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A FERROVIA BIOCEÂNICA E O DESENVOLVIMENTO REGIONAL NA AMAZÔNIA SUL-OCIDENTAL: IMPLICAÇÕES PARA O ESTADO DO ACRE

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ABSTRACT

The logistics configuration of South America has historically been oriented toward the Atlantic axis, resulting in low levels of intraregional integration and reinforcing territorial inequalities. In this context, the Bioceanic Railway is positioned as a strategic initiative by connecting Brazil and Peru to the Pacific Ocean, diversifying export routes and repositioning the country within global value chains. This article analyzes the potential impacts of the railway on the state of Acre, a territory marked by structural vulnerabilities and limited integration into major logistics flows. Methodologically, the study adopts a qualitative, exploratory, and descriptive approach, combining a systematic literature review (SLR) with documentary analysis of institutional sources and multilateral organizations. The results indicate that the railway may reduce logistics costs, expand regional connectivity, and stimulate new economic dynamics; however, these effects depend on territorial policies capable of articulating infrastructure, productive diversification, and institutional governance. In the absence of such mechanisms, large-scale integration projects tend to operate as transit corridors, with limited internalization of benefits within the territory. Based on these findings, the study proposes an integrated regional development guideline structured around four interdependent axes—integrated infrastructure and logistics, productive reconfiguration, sustainable territorial planning, and institutional capacity-building—aimed at guiding the territorial appropriation of the railway's benefits. The proposed model, modular and adaptable in nature, may help transform infrastructure into a driver of productive inclusion, territorial equity, and sustained development in peripheral territories crossed by major physical integration projects in the Global South.

Keywords: Bioceanic Railway. Regional Development. Logistical Integration. Multilevel Governance. Western Amazon.

RESUMO

A configuração logística da América do Sul foi historicamente orientada para o eixo atlântico, o que consolidou baixos níveis de integração intrarregional e acentuou desigualdades territoriais. Nesse contexto, a Ferrovia Bioceânica configura-se como iniciativa estratégica ao conectar Brasil e Peru ao Oceano Pacífico, diversificando rotas de exportação e reposicionando o país nas cadeias globais de valor. Este artigo analisa os impactos potenciais da ferrovia sobre o estado do Acre, território marcado por vulnerabilidades estruturais e baixa inserção em fluxos logísticos. Metodologicamente, adotou-se abordagem qualitativa, exploratória e descritiva, combinando revisão sistemática da literatura (RSL) e análise documental de fontes institucionais e organismos multilaterais. Os resultados indicam que a ferrovia pode reduzir custos logísticos, ampliar a conectividade regional e estimular novas dinâmicas econômicas, mas evidenciam que tais efeitos dependem de políticas territoriais capazes de articular infraestrutura, diversificação produtiva e governança institucional. Na ausência desses mecanismos, grandes projetos de integração tendem a operar como rotas de passagem, com baixa internalização de benefícios no território. Com base nessa análise, o estudo propõe uma diretriz integrada de desenvolvimento regional estruturada em quatro eixos interdependentes — infraestrutura e logística integrada, reconfiguração produtiva, planejamento territorial sustentável e capacitação institucional — destinada a orientar a apropriação territorial dos benefícios da ferrovia. O modelo, de caráter modular e adaptável, pode contribuir para transformar a infraestrutura em vetor de inclusão produtiva, justiça territorial e desenvolvimento sustentado em territórios periféricos atravessados por grandes projetos de integração física no Sul Global.

Palavras-chave: Ferrovia Bioceânica. Desenvolvimento Regional. Integração Logística. Governança Multiescalar. Amazônia Sul-Ocidental.

INTRODUCTION

The logistics configuration of South America has historically been oriented toward the Atlantic axis, in line with colonial export patterns, resulting in low levels of physical integration among the countries of the subcontinent (Neves; Honório, 2024). This arrangement consolidated around corridors directed toward European and North American markets, leaving vast inland areas, such as the Amazon and the Andean region, on the margins of the main transport and trade networks (Virga, Miranda, Marchi *et al*., 2022). This structure persists and deepens territorial inequalities, restricting intraregional circulation and international competitiveness, particularly due to dependence on traditional routes such as the Panama Canal (Miller; Hyodo, 2021).

In this context, the proposal to build the Bioceanic Railway, connecting Brazil to Peru and the Pacific Ocean, acquires strategic relevance by diversifying export channels and reducing external vulnerabilities. Although there are still few recent studies on the Brazil–Peru railway, studies such as Castro (2021) demonstrate that bioceanic corridors can function as platforms for regional development by reducing costs and expanding logistical alternatives. Supported by multilateral agreements among Brazil, China, and Peru, the initiative should be understood as a corridor of

physical integration and geopolitical repositioning, with the potential to redefine Brazil's role in transcontinental trade (Guzmán, 2021; Dourado, 2022).

