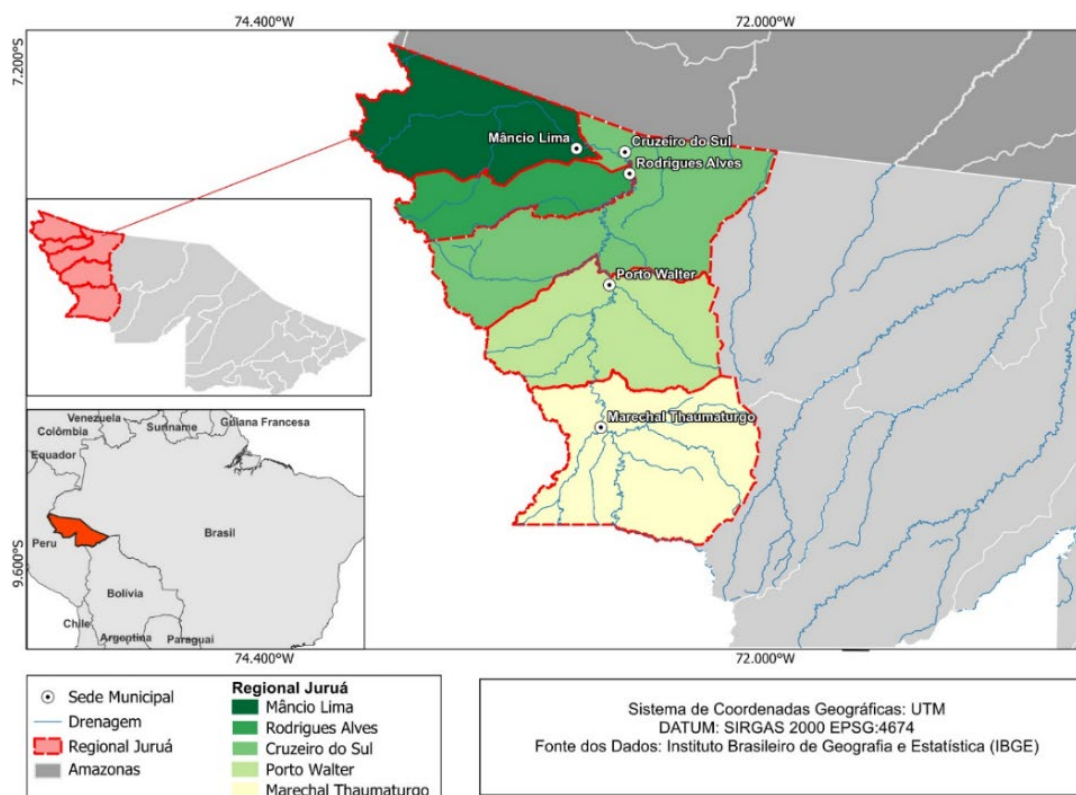
The findings were interpreted through triangulation of documentary evidence, empirical data, and theoretical categories from neo-institutionalism, with the aim of identifying how institutional, economic, and territorial factors condition the capacity of the murumuru productive chain to promote productive inclusion, value addition, and sustainable regional development.

The study area is located in the Juruá Regional Area, in the State of Acre's far northwestern corner. It comprises the municipalities of Cruzeiro do Sul, Mâncio Lima, Marechal Thaumaturgo, Porto Walter, and Rodrigues Alves. Together, these municipalities cover an area of 31,948.77 km² (Acre em Números, 2023). The territory is predominantly reliant on the river network as a means of circulation and integration, especially where road infrastructure is limited (BR-364 is the main regional overland axis). The empirical focus encompasses the Nova Cintra Settlement and communities located around the processing facility, which form part of Coopercintra's area of operation in the murumuru productive chain. The central empirical unit of the study is focused on the murumuru productive chain in the Juruá Regional Area, with emphasis on the perspectives of extractivist communities and Coopercintra, which is responsible for processing and marketing the product in the region. This approach is justified by the cooperative's role as an organizational link between communities, public policies, and markets, providing a privileged space for observing constraints and potentialities of the territorial bioeconomy.

Primary data were collected during fieldwork conducted in August 2025 through semi-structured interviews and direct observation. The communities of Miritizal and Nova Cintra were visited, the latter being home to Coopercintra and the murumuru processing facility. A total of ten semi-structured interviews were conducted with actors directly involved in the productive chain, including extractivist workers, community leaders, and cooperative representatives. Among the interviewees were the president and administrative director of Coopercintra, as well as two community leaders. In addition, a group meeting was held with approximately ten residents of the Miritizal community. The approach adopted emphasized open and participatory dialogue, allowing issues related to extractivist practices, local environmental conditions, socio-environmental concerns, and logistical challenges associated with transporting the production to markets to emerge beyond those addressed in the interview guide. Participants were selected through purposive sampling,

prioritizing individuals with experience and knowledge of the productive, organizational, and institutional processes related to murumuru. Data collection was concluded when accounts began to exhibit similar interpretive patterns regarding logistical costs, dependence on economic subsidies, and challenges related to value addition, indicating theoretical saturation.

Image 1 | Juruá Regional Area, Acre



Source: Prepared by the author (2025)

Following the initial systematization of the data, a second visit to Coopercintra was conducted in October 2025 to supplement information on murumuru production and marketing during the most recent harvests and to observe access conditions during the rainy season. Due to the difficulties involved in accessing the forest areas where murumuru is collected and the high logistical costs, it was not possible to visit the murumuru extraction sites. To mitigate this limitation, priority was given to direct observation in the communities and at the cooperative's processing facility, as well as to field records (photographs of access routes, vegetation, and production facilities), which were used to support the description and interpretation of the findings.

