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THE FERROGRÃO RAILWAY (EF-170) AND REGIONAL DEVELOPMENT IN BRAZIL'S NORTHERN EXPORT CORRIDOR: LOGISTICS EFFICIENCY, TERRITORIAL TRANSFORMATIONS, AND SOCIO-ENVIRONMENTAL SUSTAINABILITY

FERROGRÃO (EF-170) E DESENVOLVIMENTO REGIONAL NO ARCO NORTE BRASILEIRO: EFICIÊNCIA LOGÍSTICA, TRANSFORMAÇÕES TERRITORIAIS E SUSTENTABILIDADE SOCIOAMBIENTAL

EL FERROCARRIL FERROGRÃO (EF-170) Y EL DESARROLLO REGIONAL EN EL ARCO NORTE BRASILEÑO: EFICIENCIA LOGÍSTICA, TRANSFORMACIONES TERRITORIALES Y SOSTENIBILIDAD SOCIOAMBIENTAL

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ABSTRACT

This study analyzes the relationships between the Ferrogrão (EF-170) project, logistical efficiency, and regional development in the Brazilian "Northern Arc" (Arco Norte), considering potential territorial transformations and the distribution of social and environmental benefits and impacts. The objective is to understand to what extent this undertaking—conceived to facilitate the transport of agricultural produce from Mato Grosso—might contribute to the reorganization of logistical flows without reproducing or deepening territorial asymmetries. The research employs a qualitative, exploratory, and descriptive approach, based on a review of literature and documents, as well as the interpretation of cartographic representations. The analysis examines the organization of transport flows, economic opportunities, conditions for

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social participation, environmental protection, and the territorial rights of Indigenous peoples and traditional communities. The findings indicate that the railway's logistical potential does not, in itself, guarantee socially distributed regional development. Its contribution will depend on the economic and institutional conditions of the territories, socio-environmental governance, and mechanisms for participation and territorial protection. It is concluded that territorial justice serves as a relevant perspective for evaluating large-scale infrastructure projects, by linking economic efficiency, regional development, and socio-environmental responsibility.

Keywords: Ferrogrão. Regional Development. Northern Arc (Arco Norte). Territorial Justice. Socio-environmental Sustainability.

RESUMO

Este estudo analisa as relações entre o projeto da Ferrogrão (EF-170), a eficiência logística e o desenvolvimento regional no Arco Norte brasileiro, considerando as possíveis transformações territoriais e a distribuição de benefícios e impactos sociais e ambientais. O objetivo é compreender em que medida o empreendimento, concebido para o escoamento da produção agrícola de Mato Grosso, poderá contribuir para a reorganização dos fluxos logísticos sem reproduzir ou aprofundar assimetrias territoriais. A pesquisa adota abordagem qualitativa, de caráter exploratório e descritivo, fundamentada em pesquisa bibliográfica, documental e interpretação de representações cartográficas. A análise considera a organização dos fluxos de transporte, as oportunidades econômicas, as condições de participação social, a proteção ambiental e os direitos territoriais de povos indígenas e comunidades tradicionais. Os resultados indicam que o potencial logístico da ferrovia não assegura, isoladamente, desenvolvimento regional socialmente distribuído. Sua contribuição dependerá das condições econômicas e institucionais dos territórios, da governança socioambiental e dos mecanismos de participação e proteção territorial. Conclui-se que a justiça territorial constitui uma perspectiva relevante para avaliar grandes projetos de infraestrutura, articulando eficiência econômica, desenvolvimento regional e responsabilidade socioambiental.

Palavras-chave: Ferrogrão. Desenvolvimento Regional. Arco Norte. Justiça Territorial. Sustentabilidade Socioambiental.

RESUMEN

Este estudio analiza las relaciones entre el proyecto Ferrogrão (EF-170), la eficiencia logística y el desarrollo regional en el Arco Norte brasileño, considerando las posibles transformaciones territoriales y la distribución de los beneficios y los impactos sociales y ambientales. El objetivo es comprender en qué medida el proyecto, concebido para el transporte y la exportación de la producción agrícola de Mato Grosso, podrá contribuir a la reorganización de los flujos logísticos sin reproducir ni profundizar las asimetrías territoriales. La investigación adopta un enfoque cualitativo, de carácter exploratorio y descriptivo, basado en la investigación bibliográfica y documental, así como en la interpretación de representaciones cartográficas. El análisis considera la organización de los flujos de transporte, las oportunidades económicas, las condiciones de participación social, la protección ambiental y los derechos territoriales de los pueblos indígenas y las comunidades tradicionales. Los resultados indican que el potencial logístico del ferrocarril no garantiza, por sí solo, un desarrollo regional con una distribución socialmente equitativa de sus beneficios. Su contribución dependerá de las condiciones económicas e institucionales de

los territorios, de la gobernanza socioambiental y de los mecanismos de participación y protección territorial. Se concluye que la justicia territorial constituye una perspectiva relevante para evaluar grandes proyectos de infraestructura, articulando la eficiencia económica, el desarrollo regional y la responsabilidad socioambiental.