In 2024, the launch of the South American Integration Routes by the Brazilian Ministry of Planning and Budget incorporated the Bioceanic Railway as a structuring axis of the Capricorn and Southern routes, linking the project to the New Growth Acceleration Program (Novo PAC), a federal initiative aimed at implementing and monitoring major infrastructure projects through multilateral oversight mechanisms (Brazil, 2024). This inclusion signals its transition from a bilateral initiative to a state public policy, currently subject to technical and economic analyses conducted by ministries and the National Congress (Brazil, 2025).

The railway is expected to expand intermodal connections and affect historically marginalized regions such as Acre. Located in the westernmost portion of the Amazon, the state lies more than 3,000 km from Brazil's main economic centers and occupies a peripheral position within national logistics flows. Despite having one of the country's lowest GDPs per capita and strong dependence on income transfer programs (De Souza et al., 2023), Acre could become a strategic link in the Brazil–Peru–Bolivia corridor (Barros et al., 2021).

Previous experiences, such as the Initiative for the Integration of Regional Infrastructure in South America (IIRSA) and the South American Infrastructure and Planning Council (COSIPLAN/UNASUR), reveal that transnational corridors often operate merely as transit routes, prioritizing export flows and benefiting external actors (Melón, 2022). Without integrated territorial policies, such projects tend to reproduce the logic of logistical enclaves and intensify productive and institutional asymmetries. Virga, Miranda, and De Marchi (2021) emphasize that effective Amazonian integration depends on the articulation among connectivity, accessibility, and capillarity.

The South American Integration Routes policy seeks to mitigate these risks through interministerial governance, federal coordination, and continuous monitoring, which may facilitate the territorial internalization of the railway's benefits in Acre and stimulate greater local value creation (Brazil, 2024). Transforming this opportunity into effective development requires regional planning capable of integrating logistical infrastructure, productive dynamization, and environmental sustainability (Barros et al., 2023).

Given this scenario, the following research question emerges: what are the potential impacts of the Bioceanic Railway on the state of Acre, located in the Southwestern Amazon, within the context of regional development policies? Accordingly, the objective of this study is to analyze the strategic importance of the Bioceanic Railway for Brazil, with emphasis on its effects on Acre, and to propose an integrated regional development guideline aligned with the future implementation of the railway. The study seeks to identify opportunities and risks associated with the project and to formulate a model capable of articulating economic growth, social inclusion, and environmental conservation, a triad that is indispensable to debates concerning the Amazonian territory.

To achieve this objective, the article is structured into five sections. The first discusses the context of South American continental integration and the conceptual foundations that position the Bioceanic Railway within debates on logistics, geoeconomics, and regional development. Next, the methodology based on a systematic literature review and documentary analysis is presented. The third section examines the effects of the railway on Acre, organized into four analytical axes that articulate logistical, economic, territorial, and socio-environmental dimensions. Subsequently, integrated regional development guidelines are proposed to support the strategic territorial appropriation of the infrastructure. Finally, the institutional, social, and environmental challenges associated with bioceanic integration are discussed, followed by the study's concluding remarks.

THE BIOCEANIC RAILWAY AND THE RECONFIGURATION OF SOUTH AMERICAN CONTINENTAL INTEGRATION

The proposal to build the Bioceanic Railway is embedded in the context of the logistical and geopolitical transformations reshaping Brazil and South America, marked by the search for greater continental physical integration, diversification of foreign trade routes, and the strategic repositioning of the region within global production and circulation chains (Lopes Filho *et al.*, 2022a; OECD, 2023). To assess its relevance and potential impacts on Acre, the theoretical framework articulates four interdependent dimensions: continental integration, modal diversification, geopolitical repositioning, and technical-economic feasibility, which guide the subsequent analysis.

The relationship between transport infrastructure and regional development occupies a central position in debates on territorial integration and economic competitiveness (Foster *et al*., 2023; Neves; Honório, 2024). Railways, highways, and intermodal corridors expand connectivity, reduce logistical costs, and may stimulate productive diversification and the spatial reorganization of economic activities (Virga; Marques, 2020). These effects, however, depend on the articulation among territorial planning, productive policies, and local institutional capacity. In the absence of such coordination, large infrastructure projects tend to favor large-scale economic flows without generating consistent regional development (Thees; Erschbamer, 2025).

The conception of the project dates back to the memorandum signed by Brazil, China, and Peru in 2015, which established feasibility studies coordinated by the former Planning and Logistics Company (EPL), currently known as INFRA S.A. (EPL, 2025). In 2024, the South American Integration Routes Report (Brazil, 2025) incorporated the railway into a national planning strategy developed in cooperation with border states and development banks such as the Development Bank of Latin America and the Caribbean (CAF), the Inter-American Development Bank (IDB), and the Financial Fund for the Development of the Plata Basin (FONPLATA). Unlike the IIRSA and COSIPLAN initiatives, which focused on large export-oriented infrastructure projects, the new policy emphasizes multilevel governance, territorial development, and sustainability through interministerial and multilateral monitoring mechanisms.