The data were subjected to thematic content analysis guided by the categories defined in Table 1. The interview stage was concluded based on the criterion of theoretical saturation, understood as the point at which new accounts no longer yield substantively new information regarding the categories under investigation and instead reiterate patterns already identified in the research. The findings were interpreted through triangulation of interviews, field observations, and institutional documents, with the aim of strengthening analytical consistency and reliability of the findings.

Table 1 | Theoretical-Analytical Categories

Analytical Axis	Categories
Inclusive Bioeconomy	Productive inclusion; environmental sustainability
Institutions and Governance	Formal institutions; informal institutions; territorial governance
Transaction Costs	Logistical costs; information costs; coordination costs
Regional Development	Value addition; economic dynamization; territorial autonomy
Structural Constraints	Territorial constraints; institutional dependence; market constraints

Source: Original work based on research

THE CENTRALITY OF INSTITUTIONS AND TRANSACTION COSTS IN REGIONAL DEVELOPMENT

Markets and institutions are not separate spheres but interdependent dimensions that mutually shape one another. This interrelationship helps explain why countries and regions with similar resources follow different development trajectories. The key difference lies, above all, in how institutions structure, regulate, and coordinate economic activity. Markets therefore operate according to particular rules and social relationships, so that their performance is directly conditioned by the quality of these institutional structures. From this perspective, understanding economic development, especially at the regional level, requires not only an analysis of available resources but also an examination of the institutions that guide their mobilization and use (Forero, 1997).



In this context, the state goes beyond its strictly regulatory function and comes to be understood as a central element in creating institutional conditions conducive to development. Neo-institutionalism holds that institutions, understood as formal and informal rules that organize economic and social life, play a decisive role in explaining economic performance. For the debate on regional development, this approach reveals that growth does not depend exclusively on productive or technological factors, but on the quality of institutions, their stability, and the ability of actors to interact effectively within the framework of these rules.

Another fundamental aspect of the analysis of regional development concerns transaction costs. According to Forero (2017), transaction cost theory makes it possible to understand that economic relationships entail costs that go beyond production and are directly associated with the definition, transfer, and enforcement of property rights over assets. These costs arise primarily in contexts characterized by uncertainty and information asymmetries, demonstrating that markets are far from operating under conditions of full efficiency. They manifest themselves particularly in the stages of contract drafting, negotiation, and performance, encompassing activities such as planning, decision-making, monitoring, and oversight. Thus, economic dynamics depend not only on production but also on the ability of actors to organize, coordinate, and safeguard their interactions, which directly affects trade, productive specialization, and competitiveness.

Given this scenario, in addition to production costs, the various economic actors — such as extractivists, cooperatives, industries, and intermediaries — must bear additional expenses to ensure that transactions take place efficiently. These costs significantly affect the capacity to add value along productive chains. In the context of the Amazonian bioeconomy, such costs tend to be higher due to structural constraints, such as the geographic dispersion of producers, inadequate logistical infrastructure, and institutional fragility. As a result, activities related to measurement, monitoring, transportation, and marketing become more costly, limiting the potential for regional economic dynamization. In this sense, the way the murumuru chain is organized — whether through cooperatives, direct contracts with industry, or the involvement of intermediaries — has a decisive influence on its economic efficiency (Forero, 2017).

Additionally, the transaction cost theory highlights key dimensions of transactions, such as asset specificity, the frequency of relationships, and the degree of uncertainty. In the case of murumuru, there are highly specific assets, such as traditional knowledge, the location of collection areas, and productive practices adapted to the Amazonian environment. Because these assets cannot be readily transferred without a loss of value, they increase risks and, consequently, transaction costs. Conversely, the recurrence of interactions and the consolidation of long-term relationships among actors may help reduce these costs by fostering trust and contractual stability. In this regard, coordination and cooperation mechanisms, such as associations, cooperatives, and institutional partnerships, play a strategic role in mitigating uncertainty and improving the performance of productive chains.

Under these circumstances, the state plays a decisive role in establishing conditions that contribute to reducing transaction costs. This involves ensuring well-defined property rights, stable economic rules, adequate infrastructure, and stronger information and regulatory systems. These elements are essential for the efficient functioning of markets and for consolidating bioeconomy-based initiatives. Thus, when the murumuru productive chain is analyzed through this lens, it becomes evident that its challenges extend beyond the productive sphere and are deeply associated with institutional and organizational factors. At the same time, overcoming these constraints through stronger governance, reduced uncertainty, and improved coordination among actors emerges as a fundamental condition for fostering sustainable regional development trajectories in the Amazon.

THE REGIONAL CONTEXT AND THE LOCAL PRODUCTIVE STRUCTURE

Composed of 22 municipalities, Acre is a state characterized by extensive forest cover, which constitutes its primary natural resource. It exhibits high external dependence, importing the majority of its foodstuffs and virtually all manufactured goods, in addition to relying on federal transfers and the public sector. In the Juruá Regional Area, the economic dynamics are closely tied to family farming and extractivism, which utilize natural resources in a diversified manner, simultaneously serving different purposes such as subsistence, income generation, and environmental conservation (Acre, 2023b). Within this context, productive chains with strategic potential emerge, such as that of murumuru. According to the Instituto Bem-Estar (IBE, 2023), family farming participates in agroforestry, extractivist,



and agropastoral activities, supplying both local and external markets. These chains organize activities from production to commercialization, contributing to income generation and highlighting the economic and territorial importance of these activities in the Amazon.

The murumuru productive chain, in the setting of the Amazonian bioeconomy, constitutes a relevant example of the articulation between traditional extractivist practices, collective organization, and insertion into broader markets. In this scenario, Coopercintra stands out as an emblematic experience of cooperativism in the Juruá Regional Area (Acre), playing a central role in structuring and driving this productive chain. Founded in 2011 by family farmers and extractivists linked to the Nova Cintra Settlement Project, in the municipality of Rodrigues Alves, the cooperative emerged as the result of a historical process of social organization that began in the 1990s. Currently, Coopercintra brings together approximately 200 members distributed across 52 communities in the region, underscoring its importance as an organizing link in the murumuru productive chain by integrating stages of production, processing, and commercialization. The cooperative's trajectory is directly associated with the strengthening of sustainable extractivism in the region.