Palabras clave: Ferrogrão. Desarrollo Regional. Arco Norte. Justicia Territorial. Sostenibilidad Socioambiental.

1 INTRODUCTION

Transport infrastructure plays a fundamental role in organizing economic flows and shaping the territorial configuration of large countries such as Brazil. The distances between production areas, consumer centers, and export ports mean that the conditions under which goods circulate extend beyond the strictly technical dimensions of transportation to encompass costs, time, accessibility, competitiveness, and the capacity to integrate different regions. In this context, logistics has become an important component of the economic organization of territory and of the relationships established between places.

Over recent decades, the expansion of agricultural production in Brazil's Central-West region, particularly in the state of Mato Grosso, has increased demand for corridors capable of accommodating growing commodity flows while reducing the effects of the long distances between production areas and international markets. The need to diversify export routes has contributed to the growing importance of the Northern Export Corridor (*Arco Norte*) as a strategic component of Brazilian logistics, bringing production from the Central-West closer to port terminals located in the Northern region. In this process, infrastructure ceases to represent merely a means of transporting cargo and becomes an element in the reorganization of economic and territorial relationships.

The Ferrogrão railway project (EF-170) is situated within this context. It was conceived to connect Sinop, in northern Mato Grosso, to Miritituba, a district of Itaituba in the state of Pará. The proposal envisages integrating rail transport with the Tapajós River waterway system, thereby establishing an export corridor associated with agricultural production in Brazil's Central-West and with the expansion of the Northern Export Corridor's role in national logistics. With approximately 933 kilometers planned for its main section, the project has the potential to change the organization of cargo flows between Mato Grosso's production areas and the export terminals of the Amazon region. This possibility, however, must be examined in light of the project's institutional status and the conditions required for its potential implementation.

Nevertheless, understanding Ferrogrão solely in terms of its transport capacity, potential reductions in logistics costs, or increased competitiveness in agricultural commodities would be insufficient. The project is located in a region characterized by the presence of conservation units, Indigenous lands, traditional communities, water resources, and different forms of territorial occupation and appropriation. In this area, the implementation of large-scale infrastructure establishes relationships with territories that have distinct

economic, environmental, cultural, and social functions. Accordingly, discussion of Ferrogrão necessarily involves a territorial dimension that extends beyond the movement of goods.

This dimension becomes particularly relevant when considering that the benefits and impacts of large infrastructure projects are not always distributed spatially in the same way. Lower logistics costs, increased transport capacity, and the strengthening of economic activities may generate effects at the state, national, and international levels, whereas certain environmental, social, and territorial impacts may be concentrated in municipalities, communities, and territories located near the project. This difference between the scale at which benefits arise and the scale at which impacts occur is a central issue in the analysis of Ferrogrão.

The issue becomes even more complex when the presence of Indigenous Peoples and traditional communities within the project's area of influence is taken into account. For these populations, territory is not merely a surface on which infrastructure can be installed or economic activities carried out. It is connected to identity, memory, culture, subsistence, social organization, and the continuity of ways of life. Consequently, potential territorial changes associated with the railway's implementation must also be examined in light of the social and cultural relationships historically established within these spaces.

The Ferrogrão project also provides an opportunity to discuss the economic prospects that may emerge in the territories associated with its area of influence. The potential construction and operation of the railway may stimulate activities related to storage, maintenance, commerce, services, and cargo handling, while also changing the relationships between producing municipalities and the Northern Export Corridor's export routes. These possibilities, however, do not guarantee that the benefits will be accessible to all social groups or that they will automatically translate into regional development. Such a transformation will depend on the economic and institutional conditions of the territories, municipal planning capacity, professional training, and opportunities for participation in decision-making processes.

In this context, this study addresses the following central research question: to what extent can the Ferrogrão railway project (EF-170), conceived as a strategic corridor for transporting agricultural production from Mato Grosso through the Northern Export Corridor, promote logistical and economic transformations without reproducing or deepening territorial, social, and environmental inequalities in the areas concerned?

In response to this question, the article aims to analyse the potential effects of the Ferrogrão project on the organization of logistics flows, territorial transformation, and regional development in the Northern Export Corridor, with particular attention to the distribution of potential benefits and impacts among different social groups and territories. The study is based on the understanding that increased logistics efficiency does not, in itself, imply socially equitable regional development. The realization of this potential will depend on the institutional, economic, social, environmental, and territorial conditions guiding decisions concerning the project, as well as on the capacity of municipalities and different social groups to access the opportunities that may arise, while respecting the territorial rights, ways of life, and environmental resources involved.