Although conceived to expand Brazilian access to the Pacific, the railway faces complex technical and institutional challenges, including the crossing of environmentally sensitive areas and the need for political coordination among the countries involved. The project follows the logic of integration corridors aimed at reducing transaction costs and overcoming dependence on Atlantic routes and the Panama Canal. Preliminary simulations indicate significant reductions in transport time and logistical costs (Castro, 2021; OECD, 2023), although such gains depend on political stability and on an institutional structure capable of sustaining long-term regional cooperation.

The Economic Commission for Latin America and the Caribbean (ECLAC, 2024) emphasizes that physical integration only produces structural effects when articulated with productive and territorial policies. In this sense, the direct connection between Santos and the Peruvian coast may

reduce distances and transportation times in trade with Asia, especially China, Brazil's main trading partner (Barros; Carneiro, 2025; Guzmán, 2021). This perspective converges with approaches that associate infrastructure with regional competitiveness, highlighting that lasting logistical gains depend on multilevel governance and articulated territorial development (Foster *et al*., 2023; Virga; Marques, 2020; CAF, 2022; Thees; Erschbamer, 2025).

This debate approaches the geoeconomic literature associated with the Belt and Road Initiative (BRI), which interprets large-scale corridors as instruments of global strategic insertion. While IIRSA prioritized physical connectivity focused on commodity flows, the BRI integrates infrastructure, investment, and financing as mechanisms of geopolitical influence (Rodrigues, 2022). Studies by Virga and Marques (2020) and Lopes Filho *et al*. (2022b) indicate that projects such as the Bioceanic Railway articulate trade flows, external capital, and global-scale power disputes, configuring a new logic of interdependence within the Global South.

From a supply chain perspective, regional competitiveness depends on the integrated efficiency of the logistics network, a core principle of supply chain management (Anwar *et al*., 2025). Corridors such as the Bioceanic Railway reduce costs, synchronize logistical flows, and strengthen productive resilience, aligning with debates on operational efficiency and logistical sustainability (Acero *et al*., 2022; Lazar *et al*., 2021; Rahman *et al*., 2023).

In Brazil, the predominance of road transportation, responsible for approximately 65% of freight movement, maintains high costs and intensive fossil fuel consumption, limiting long-distance competitiveness (De Souza *et al*., 2022; Soliani *et al*., 2022; Guimarães *et al*., 2023). Expanding the railway network represents a more efficient and environmentally viable alternative, although it requires continuous investment and federal coordination (Gonçalves *et al*., 2022).

From a geopolitical perspective, the railway may redefine South America's economic axis by strengthening Brazil–Peru–Bolivia integration and consolidating Brazil as a relevant actor in hemispheric logistics (Guzmán, 2021). Its potential linkage to the New Silk Road expands Brazil's insertion into global logistics chains (Dourado, 2022), although it also raises debates concerning financial and technological dependence and the power asymmetries associated with the Chinese presence in Latin American infrastructure (Colom-Jaén; Mateos, 2022).

More than merely a transport route, the Bioceanic Railway constitutes a strategic node of regional and global integration, with the potential to connect Acre and other peripheral states to larger-scale productive flows (Lopes Filho *et al.*, 2022a; Melón, 2022). This insertion repositions the debate within the global dynamics of supply chains, in which logistics corridors function as platforms for local value creation (Alavi-Borazjani *et al.*, 2025). For such benefits to be internalized, it is necessary to articulate intermodal hubs, Export Processing Zones (EPZs), and regional innovation policies. Without these instruments, the railway risks reproducing dependency patterns typical of the Global South (Mudimu *et al.*, 2025).

The Bioceanic Railway constitutes a field of articulation among technical, economic, and political dimensions that redefine integration corridors in South America. For peripheral states such as Acre, it represents a unique opportunity to overcome logistical barriers and expand the conditions for sustainable regional growth, in line with Lobão's (2024) discussion of the historical constraints that have limited integration and development in the Brazilian Amazon.

METHODOLOGY

This study adopts a qualitative, exploratory, and descriptive approach aimed at understanding the strategic foundations of the Bioceanic Railway and analyzing its potential implications for the state of Acre (Yadav, 2022). The methodological strategy combines a Systematic Literature Review (SLR) with documentary research based on national and multilateral technical-institutional sources. This articulation ensures conceptual consistency and empirical alignment: the SLR enables the mapping of theoretical approaches and research gaps (Sauer; Seuring, 2023), while documentary analysis incorporates the political and institutional dimensions of the project (Morgan, 2022).

The theoretical framework presented in the previous section also guided the organization of the methodological design, the definition of data collection criteria, and the study's analytical parameters. Based on the SLR, four recurring analytical dimensions were identified in the debate on logistics infrastructure and regional development, which guided the selection of documentary sources and the interpretation of empirical evidence.

DATA COLLECTION AND ANALYSIS PROCEDURES

The SLR was conducted in accordance with the guidelines proposed by Sauer and Seuring (2023) and the PRISMA protocol (Page *et al*., 2021), ensuring transparency and reproducibility. The objective was to identify theoretical and empirical approaches related to South American continental integration, regional planning, and Amazonian sustainability. Based on an exploratory reading of documents produced by ECLAC, OECD, and IPEA, four recurring analytical axes were identified: (i) logistics infrastructure and development; (ii) South American continental integration; (iii) multilevel territorial planning; and (iv) sustainability in the Amazon.