THE EXTRACTIVISM SUBSIDY POLICY: INSTITUTIONAL ADVANCES AND CONSTRAINTS ON REGIONAL DEVELOPMENT

The policy of incentives for extractivism in Acre is a relevant example of institutional development aimed at sustainable regional development. Its origins date back to Law No. 1,277/1999, known as the “Chico Mendes Law”, which initially established an economic subsidy for rubber. This policy emerged in response to the difficulties faced by extractivists amid fluctuations in market prices, serving as an income compensation mechanism. At the same time, it incorporated an innovative perspective by recognizing the value of environmental services and traditional ways of life, anticipating contemporary debates on bioeconomy and sustainability (Acre, 1999).

Over time, this policy was progressively expanded and refined. The inclusion of murumuru, formalized in 2012 by Decree No. 4,836/2012, represented a significant advance, as it broadened the scope of the subsidy to encompass other socio-biodiversity productive chains. This development aligns with regional development approaches that advocate productive diversification as a strategy for



peripheral regions, such as the Amazon. By valuing non-timber forest products, such as murumuru, the state recognizes the economic potential of biodiversity and encourages activities that reconcile income generation with environmental conservation.

However, the public policy subsidizing extractivism, although relevant, presents important economic limitations when analyzed in relation to the murumuru productive chain and regional development in the State of Acre. These limitations can be understood through the neo-institutional approach and transaction cost theory. First, there is a structural dependence on public resources; the subsidy functions as a supplementary income but does not, by itself, alter the productive structure. This means that the activity remains vulnerable to fiscal discontinuity and political changes, compromising long-term economic predictability.

Another central point is the limited capacity to induce value addition. The policy encourages the production and commercialization of murumuru in its natural state or with a low level of processing, but does not ensure sufficient investments in innovation or productive diversification. Thus, a large share of the value continues to be captured outside the territory, limiting the multiplier effects on the regional economy.

The inadequacy in reducing transaction costs is also noteworthy. Although the subsidy increases the income of extractivists, it does not solve structural problems such as logistical precariousness, difficulties in accessing information, contractual insecurity, and organizational fragility. These costs remain high and directly affect the competitiveness of the chain.

Another limitation concerns market integration. The policy does not ensure stable marketing channels, nor does it fully strengthen producers' access to more dynamic markets. As a result, extractivists remain dependent on a small number of buyers or on unfavorable market conditions.

In addition, there is limited coordination with other public policies. When implemented in isolation, the subsidy is insufficient to promote regional development. Its effectiveness depends on integration with policies concerning infrastructure, technical assistance, credit, innovation, and productive capacity building, which remains limited.

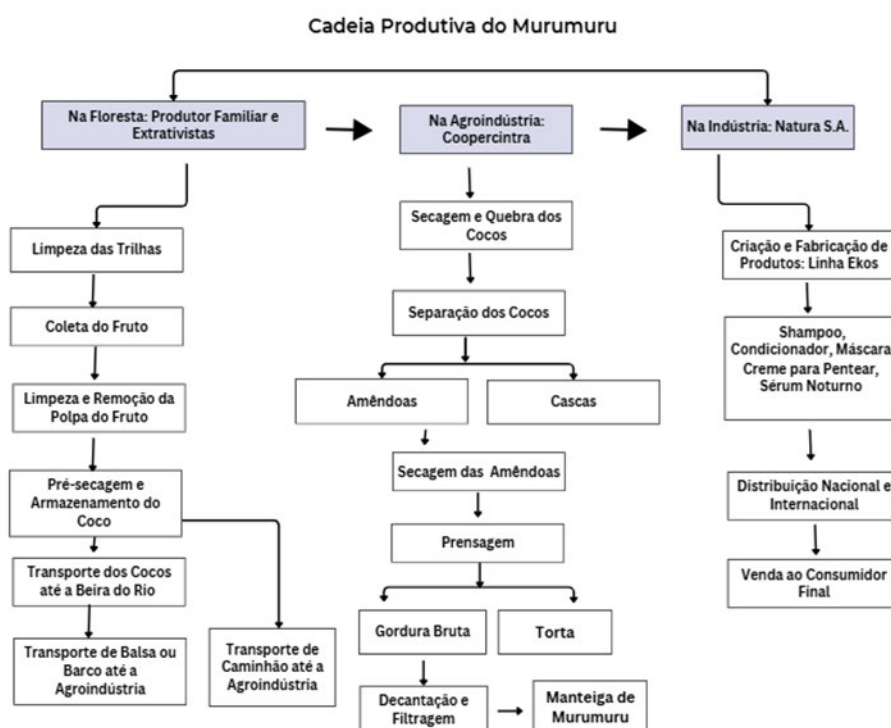
Although the murumuru subsidy represents an important institutional advance, its economic limitations reveal that it functions more as a compensatory mechanism than as a structural instrument

for development. To broaden its effects, it must be integrated into more comprehensive strategies aimed at strengthening governance, reducing transaction costs, adding value, and achieving more effective market integration.

BETWEEN THE FOREST AND THE MARKET: LOGISTICS, PRODUCTION, AND VALUE ADDITION IN THE MURUMURU CHAIN

According to empirical evidence, the murumuru productive chain in the Juruá Regional Area (Acre) begins with the work of extractivists, who are responsible for collecting the fruits in the forest. This step is fundamental, as it guarantees the supply of raw material used in the production of murumuru butter, a high value-added input that is widely demanded by the cosmetic industry due to its moisturizing properties (Coopercintra, 2025). This activity is based on the sustainable use of natural resources, integrating traditional knowledge and productive practices adapted to the Amazonian context, as shown in Image 1.