To develop this analysis, the study combines bibliographic research, documentary research, and the interpretation of cartographic representations. The discussion is organized around four dimensions: logistics and economics; territory and regional development; social and distributive aspects; and environmental and sociocultural issues. The maps help contextualize the project spatially and illustrate its relationships with transport networks, Indigenous lands, and the conservation units represented. By examining these dimensions, the study seeks to understand not only the logistical transformations that may result from the project, but also the territorial, social, and environmental conditions that will influence its potential contribution to regional development.

2 THEORETICAL FRAMEWORK

2.1 LOGISTICS, CIRCULATION, AND INFRASTRUCTURE

The discussion of Ferrogrão begins with the understanding that logistics is not limited to the physical movement of goods. In an extended supply chain, the conditions of transportation, storage, transhipment, and distribution affect circulation time, costs, and the ability of products to access markets. Christopher (2016) conceptualizes logistics as an integrated set of processes related to the planning, implementation, and control of product and information flows. From this perspective, logistics efficiency depends on coordination among different stages and stakeholders, as well as on the integration of transport systems with other components of the supply chain.

This perspective is particularly relevant to the transportation of agricultural commodities produced in areas far from major consumer markets and export ports. In the case of soybeans and corn, the large volumes transported and the distances between

production areas and export terminals make transport conditions an important component of logistics organization. The availability of corridors capable of handling large quantities of cargo and integrating different transport modes may change circulation conditions and influence the competitiveness of producing regions. The scale and intensity of these effects, however, depend on infrastructure characteristics, operating costs, and the degree of integration among the different segments of the logistics chain.

Ferrogrão should be understood within this framework of integration. The project envisages a railway connection between Sinop, in Mato Grosso, and Miritituba, in Pará, with the aim of linking rail transport to the waterway and port systems of the Northern Export Corridor (Arco Norte). The railway is therefore conceived as part of a transport network connecting production areas, transhipment terminals, transport systems, and international markets. Its potential contribution to regional logistics nevertheless depends on the connectivity among these components and their integration with existing infrastructure.

The analysis of logistics efficiency must therefore consider the spatial relationships that infrastructure may reorganize. The implementation of a new transport corridor changes not only the conditions under which goods are moved; it may also alter the relative importance of transport routes, terminals, and localities connected to the network. In the case of Ferrogrão, this possibility provides a basis for discussing how a new railway connection may change the relationships between production areas in Mato Grosso and the export corridors of the Northern Export Corridor, without presupposing the magnitude or territorial distribution of these effects.

Logistics efficiency, however, should not be equated with regional development. Infrastructure may increase the capacity to move goods and create favourable conditions for attracting certain economic activities, but the distribution of these benefits depends on the social, economic, and institutional relationships within the territories concerned. For this reason, the analysis of Ferrogrão must go beyond the potential performance of the transport system and consider how the infrastructure may reorganize spatial relationships and economic opportunities. This transition from logistics to territory provides the link between the present discussion and the approach developed in the following subsection.

2.2 TERRITORY, NETWORKS, AND SPATIAL TRANSFORMATION

The analysis of Ferrogrão requires an understanding of territory that extends beyond its physical dimension. The perspective developed by Santos and Silveira (2001) makes it

possible to examine Brazil's territorial organization in terms of land use, techniques, networks, and historically constructed relationships. From this standpoint, infrastructure contributes to the organization of territory by establishing connections, facilitating particular flows, and changing circulation conditions between places. Large-scale infrastructure, therefore, is not built in an empty or neutral space; rather, it becomes part of already constituted territories in which economic activities, forms of occupation, social relationships, cultural heritage, and competing interests coexist.

This understanding is particularly important in the case of Ferrogrão, whose reference alignment lies within a region characterized by different forms of environmental protection, human occupation, and territorial organization. The proposed connection between production areas in Mato Grosso and terminals in Pará must be analysed in relation to the existing territories of the region, including Indigenous lands, conservation units, traditional communities, and water resources. These spatial relationships should not be interpreted merely as obstacles or physical constraints on infrastructure, since they involve land uses, rights, cultural ties, and forms of social organization that must be considered when assessing the project.

Infrastructure may thus act as a driver of change in flows and spatial relationships. Its potential implementation may stimulate new economic activities, modify circulation patterns, influence the appreciation of certain areas, and change the relative importance of municipalities and localities connected to the logistics corridor. From this perspective, territory is not merely the physical space in which the infrastructure may be built; it is part of the transformation process itself, since its economic, social, environmental, and institutional characteristics condition both the prospects for implementation and the distribution of the effects associated with the infrastructure.