The bibliographic search was carried out between March and April 2025 in the SciELO, Scopus, and Web of Science databases, covering the 2015–2025 period, beginning with the Brazil–China–Peru memorandum. Publications in Portuguese and English were included, using descriptors combined through Boolean operators. Peer-reviewed articles addressing physical integration corridors and presenting logistics performance metrics were selected, while duplicates, studies published before 2015, and works lacking a logistics interface were excluded.

The screening process was conducted independently by the authors, with any disagreements resolved by consensus. Of the 426 records initially identified, 38 met the inclusion criteria and composed the final corpus of analyzed studies. The selected works were organized into an analytical matrix and thematically coded according to Bardin's (2016) content analysis technique. Coding consistency was validated through consensus among the evaluators, enabling the identification of convergences, gaps, and conceptual patterns that supported the study's theoretical framework.

In addition, the documentary research analyzed ministerial reports, legislative briefs, regional diagnoses, and publications from multilateral organizations, prioritizing recent and technically relevant sources. The analysis, also guided by Bardin's (2016) content analysis technique and supported by NVivo 15 software, enhanced evidence traceability and facilitated the integration between literature and institutional documents. The sources were categorized according to the four analytical axes defined in the SLR, enabling the identification of patterns, convergences, and dissonances between academic and policy-oriented perspectives.

Finally, the triangulation between the SLR results and the documentary research, summarized in Table 1, generated an evidence map that supported the formulation of the guidelines presented in the following section.

CONSTRUCTION OF THE INTEGRATED GUIDELINES

Based on the evidence systematized through the SLR and the documentary analysis, an empirical and conceptual synthesis of the findings was conducted, from which thematic convergences were identified to guide the formulation of the axes of an integrated regional development guideline aimed at the strategic appropriation of the Bioceanic Railway. The guidelines were structured around four interdependent axes: (i) integrated infrastructure and logistics, focused on Acre's insertion into regional and global flows; (ii) productive reconfiguration and economic insertion, aimed at strengthening local value chains and value creation; (iii) territorial planning and sustainability, directed toward mitigating socio-environmental risks and promoting territorial equity; and (iv) institutional capacity-building and human development, oriented toward strengthening technical and administrative capacities.

Each axis includes objectives, instruments, responsible actors, funding sources, and monitoring indicators. The guideline incorporates, in a cross-cutting manner, the principles of sustainability and multilevel governance, articulating coordination mechanisms aimed at reducing logistical costs and expanding the territorial internalization of the railway's benefits.

THE BIOCEANIC RAILWAY AND ITS POTENTIAL IMPACTS ON REGIONAL DEVELOPMENT IN ACRE

The implementation of the Bioceanic Railway represents a turning point in Acre's geoeconomic position. Historically located on the margins of major logistical and productive flows, the state is characterized by territorial isolation, low population density, limited infrastructure, and strong dependence on income transfer programs. Approximately 46% of the population is concentrated in Rio Branco, while 25% of households are located in rural areas with restricted access to markets and services (Cedeplar, 2023a). Acre ranks 25th in the State Competitiveness Ranking (CLP, 2024),

maintaining modest performance despite advances in human capital and infrastructure. Under these conditions, the railway constitutes a structuring vector capable of transforming the state's pattern of integration into the national and South American economies.

The analysis of the results was organized into four interdependent axes, defined through the SLR and further developed through documentary analysis. These axes function as interpretative lenses for understanding the potential impacts of the railway on Acre, articulating logistical, economic, territorial, and socio-environmental dimensions, as shown in Table 1.

Table 1 | Analytical axes of the SLR, empirical foundations, and implications for the Bioceanic Railway

Analytical Axis	Sources of evidence	Main challenges	Expected impact
Logistics infrastructure as a development driver	More than 90% of Acre's freight depends on road transportation. The state ranks 24th in infrastructure.	Poor road conditions and lack of multimodal alternatives.	Reduction of structural isolation and greater integration into national and international value chains.
South American continental integration	Brazil (2024) and Agenda Acre (2022) identify bioceanic corridors as a strategy for regional integration.	Overcoming exclusive dependence on Atlantic routes and the Panama Canal.	Consolidation of Acre as a Brazil–Peru–Asia link, facilitating access to Asian markets.
Multilevel territorial planning	The capital, Rio Branco, concentrates 46% of the population and more than 58% of GDP. Approximately 93.38% of rural properties are informal.	Urban concentration and low intermunicipal connectivity.	Potential strengthening of intermediary municipalities, provided that supported by urban and land-use policies.
Sustainability in the Amazonian context	Average annual deforestation reached 9.2 thousand hectares between 2020 and 2022. Approximately 66% of the population depends on income transfer programs.	Socio-environmental and social vulnerabilities.	Need for robust environmental governance and consultation with local populations.

Source: prepared by the authors (2025).