Image 2 | Flow of the murumuru productive chain in Acre



Source: Prepared by the authors (2026)



Logistics are strongly conditioned by the region's geographical characteristics, which are marked by vast distances, limited infrastructure, and dependence on river transport. Transportation to the cooperative occurs primarily via waterways and roads. During the high-water season, the use of barges enables the transport of larger volumes at lower cost. In contrast, during the low-water season, river navigability decreases, requiring smaller vessels — something that increases the number of trips and, consequently, operational costs. Moreover, existing roads are often in poor condition, especially during the rainy season, making the distribution of production even more difficult (Coopercintra, 2025).

These limitations make logistics a decisive factor for the performance of the productive chain, as they directly affect costs, raw material quality, and supply regularity. As a result, the competitiveness of murumuru in the market may be compromised, even in light of its significant economic and environmental potential.

Image 3 | Murumuru barge transport in the Juruá Regional Area — Acre



Source: Reproduction from Coopercintra's social network (2020)

In addition to the logistical stage, murumuru processing represents a crucial stage in value addition. After collection, the kernels undergo drying and pressing processes, resulting in the extraction of the vegetable fat, which, after further treatment, is transformed into murumuru butter. This final product meets the quality standards required by the industry, allowing it to be marketed at both the regional and national levels (Coopercintra, 2025).

The production stages — including collection, preliminary processing, drying, pressing, storage, and marketing — reveal an organized system, albeit one constrained by structural limitations. The final product is generally transported to consumer markets by road, with the support of freight carriers, ensuring the product's integrity (Coopercintra, 2025).

The empirical evidence demonstrates that the establishment of Coopercintra consolidated this advance, as the cooperative provided an institutional structure for the productive chain and expanded access to markets — particularly the cosmetics sector, which demands natural inputs such as murumuru oil and butter. From a production perspective, it becomes evident that the murumuru chain does not operate in a conventional competitive market but rather within a hybrid arrangement in which the cooperative, the state, and producers interact to make the activity viable. This type of configuration is characteristic of peripheral economies and socio-biodiversity-based chains, in which development depends on coordination among public policies, collective organization, and territorial conditions.

The production and remuneration of the murumuru extractivist chain in the Juruá Regional Area (2018–2025), as shown in Table 2, reveals high volatility in production throughout the period. The harvest varies from 56,116.77 kg (2019) to 147,015.25 kg (2022), indicating strong productive instability. This fluctuation cannot be attributed solely to natural factors, such as seasonality or climatic conditions, and must be understood as a result of the interaction between environmental, logistical, and institutional constraints.

Regarding the price structure, there is a progressive increase in the value paid per kilogram by the cooperative — from R\$ 0.46 (2018–2019) to R\$ 0.89 (2025). This growth suggests a gradual appreciation of the product in the market or improvements in the cooperative's negotiating capacity. However, this progress should be put into perspective, as it occurs in a context where the public subsidy remains fixed at R\$ 1.00/kg throughout the entire historical series, playing a central role in the composition of the producers' income.

Table 2 | Evolution of murumuru production and remuneration structure for producers in the Juruá Regional Area (2018–2025)

Period	Murumuru harvest in kg	Market value per kg (R\$/kg)	Amount paid by the cooperative to the producers	Subsidy amount (R\$/kg)	Subsidy paid to producers
2018	126,525.60	R\$ 0.46	R\$ 58,201.78	R\$ 1.00	R\$ 126,525.60
2019	56,116.77	R\$ 0.46	R\$ 25,813.71	R\$ 1.00	R\$ 56,116.77
2021	58,201.00	R\$ 0.70	R\$ 40,740.70	R\$ 1.00	R\$ 58,201.00
2022	147,015.25	R\$ 0.70	R\$ 102,910.68	R\$ 1.00	R\$ 147,015.25
2024	68,979.50	R\$ 0.82	R\$ 56,563.19	R\$ 1.00	R\$ 68,979.50
2025	93,331.25	R\$ 0.89	R\$ 83,064.81	R\$ 1.00	R\$ 93,331.25

Source: Prepared by the authors based on data from SEAGRI — Acre (2026)³

Note: Production records for 2020 and 2023⁴

An analysis of the income composition highlights one of the most relevant aspects from a neo-institutional perspective: the strong dependence on public transfers. In 2018, for example, the amount paid directly by the cooperative (R\$ 58,201.78) was less than half of the subsidy (R\$ 126,525.60). Even in 2025, when there is a relative improvement, the subsidy (R\$ 93,331.25) still exceeds market payments (R\$ 83,064.81). This indicates that the producers' income is not predominantly determined by market mechanisms, but by an institutional arrangement in which the State plays a key role in providing economic support.

In this sense, subsidies can be interpreted as formal "rules of the game" aimed at reducing uncertainties and making extractivist activities economically viable. According to Forero (2017) and North (1990), institutions are the rules of the game that structure incentives and reduce risks. In the case analyzed, the subsidy functions as an income stabilization mechanism, especially in years of low production, such as 2019. Its centrality, however, also reveals a structural weakness: the inability of the chain to generate sufficient value to sustain itself autonomously. Thus, empirical evidence from the Juruá Regional Area (Acre) indicates that the main challenge is not only to increase production, but also to reduce transaction costs, strengthen local institutions, and expand value-addition capacity.

³ The data in Table 2 were obtained from administrative documents used by the Acre Office of Agriculture (SEAGRI) to process the payment of the economic subsidy for murumuru destined for extractivist producers in the Juruá Regional Area (Acre).

⁴ During the data collection process, it was found that there was a lack of systematized administrative records regarding the cooperative's production and marketing during this period (2020 and 2023), which made it impossible to completely reconstruct the annual information.