The railway has the potential to reduce Acre's logistical isolation, as the state's land access is restricted to highways BR-364 and BR-317, which are frequently affected by seasonal interruptions and high maintenance costs (Acre, 2023a). In 2021, 98.4% of the paved road network presented deficiencies, increasing transport operating costs by 67% (CNT, 2022). The connection to the Port of Chancay, in Peru, may reduce export distances and costs, bringing the state closer to Asian markets

and expanding the flow of timber products, animal-based products, and Brazil nuts, which account for 75% of Acre's exports (Cedeplar, 2023b).

The efficient operation of the railway will depend on coordination among transport modes and articulated border management, including service regularity, customs integration, and supporting infrastructure. The railway's net environmental effect remains uncertain and varies according to the proportion between road and rail segments and the occupancy rates of wagons and vessels (Soliani, 2021).

Acre's economy remains highly dependent on the public sector, which accounts for approximately 50% of the state GDP (Cedeplar, 2023a), a characteristic associated with low economic diversification and structural limitations in the regional innovation and economic development ecosystem (Silva *et al*., 2025). Within this framework, the railway could stimulate regional productive chains in sectors such as agroindustry, non-timber forest products, family farming, and short-cycle livestock production, creating conditions for the formation of integrated industrial hubs. The EPZ of Senador Guiomard, currently underutilized, could become a strategic point for the outflow of local production, connecting it to international markets, particularly in the United States and Asia (Acre, 2023a). The advancement of this diversification, however, will depend on consistent sectoral planning and coordinated tax incentives, since, without these measures, there is a risk of concentrating benefits among external actors and maintaining low value-added activities.

Acre presents a concentrated urban structure, with Rio Branco accounting for 46% of the population, 58% of GDP, and 61.5% of formal enterprises (Acre, 2023a). The corridor may contribute to strengthening intermediary municipalities such as Cruzeiro do Sul, Sena Madureira, and Brasiléia by expanding connectivity and reducing territorial fragmentation. For this to occur, urban planning and land regularization policies are required, considering that 93.38% of rural properties, corresponding to 55% of the occupied area, lack formal land titles (Mastrangelo *et al*., 2019).

The management of the railway requires multilevel governance involving federal, state, and municipal governments to ensure that logistical gains translate into productive linkages and territorial services. Such coordination must include shared information systems, integrated operational agreements, and mechanisms for social participation in decision-making processes.

Social and environmental impacts are directly linked to economic outcomes. Currently, 66% of Acre's population depends on income transfer programs (Cedeplar, 2023a), and more than half of the workforce operates within the informal sector (CLP, 2024). The railway may contribute to increasing state revenues and creating fiscal space for investments in education, healthcare, and basic infrastructure, thereby fostering social inclusion.

Economic expansion, however, may intensify environmental pressures. Deforestation increased from 682 km² in 2019 to 847 km² in 2022 (Acre, 2023b), highlighting the need for effective environmental regulation and licensing instruments, as well as prior and informed consultation with local populations. The challenge lies in reconciling logistical efficiency with ecological sustainability, an essential condition for the railway to contribute to long-term Amazonian development.

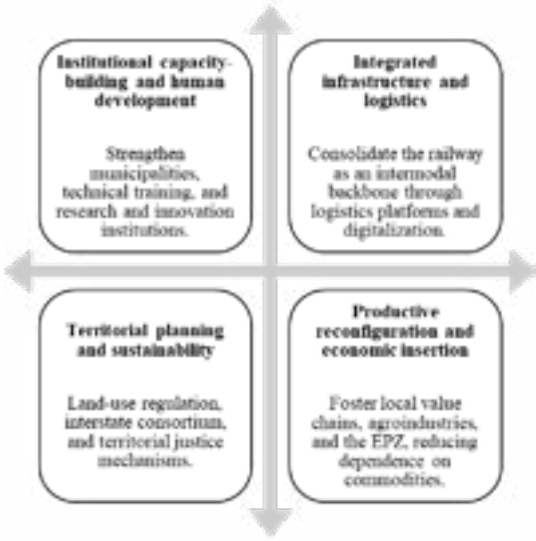
Based on the four analytical axes examined, the Bioceanic Railway appears capable of redefining Acre's territorial role by connecting it to South American and Asian logistics chains. The extent of these impacts will depend on regional planning capacity and integrated governance. Without an articulated territorial strategy, there is a risk that the project will function merely as a transit corridor, reproducing patterns of dependency and vulnerability typical of the Amazon. From this perspective, the formulation of integrated regional development guidelines that articulate infrastructure, economic diversification, sustainability, and institutional capacity-building constitutes a necessary condition for ensuring that the railway's benefits are distributed in a balanced and lasting manner.

REGIONAL DEVELOPMENT GUIDELINES FOR ACRE IN THE CONTEXT OF THE BIOCEANIC RAILWAY

Based on the analysis of the potential impacts of the Bioceanic Railway on Acre, regional development guidelines are proposed to support the strategic territorial appropriation of the infrastructure. The underlying assumption is that the mere presence of the railway does not, by itself, ensure redistributive or structuring effects. For Acre to transform its geographical position into a competitive advantage, it is necessary to articulate coordinated actions, social mobilization, and territorial planning across multiple scales.

In this sense, four integrated axes were defined: (i) integrated infrastructure and logistics, (ii) productive reconfiguration and economic insertion, (iii) territorial planning and sustainability, and (iv) institutional capacity-building and human development. These axes were designed to address previously identified risks, such as the possibility of the railway functioning merely as a transit corridor, the persistence of commodity dependence, land tenure informality, and institutional fragility. A synthesis of these axes is presented in Figure 1.

Figure 1 | Integrated axes of the regional development guideline for Acre in the context of the Bioceanic Railway



Source: prepared by the authors (2025).

The first axis proposes consolidating the railway as the foundation of an intermodal regional logistics network capable of connecting Acre to major national and international transportation systems. The creation of logistics platforms integrating the railway with federal highways (BR-364 and BR-317) and with river ports in the Purus and Juruá basins is recommended. The installation of intermodal terminals in municipalities with centrality potential may expand the reach of the infrastructure and foster territorial inclusion (Bergqvist; Monios, 2021). The digitalization of logistics systems, combined with tracking and control technologies, is essential to ensure safe, predictable, and sustainable operations. These measures increase operational efficiency and strengthen supply chain resilience, reducing vulnerabilities to external disruptions and climate-related variations (Spieske; Birkel, 2021).

The second axis addresses the economic activation of the territory. The effective appropriation of logistics corridors requires policies aimed at stimulating local production aligned with regional specializations (Abrita *et al*., 2023). In Acre, productive chains compatible with regional vocations include non-timber forest products, family farming, short-cycle livestock production, and small- and medium-scale agroindustries. To capture value within the territory, it is recommended to reposition the Senador Guiomard EPZ and the Rio Branco Industrial Pole by articulating credit lines, technical assistance, innovation initiatives, and incentives for the formalization of local producers. A diversified and innovative productive structure may enhance economic resilience and reduce the state's exposure to market fluctuations and external shocks.

The third axis addresses territorial planning and socio-environmental sustainability. The railway crosses areas of high ecological and social sensitivity, requiring mechanisms for land regularization, conflict mediation, and consultation with affected populations. The establishment of an interstate planning and monitoring consortium is proposed, involving federative entities, environmental agencies, productive sectors, and civil society. Inspired by the Legal Amazon Consortium (CAL), this arrangement would coordinate investments, supervise impacts, and ensure that the railway project is conducted within a development model that respects environmental integrity and promotes inclusive territorial governance (Teixeira; Cichovski, 2023).

The fourth axis emphasizes the development of local capacities as a condition for Acre to fully benefit from the railway. The implementation of technical and professional training programs focused on logistics operations, productive chain management, and regional innovation is recommended. Municipalities with low administrative capacity should receive support for institutional modernization, including urban planning, tax collection, land regulation, and environmental management (Nascimento *et al*., 2023). Collaboration with universities, federal institutes, and research centers is essential for generating applied knowledge, supporting public decision-making, and developing technological solutions adapted to local realities (Brondizio *et al*., 2021).

To make the guideline operational, Figure 2 summarizes, by axis, the main actions, responsible actors, monitoring indicators, and risks together with their respective mitigation measures. This framework functions both as an implementation roadmap and as a basis for continuous monitoring.

Figure 2 | Guideline implementation matrix by axis

Axis	Objective	Key actions	Responsible actors	Monitoring indicators	Risks and mitigation
Integrated infrastructure and logistics	Consolidate an efficient and predictable intermodal network	Intermodal terminals along BR-364 and BR-317 and in river ports; border facilitation (single window, pre-clearance); digitalization and traceability with capacity contracts	**Lead:** Government of Acre and Ministry of Transport / **Support:** municipalities, Federal Revenue Service, ANTT, railway and port operators	Door-to-door travel time from Acre to the Pacific; service reliability (% of trips on schedule); average border crossing time	Border bottlenecks and delays → operational agreements; critical maintenance plan
Productive reconfiguration and economic integration	Stimulate local value chains and diversify the export portfolio	Reposition the Export Processing Zone (EPZ) and Industrial Hub; credit and guarantees with local content; linkages with local procurement and technical assistance	**Lead:** Secretariat of Economic Development of Acre / **Support:** SEBRAE, SENAI, Apex, MAPA, public banks, private sector	Local value added in exports; EPZ utilization rate; formal employment in logistics and manufacturing	Commodity specialization → vocation-based portfolios; low technical capacity → assistance hubs
Territorial planning and sustainability	Anchor the railway in land-use planning and safeguards	Ecological-Economic Zoning (ZEE) and land regularization; master and mobility plans for terminal access; participatory socio-environmental monitoring	**Lead:** Secretariats of Environment and Planning of Acre and municipalities / **Support:** federal environmental agencies, Public Prosecutor's Office, civil society, universities	Annual deforestation along the corridor; regularized rural areas; compliance with environmental conditions	Deforestation and conflicts → territorial pacts, risk-based monitoring; litigation → data transparency
Institutional capacity building and human development	Strengthen state capacities and human capital	Multilevel governance consortium and project coordination center; technical training programs (IFAC, UFAC, SENAI); municipal administrative modernization	**Lead:** State Civil Office and Planning Secretariat / **Support:** municipalities, IFAC, UFAC, public administration schools, banks, multilateral organizations	Number of trained civil servants per year; volume of external funds raised; project implementation (executed vs. planned budget)	Staff turnover and fiscal constraints → cooperation and incentives; decision-making fragmentation → executive committee

Source: prepared by the authors (2025).