BETWEEN POTENTIAL AND CONSTRAINTS: A NEO-INSTITUTIONAL ANALYSIS OF THE MURUMURU PRODUCTIVE CHAIN IN THE JURUÁ REGIONAL AREA

When the productive chain is analyzed from a neo-institutional perspective, it becomes evident that the economic performance of this activity cannot be explained solely by productive factors, but also, and above all, by the way institutions, transaction costs, and structural constraints shape interactions among actors. As Forero (1997) argues, real-world markets operate in contexts characterized by uncertainty, imperfect information, and coordination costs — elements that are clearly observed in the dynamics of Amazonian extractivism.

Contrary to the assumptions of neoclassical theory, this activity is far from operating under conditions of efficiency. Geographic dispersion, inadequate infrastructure, and dependence on natural factors create an environment of high uncertainty, reinforcing the notion that transaction costs are positive and significant. According to Williamson (1985) and Forero (2017), these costs include not only the negotiation and performance of contracts, but also the effort required to organize and facilitate transactions, which, in the case of murumuru, is particularly evident in logistics.

The transportation of the product constitutes the main bottleneck in the chain and clearly exemplifies the incidence of high transaction costs. The need to manually transport heavy loads, hire transportation services in remote areas, and rely on river transport subject to seasonal variations significantly increases operating costs and reduces the profitability of extractivists (Coopercintra, 2025). This scenario supports the neo-institutional perspective, according to which market failures, such as inadequate infrastructure and information asymmetries, undermine economic efficiency (Forero, 1997).

[...] nowadays we operate on a very large logistical scale [...] We work in the municipalities of Porto Walter, Rodrigues Alves, Cruzeiro do Sul, and Guajará-Ipixuna (AM). We make two trips by barge, two trips [...] It takes us a day and a half to get past Porto Walter; then, when the water gets very low, we bring the rest in a smaller boat. [...] Going downstream (to Ipixuna) is much farther; we make about four or five trips to bring the product back (Cooperative Representative — Interviewee 1).

Furthermore, the territory's structural constraints — such as the poor condition of the road network, long distances, and limited accessibility — increase coordination costs and hinder both the distribution of production and the integration of the chain with more dynamic markets. These



difficulties begin even with the movement of raw materials between collection areas and communities, as illustrated by the account of one of the extractivists: **“when we leave the forest, we bring it by canoe”** (Interviewee 2 — Producer). This account reveals a specific territorial dimension of the murumuru chain: before even reaching the *ramais* (local roads) and land-based means of transport, production depends on river transport carried out by the extractivists themselves. Thus, the chain’s logistics involve different transport modes and successive stages of transportation — from the forest to the communities, from there to the cooperative, and subsequently to the markets — which increases the costs, time, and uncertainties associated with commercialization. In this context, the insufficiency of infrastructure and of institutional arrangements capable of reducing such barriers contributes to the persistence of high transaction costs and limits the competitiveness of the activity. As highlighted by North (1994) and Forero (2017), economic performance depends not only on the availability of productive resources, but also on the quality of the formal and informal institutions that structure interactions, reduce uncertainties, and create conditions for coordination among actors.

Given this scenario, the cooperative emerges as a relevant institutional mechanism for mitigating some of these costs. By organizing transportation, mediating marketing, and promoting coordination among actors, the cooperative reduces uncertainty, increases the predictability of transactions, and strengthens producers’ bargaining power. This function is consistent with transaction cost theory, which recognizes organizations as institutional arrangements created to minimize market failures and improve the efficiency of transactions (Williamson, 1985; Forero, 2017). However, although important, this role does not fully eliminate structural constraints, highlighting the limitations of local coordination in addressing systemic problems.

In the words of Interviewee 3 — Producer, **“We want the government to pay more attention to our ramal so we can get to the cooperative, because if there’s no ramal, how are they going to come and collect the product?”**. This statement shows that local road infrastructure is one of the main factors conditioning the murumuru productive chain. The term *ramal*, referring to the local road connecting the extractivist communities to Coopercintra, is perceived by producers as an essential condition for transporting the production to market. Its poor condition makes it difficult for the cooperative to access production areas, increases transportation costs, and creates greater uncertainty regarding product

collection. Thus, the demand for greater attention from public authorities reflects a concrete need to reduce transaction costs and improve territorial conditions for the functioning of the productive chain.

With regard to processing, progress can be observed in value addition, particularly through the production of murumuru butter and the full utilization of by-products. This process reduces waste and expands sources of income, reinforcing the principles of the bioeconomy. From a critical perspective, however, it is evident that such value addition remains limited, as more sophisticated stages of the productive chain take place outside the territory, restricting the multiplier effects on the regional economy.

With regard to processing, the findings show progress in value addition within the territory, particularly through the production of murumuru butter and the utilization of by-products, thereby reducing waste and expanding income-generation opportunities. However, the analysis of the chain reveals that local processing capacity remains a significant bottleneck. As the cooperative representative puts it, **“there is no point in producing a lot if we have no way to process it and end up losing the production”** (Interviewee 1). This highlights a central issue for the consolidation of the chain: the expansion of production needs to be accompanied by an increase in processing capacity. If this does not occur, an increase in the supply of raw materials may lead to losses, increase costs, and undermine extractivists’ income rather than generating greater regional economic dynamization.

The interviewee’s statement also shifts the discussion from mere production expansion to the question of the territory’s capacity to retain the value generated by socio-biodiversity. Although Coopercintra plays an important role by internalizing part of the processing activities, more technologically complex and higher-value-added stages continue to be carried out outside the Juruá Regional Area, reducing the multiplier effects of the activity on the regional economy. This situation is consistent with the findings of the study, which identify the concentration of the most profitable stages outside the region as one of the factors constraining the chain’s territorial autonomy.

The interviewee’s statement reveals that the main challenge is not simply to **“produce more”**, but to build the institutional, technological, and productive conditions needed to **“process more within the territory”**. This entails investments in the cooperative’s installed processing capacity, equipment, storage, technical training, innovation, and diversification of murumuru-derived products. Expanding local processing capacity would not only reduce losses but also allow a greater share of the value added to

be retained in the region, strengthen the cooperative, and amplify the chain's effects on employment, income, and regional development.