The guideline is operationalized in an articulated manner. Within the integrated infrastructure and logistics axis, feeder connections and border management are prioritized to ensure that the time gains associated with the Pacific connection translate into operational predictability. The digitalization of flows and the formalization of capacity contracts contribute to reducing variability and sustaining system performance.

The productive reconfiguration and economic insertion axis focuses on repositioning the EPZ and the Industrial Pole by linking credit and incentives to innovation and local content generation. Programs aimed at productive linkages and regional procurement may strengthen supply chain integration and reduce dependence on commodities.

Within the territorial planning and sustainability axis, the focus lies on land-use regulation and territorial management to guide occupation patterns around terminals and access corridors. Participatory monitoring and transparency strengthen environmental safeguards and reduce the risk of judicial disputes.

Finally, the institutional capacity-building and human development axis proposes a multilevel governance consortium responsible for coordinating projects and decision-making processes. This axis combines training pathways with municipal administrative modernization, strengthening implementation capacity and the retention of technical expertise within municipalities.

Considering that the Bioceanic Railway is situated within the context of the Belt and Road Initiative, the guideline also incorporates a geoeconomic dimension. It is recommended that Acre actively participate in diplomatic networks, interstate forums, and international cooperation arrangements in order to expand its bargaining capacity and ensure that external investments are linked to social, environmental, and technological counterparts.

The proposed guidelines are not intended to replace existing policies, but rather to function as an integrative framework guiding the transformation of the railway into an instrument of sustainable regional development. Its modular and adaptable structure allows for progressive implementation, following the advancement of the railway project and the consolidation of local capacities. By combining infrastructure, productive diversification, sustainability, and institutional development, the proposal seeks to transform the Bioceanic Railway into an axis of integration and territorial value creation, contributing to a new development dynamic in the Southwestern Amazon.

REGIONAL INTEGRATION AND THE CHALLENGES OF LOCAL APPROPRIATION OF THE BIOCEANIC RAILWAY

The guideline proposal presented in this study is grounded in the understanding that the Bioceanic Railway may function as a strategic vector for regional development, provided that its effects are anticipated, planned, and territorially anchored. The implementation of this guideline, however, faces challenges that go beyond the technical dimension and involve institutional, financial, and political aspects.

A first point of concern relates to the asymmetry between the pace of railway implementation and the time required for regional policy maturation. While the railway project follows the logic of large-scale investments and engineering schedules, the productive and institutional reconfiguration of Acre requires medium- and long-term processes, which remain constrained by fragile local

capacities. This mismatch may lead to unequal appropriation of benefits, concentrating gains among external actors and aggravating existing inequalities, such as dependence on income transfer programs (66% of the population) and land tenure informality affecting 93.38% of rural properties (Cedeplar, 2023a; Mastrangelo *et al*., 2019).

A geoeconomic interpretation of the project broadens this diagnosis. While the Bioceanic Railway may connect Acre and Brazil to global productive chains, it also inserts the territory into a network of financial and technological dependencies linked to the Chinese presence in strategic sectors. The railway should therefore be understood as part of the BRI, in which logistics infrastructure is associated with regional and global influence disputes. This perspective demonstrates that the project transcends the transportation dimension, constituting an instrument of strategic insertion that may both expand regional competitiveness and reproduce new power asymmetries. Understanding its effects thus requires simultaneously evaluating opportunities for productive integration and risks of geopolitical subordination, reinforcing the need for a regional guideline capable of balancing these tensions.

This scenario highlights a decisive point for interpreting the project: the expansion of logistical connectivity does not automatically translate into socially distributed territorial development. In Amazonian regions historically subordinated to external circuits of valorization, large infrastructure projects may intensify the fluidity of economic flows without proportionally improving the living conditions of local populations, while simultaneously transferring the ecological and social costs of integration to the territory (Hecht *et al*., 2024). Therefore, the central issue is not merely whether the railway will increase regional competitiveness, but rather under which institutional, environmental, and political arrangements this competitiveness may be territorially appropriated.

This concern converges with the debate on multilevel governance developed by Virga, Miranda, and De Marchi (2021), according to which Amazonian physical integration depends on coordination among different levels of government and on the articulation of three complementary dimensions: connectivity, accessibility, and capillarity. In the absence of such coordination, logistics corridors tend to reproduce inequalities, functioning as transit routes that connect global markets without integrating the territories they cross. Previous experiences under IIRSA confirm this risk,

since the absence of articulated territorial policies resulted in localized impacts, land-use disorder, and limited economic dynamization (Melón, 2022).