Economic constraints are also evident in the small scale of production, the limited capital of extractivists, and the difficulty of accessing market information. These factors increase the vulnerability of producers and diminish their decision-making capacity, corroborating the idea that imperfect information is a central element in neo-institutional analysis (Forero, 1997). Furthermore, dependence on natural and seasonal conditions reinforces the instability of production and supply, hindering the consolidation of more stable commercial relationships.

Based on the empirical findings, it is possible to identify what may be termed a “geography of transaction costs” in the murumuru productive chain, whereby the territorial characteristics of Juruá directly condition the possibilities for moving production and coordinating the different links in the chain. The route from forest → canoe → community → *ramal* → cooperative → market shows that the product passes through successive logistical stages before reaching processing and marketing, each involving specific costs, time requirements, risks, and uncertainties. The initial movement carried out by the extractivists themselves, often by river, is conditioned by the state of the *ramais*, transportation to the cooperative, and, ultimately, connection to external markets. Thus, transaction costs are not distributed in an abstract or homogeneous manner; they are territorially produced, reflecting distances, river seasonality, navigability conditions, inadequate road infrastructure, and difficulties in coordinating among actors. This is a significant finding of the study, as it demonstrates that the competitiveness of the murumuru chain depends not only on productive efficiency or market demand, but also on the concrete conditions under which the product can circulate throughout the territory. In this sense, reducing transaction costs necessarily entails addressing their territorial foundations, taking into account infrastructure, logistics, collective organization, and institutional coordination, so as to transform the specific characteristics of Juruá from constraining factors into elements incorporated into the construction of a genuinely territorialized bioeconomy.

From the perspective of regional development, the murumuru productive chain presents a paradox typical of economies based on socio-biodiversity. On the one hand, it holds significant potential for income generation, valorization of local resources, and promotion of environmental sustainability. On the other, it faces structural limitations that prevent its full consolidation as a driver of development. This

paradox highlights that isolated public policies, although important, are insufficient to overcome historical bottlenecks; an integrated approach encompassing infrastructure, technical assistance, innovation, and institutional strengthening is required.

The analysis demonstrates that the murumuru productive chain is strongly conditioned by high transaction costs and structural economic constraints, which limit its competitiveness and its impact on regional development. From a neo-institutional perspective, it is concluded that overcoming these barriers depends on strengthening institutions, improving logistical infrastructure, and expanding the organizational capacities of local actors. Without these transformations, the Amazonian bioeconomy is likely to remain underutilized, operating below its potential to promote sustainable development and socioeconomic inclusion.

INCLUSIVE BIOECONOMY, LOCAL CAPACITIES, AND REGIONAL DEVELOPMENT

The analysis of the murumuru productive chain makes it possible to understand that the challenges facing the Amazonian bioeconomy transcend a strictly economic scope, as they are associated with the capacity of territories to transform natural resources into opportunities for social, productive, institutional, and environmental development. Thus, the contribution of the chain cannot be measured solely by the volume produced or the income generated, but also by the effects it has on local capacities, territorial autonomy, and the valorization of socio-biodiversity resources.

In the context of the inclusive bioeconomy, the murumuru chain can be seen to promote significant forms of productive inclusion for family farmers and extractivists in the Juruá Regional Area. The participation of approximately 200 cooperative members distributed across more than fifty communities demonstrates the activity's capacity to involve populations traditionally excluded from more dynamic economic circuits. Furthermore, the economic valorization of a non-timber forest product contributes to expanding income-generation opportunities compatible with forest conservation, thereby strengthening productive strategies based on the sustainable use of biodiversity.

The analysis also shows that productive inclusion does not automatically translate into full economic inclusion. Although producers participate in the stages of raw material collection and supply, a significant share of the added value remains concentrated in industrial and commercial

segments located outside the region. Thus, the distribution of benefits along the chain proves to be asymmetric, limiting the local capture of wealth generated by Amazonian biodiversity. This situation reinforces the need to expand investments in processing, innovation, and productive diversification within the territory itself, in order to strengthen the region's capacity to retain value.

Based on the capability approach proposed by Amartya Sen (2000), development can be understood as a process of expanding the opportunities effectively available to people. From this perspective, the murumuru chain contributes to expanding certain capabilities of producers, particularly by creating income-generation opportunities, strengthening collective organizations, and expanding access to markets. However, logistical constraints, dependence on public subsidies, and limited capacity for value addition constrain the economic autonomy of local actors, limiting their freedom to define their own development strategies and reduce their vulnerability to fluctuations in markets and public policies.

The findings are also consistent with the contributions of Schneider (2010), who emphasizes the importance of economic diversification and the valorization of territorial resources in building sustainable rural development pathways. In this regard, the murumuru chain represents an important alternative to dependence on traditional activities and contributes to strengthening forms of social reproduction linked to the forest. Coopercintra's activities further enhance this potential by promoting economic coordination, cooperation among producers, and access to markets that would be difficult to reach individually.

An understanding of these processes can be deepened from the territorial perspective proposed by Saquet (2007; 2015). For this author, territory is not restricted to a physical or administrative base; it constitutes a historical and relational construction produced through interactions among actors, institutions, identities, economic practices, and natural resources. Along these lines, the murumuru productive chain represents not only an economic activity, but a process of territorialization that combines traditional knowledge, forms of cooperation, relations of belonging, and strategies for the sustainable use of forest resources. Strengthening extractivist activity — mediated by the cooperative — contributes to consolidating social and economic ties that reinforce the capacity for organization and reproduction of local communities.