Accordingly, the South American Integration Routes policy (Brazil, 2024) seeks to mitigate these risks by establishing that bioceanic corridors, such as the Southern and Capricorn Routes, should be accompanied by interministerial arrangements, federal coordination, and monitoring mechanisms. By incorporating the Bioceanic Railway as a strategic state project, the policy signals an effort to overcome the export-oriented logic and reaffirms the need to internalize benefits at the territorial level.

Another challenge concerns the institutional capacity of subnational governments to coordinate public policies on a regional scale. Acre faces limitations in fiscal capacity, technical personnel, and management infrastructure, especially in smaller municipalities (Acre, 2023b; Acre, 2023c). The proposed guideline seeks to address this obstacle through the creation of a multilevel governance consortium, although its effectiveness will depend on the consolidation of stable intergovernmental arrangements with clearly defined competencies, resources, and responsibilities. This point directly relates to the literature on multilevel governance, which emphasizes the need to balance functions across local, national, and regional scales in order to prevent institutional asymmetries from undermining the appropriation of benefits.

The environmental dimension also imposes important constraints. Although official discourse associates the railway with sustainability due to the replacement of road transportation, its implementation within the Amazon territory involves concrete risks of deforestation, land pressure, and socio-environmental conflicts. These risks cannot be addressed solely through compensatory measures, but require active territorial planning, anticipatory land regulation, and mechanisms of social oversight. The South American Integration Routes policy reinforces this perspective by arguing that physical integration will only generate structuring effects when associated with environmental and social policies, recognizing that sustainability and governance are inseparable dimensions of the bioceanic agenda (Brazil, 2024).

Despite these challenges, the guideline formulated in this study holds strategic value by mediating between a continental-scale project and a historically marginalized territory. Acre ranks

25th in the State Competitiveness Ranking and presents one of the country's lowest GDPs per capita (CLP, 2024), highlighting its structural vulnerability. The proposed guidelines seek to reduce the distance between global and local dynamics by creating instruments capable of internalizing the railway's benefits in a planned and equitable manner.

The incorporation of an axis dedicated to institutional capacity-building and human development strengthens the consistency of the proposal, as it establishes connections among infrastructure, economy, territory, institutions, and society. From this perspective, the guideline constitutes both a conceptual framework and a practical guide for bioceanic integration policies capable of reconciling competitiveness, territorial justice, and sustainability.

Although formulated from the reality of Acre, the guideline may serve as a reference for other regions affected by large logistics projects. Its modular and axis-oriented structure allows adaptations according to different institutional contexts. By articulating existing planning instruments, such as master plans, ecological-economic zoning, and state development policies, the proposal enhances its political and operational feasibility. In the case of Acre, it represents a concrete opportunity to align logistical integration, productive dynamization, and territorial sustainability, contributing to transforming the Bioceanic Railway into an effective instrument of regional development.

FINAL CONSIDERATIONS

This article analyzed the strategic importance of the Bioceanic Railway for Brazil, with emphasis on its potential impacts on the state of Acre. Based on a SLR and documentary research grounded in official and institutional sources, regional development guidelines aimed at the territorial appropriation of the infrastructure were formulated. The study demonstrated that, although the railway represents a significant opportunity for logistical diversification and geoeconomic repositioning, its benefits do not materialize automatically. Their realization depends on the capacity to articulate integrated regional policies capable of ensuring productive inclusion, sustainability, and territorial governance.

The findings revealed that Acre presents historical vulnerabilities, such as low economic diversification, high dependence on income transfer programs, and institutional fragility, which may limit its capacity to fully benefit from a project of this magnitude. The proposed guidelines, structured around four axes (integrated infrastructure and logistics, productive reconfiguration and economic insertion, territorial planning and sustainability, and institutional capacity-building and human development), seek to address these challenges. The proposal offers a systemic model aimed at aligning economic growth, territorial justice, and multilevel coordination, representing a concrete opportunity to transform the railway into a public policy instrument capable of inducing regional development in accordance with the specificities of the Amazonian territory.

From an academic perspective, the study contributes by integrating debates on international logistics, territorial governance, and geoeconomics, highlighting the Bioceanic Railway as a field of articulation between global supply chains and regional dynamics. From a practical standpoint, the proposed guideline provides support for public policies aimed at internalizing the benefits of large logistics projects, with potential replication in other peripheral territories of the Global South.

As a limitation, the study acknowledges the absence of primary data regarding the perceptions of local actors, which restricts the analysis to documentary and secondary evidence. Future research may deepen this dimension by incorporating the perspectives of subnational governments, local communities, and productive sectors directly involved in the railway project. Comparative studies involving other bioceanic corridors and experiences associated with the Belt and Road Initiative are also recommended in order to expand understanding of the mechanisms that condition the regional appropriation of the benefits generated by physical integration.

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