From a territorial perspective, the effects of the productive chain extend beyond the economic dimension. The valorization of murumuru strengthens traditional knowledge associated with extractivism, encourages environmental conservation practices, and contributes to the continued presence of populations in their territories. By attributing economic value to the standing forest, the activity creates incentives for the maintenance of natural resources and reinforces the importance of local territorial assets as a basis for strategies of sustainable regional development. Thus, the bioeconomy assumes a relevant role in the construction of territorialities associated with environmental conservation and the valorization of Amazonian ways of life.

Table 3 | Empirical evidence by analytical category in the murumuru productive chain

Category	Evidence from the Article
Value addition	Production of murumuru butter and utilization of derived products
Economic dynamization	Income generated for cooperative members and regional economic circulation
Local capacities (Sen)	Collective organization, access to markets, and generation of opportunities
Productive diversification (Schneider)	Forest-based economic alternative
Territorialization (Saquet)	Retention of families in the territory and strengthening of local knowledge
Regional development (Brandão e Diniz)	Constraints on wealth retention and the generation of multiplier effects

Source: Original work based on research (2026)

The results indicate that the chain’s territorial autonomy remains limited. Strong dependence on public subsidies, high logistical costs, and the concentration of the most profitable stages outside the region reduce the territory’s capacity to transform its natural resources into broader processes of economic dynamization. This situation shows that the existence of abundant natural resources is not sufficient to promote regional development; it is necessary to strengthen institutions, expand actors’ coordination capacity, and create conditions for a larger share of the generated wealth to remain in the territory.

The analysis aligns with the reflections of Brandão (2007) and Diniz (2000), for whom regional development depends on the capacity to mobilize local resources, institutional construction, and the generation of multiplier effects on the regional economy. Although the murumuru chain has the potential to stimulate income circulation, strengthen local organizations, and expand economic opportunities, its contribution to regional development remains conditioned by structural constraints that limit the retention of added value and the autonomy of local actors.

The results suggest that the main challenge for the Amazonian bioeconomy consists not only in expanding production or market access, but also in strengthening local capacities, increasing value addition within the territory, and building institutional conditions capable of transforming biodiversity assets into effective processes of regional development. Thus, the consolidation of an inclusive bioeconomy depends on the articulation between environmental conservation, organizational strengthening, productive innovation, valorization of territorial capabilities, and reinforcement of the territorialities constructed by local populations.

Table 4 | Concrete measures to overcome the constraints identified in the Murumuru supply chain

Identified constraint	Proposed concrete measure	Expected outcome
High logistical costs	Establish a territorial logistics program for socio-biodiversity products, including maintenance of the <i>ramais</i> used by communities, improvement of loading and unloading points, support for river transportation, and cooperative-based coordination of transportation.	Reduction in the cost per kilogram transported and in production losses.
Seasonality and transportation difficulties	Plan harvest logistics in advance, establishing routes, community collection and storage points, and differentiated schedules for high-water and low-water periods.	Greater supply regularity and predictability of production.
Limited value addition within the territory	Expand Coopercintra's technological capacity for processing, standardization, and development of murumuru-derived products, seeking to retain within the Juruá Regional Area processing stages currently carried out outside the region.	Retention of a larger share of value added within the territory.
Dependence on a small number of buyers	Diversify marketing channels by prospecting companies in the cosmetics, pharmaceutical, and natural products sectors and promoting medium- and long-term contracts.	Reduced commercial dependence and greater bargaining power.
Information asymmetry	Implement a simple information system on prices, production volumes, costs, buyers, and demand, accessible to the cooperative and communities.	Greater transparency and bargaining capacity among extractivists.
Organizational fragility	Develop continuing training in cooperative management, costs, negotiation, production planning, quality, and marketing.	Enhanced local capacities and greater cooperative autonomy.
Dependence on public subsidies	Maintain the subsidy in the short term while combining it with structural investments in logistics, processing, innovation, credit, and market access.	A gradual transition from a predominantly compensatory policy toward a policy that actively promotes development.
Fragmentation of public policies	Establish a permanent territorial governance body for the chain, involving Coopercintra, communities, state and municipal governments, research and extension institutions, and buyers.	Reduced coordination costs and greater institutional integration.
Limited capital available to producers/cooperative	Create or adapt credit lines to the particularities of Amazonian extractivism, taking into account seasonality, production cycles, and difficulties related to conventional collateral requirements.	Increased investment and production capacity.
Concentration of value outside the territory	Promote local processing, product innovation, and the full utilization of co-products and residues.	Job creation, income generation, and regional multiplier effects.

Source: Prepared by the authors based on research results (2025)



The findings make it possible to move beyond identifying the constraints toward proposing measures capable of reducing transaction costs and increasing the territorial retention of value generated by the murumuru chain. First, the centrality of logistical costs points to the need for a specific territorial strategy for socio-biodiversity products involving improvements to the ramais used by communities, the establishment of community collection and storage points, support for river transportation, and the planning of operations according to high-water and low-water periods. These measures could reduce the costs, losses, and uncertainties associated with transporting the production, which was identified as one of the chain's main bottlenecks.

Second, the limited retention of value generated within the territory requires investments in expanding Coopercintra's processing capacity, productive innovation, diversification of murumuru-derived products, and the utilization of co-products, so as to enable processing stages currently carried out outside the Juruá Regional Area to be progressively internalized. The research demonstrates that, although value is added through the production of murumuru butter, a significant share of the benefits remains concentrated in industrial and commercial segments outside the region.

Third, strengthening the organizational and informational capacities of local actors is necessary. Establishing mechanisms for monitoring prices, costs, production, and demand, together with training in management, planning, negotiation, and marketing, could reduce information asymmetries and enhance the bargaining power of the cooperative and extractivists. At the same time, diversifying buyers and establishing medium- and long-term contractual relationships could reduce dependence on a small number of markets and increase the predictability of transactions.

Finally, the subsidy policy should be maintained as an instrument for supporting extractivists' income, but combined with a transition strategy capable of progressively reducing the chain's economic dependence on public transfers. This requires replacing a predominantly compensatory approach with an integrated territorial policy encompassing subsidies, infrastructure, technical assistance, credit, innovation, processing, and market access. Establishing a permanent governance body for the chain, bringing together extractivist communities, Coopercintra, state and municipal governments, research and extension institutions, and market actors, could help coordinate these actions, reduce uncertainties and transaction costs, and enhance the territory's capacity to retain the wealth generated from its biodiversity.



FINAL REMARKS

This article analyzed the factors that explain the mismatch between the potential of the bioeconomy and its actual contribution to regional development, based on the murumuru productive chain in the Juruá Regional Area, in the State of Acre. The research was guided by the question of why an activity associated with Amazonian socio-biodiversity — recognized for its economic, environmental, and social potential — still faces difficulties in promoting broader processes of productive inclusion, value addition, and territorial economic dynamization.

The results reveal that this mismatch does not stem from a scarcity of natural resources, the absence of markets, or a lack of local organizational initiatives, since the study demonstrated that the murumuru productive chain is embedded in an environment characterized by considerable productive and environmental potential. However, this environment is strongly constrained by institutional, economic, and territorial limitations that restrict its capacity to foster broader regional development processes.

From a neo-institutional perspective, it was found that the high transaction costs associated with logistical precariousness, information asymmetries, coordination difficulties, and dependence on public policies are essential elements for understanding the chain's limited capacity for expansion and consolidation. According to North (1990) and Williamson (1985), economic performance depends not only on the availability of resources, but also on the quality of the institutions responsible for reducing uncertainties and organizing interactions among actors. In the case analyzed, fragile infrastructure, instability in support mechanisms, and governance limitations raise transaction costs and restrict the activity's competitiveness.

The subsidy policy for extractivism proved to be an important institutional advance by guaranteeing supplementary income to households and reducing vulnerabilities during periods of low production. However, its role remains predominantly compensatory and is insufficient to promote structural transformations capable of expanding producers' economic autonomy or reducing their dependence on public transfers. The results demonstrate that, although essential for the economic reproduction of extractivist households, the subsidy does not substantially alter producers' position in the value chain nor, by itself, strengthen the capacity to retain the wealth

generated in the territory.

From the perspective of regional development, the results corroborate the reflections of Diniz (2000) and Brandão (2007), showing that development does not automatically result from the existence of natural resources or promising economic activities. The capacity to mobilize local resources, institutional density, coordination among actors, and the generation of multiplier effects on the regional economy constitute decisive factors for transforming territorial potential into effective development processes. In this sense, the murumuru chain has the potential to dynamize local economies, generate income, and strengthen collective organizations, but still faces limitations in producing broader structural impacts in the Juruá Regional Area.

The findings also make it possible to understand that an inclusive bioeconomy cannot be reduced to increasing production or accessing markets. According to Sen (2000), development should be interpreted as the expansion of people's capabilities and substantive freedoms. Although the productive chain broadens opportunities for income generation and economic participation for family farmers and extractivists, limitations persist that restrict their productive autonomy and their capacity to build their own development trajectories. Low value addition, dependence on subsidies, and the concentration of the most profitable stages outside the region reduce the possibilities for expanding these capabilities.

Complementarily, Schneider's (2010) contributions make it possible to interpret the murumuru chain as a strategy of economic diversification based on the valorization of territorial resources and socio-biodiversity. The activity strengthens forms of social reproduction associated with the forest and creates economic opportunities compatible with environmental conservation. However, the consolidation of these development pathways depends on a harmonious relationship among public policies, local organizations, productive innovation, and markets, so that sectoral and fragmented approaches can be overcome.

Saquet's (2007, 2015) territorial perspective helps elucidate the effects of the chain beyond the economic sphere. The production and processing of murumuru constitute processes of territorialization that mobilize traditional knowledge, cooperative relationships, local identities, and specific forms of interaction between society and nature. By assigning economic value to the standing

forest, the activity contributes to strengthening territorialities associated with environmental conservation and the continued presence of local populations in their territories. However, the observed constraints reveal that the economic valorization of biodiversity alone is insufficient to ensure territorial autonomy or trigger lasting processes of regional development.

Thus, it can be concluded that the mismatch between the potential of the bioeconomy and its effective contribution to development in the Juruá Regional Area can be explained by the combination of high transaction costs, institutional weaknesses, logistical constraints, dependence on public subsidies, and limited capacity for value addition within the territory. Overcoming these constraints requires integrated strategies involving investments in infrastructure, institutional strengthening, the expansion of local organizational capacities, productive innovation, and territorially oriented public policies capable of promoting greater retention of the wealth generated by Amazonian biodiversity.

As a limitation of the research, the impossibility of directly observing the murumuru collection areas stands out, owing to logistical difficulties and the high costs of accessing forest areas. Furthermore, the study was concentrated on a single empirical case, which limits the generalization of the results to other Amazonian socio-biodiversity productive chains. It was also not possible to measure in depth the indirect economic impacts and the multiplier effects of the activity on the regional economy.

As an agenda for future research, the conduct of comparative studies among different Amazonian socio-biodiversity productive chains is suggested, as well as investigations aimed at measuring the territorial impacts of the bioeconomy on income, employment, environmental conservation, and the strengthening of local capacities. It is further recommended to deepen analyses on territorial governance, the distribution of economic benefits along value chains, and mechanisms capable of expanding wealth retention in Amazonian territories. Such investigations may contribute to the construction of truly inclusive bioeconomy models, capable of combining environmental conservation, territorial autonomy, and sustainable regional development.

STATEMENT ON THE USE OF ARTIFICIAL INTELLIGENCE

The authors used ChatGPT, GPT-4o version, OpenAI solely for language editing and stylistic improvement. All scientific content, analysis, and intellectual contribution were developed and verified by the authors. We assume full responsibility for the accuracy and integrity of the manuscript.

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