The territorial dimension also requires consideration of the different scales at which the effects of infrastructure may occur. Decisions concerning the transportation of agricultural commodities produced in Mato Grosso are linked to national and international economic chains, whereas potential changes in land use, local mobility, and living conditions may be concentrated in municipalities and communities within the project's area of influence. This difference in scale is relevant to the analysis of Ferrogrão because it makes it possible to investigate whether the expected logistics benefits and the potential territorial and socio-environmental costs associated with the infrastructure will be distributed unequally.

The analysis of Ferrogrão must therefore bring together different territorial scales. The corridor is associated with agricultural production in Mato Grosso, national logistics, and Brazilian exports, but its potential implementation also involves specific territories with their own populations, economic activities, and environmental characteristics. Considering these relationships helps prevent the project's economic significance at the national level from obscuring the local conditions under which its effects may emerge. This perspective leads to a discussion of regional development and of the capacity of territories to transform infrastructure-related opportunities into socially distributed benefits

2.3 REGIONAL DEVELOPMENT, OPPORTUNITIES, AND TERRITORIAL CAPACITIES

The existence of infrastructure does not, in itself, mean that regional development will occur. Railway construction may mobilize investment, create jobs, and increase the movement of goods, but these processes do not automatically ensure lasting improvements in living conditions or a balanced distribution of opportunities among territories. For infrastructure investment to contribute effectively to regional development, it is necessary to consider the economic, social, and institutional conditions that enable different groups and municipalities to participate in the resulting benefits.

Brandão's contribution (2017) helps explain regional development in terms of relationships across different scales and the inequalities that shape the economic organization of territory. This perspective is relevant to the analysis of Ferrogrão because the project connects agricultural commodity-producing areas in Mato Grosso to transport networks and national and international markets. Logistics connectivity, however, does not by itself determine development outcomes in the territories concerned. It is necessary to examine how investment, economic activities, and opportunities potentially associated with the infrastructure interact with local conditions and with the distribution of the resulting benefits.

The potential expansion of goods circulation may create opportunities for municipalities associated with the logistics corridor, particularly in activities such as storage, maintenance, commerce, food services, accommodation, transportation, and professional training. The realization of these opportunities, however, will depend on the conditions prevailing in each territory and on the ability of local institutions, businesses, and workers to participate in new economic dynamics. The discussion of development, therefore, goes beyond identifying potential opportunities: it requires consideration of the social and

economic conditions that enable these opportunities to generate lasting changes for local populations.

Sen's perspective (2010) deepens this discussion by understanding development in terms of expanding people's capabilities and substantive freedoms. From this standpoint, economic growth is not a sufficient end in itself, since its significance also depends on people's actual opportunities for social participation and choice. Applied to the analysis of Ferrogrão, this perspective makes it possible to ask who may gain access to jobs, services, and economic opportunities potentially associated with the project, as well as which conditions may restrict the participation of certain social groups in these processes.

This approach broadens the criteria used to assess the potential outcomes of Ferrogrão. In addition to transport capacity, planned investment, and potential job creation, it is necessary to examine who may access the opportunities, under what conditions, and with what prospects for sustained participation in economic transformation. Since municipalities, social groups, and communities differ in their capacity to take advantage of opportunities and respond to change, the effects of infrastructure may be distributed unequally. This issue connects the discussion of regional development with the debate on territorial justice, which is examined in greater detail in the following subsection.

At this point, the concept of regional development converges with the idea of territorial justice. If different municipalities, social groups, and communities have unequal capacities to access opportunities and respond to change, the effects of infrastructure are unlikely to be distributed uniformly. The analysis of development must therefore take these differences into account.

2.4 SUSTAINABILITY, CONFLICTS, AND TERRITORIAL JUSTICE

Assessing Ferrogrão requires consideration not only of its logistical and economic purpose but also of the environmental and social conditions of the territories associated with the project. Sachs's discussion of sustainable development (2009) contributes to this analysis by emphasizing the interconnectedness of different dimensions of development. In the case of large-scale infrastructure located in a region of considerable environmental and sociocultural diversity, this approach makes it possible to question whether the expected economic gains can be reconciled with environmental protection, territorial rights, and the living conditions of the populations concerned.

In the case of Ferrogrão, socio-environmental analysis encompasses Indigenous lands, conservation units, water resources, and traditional communities present in the region considered in this study. The potential effects of infrastructure on this scale are not necessarily confined to the area physically occupied by the project. Depending on how it is implemented and integrated with other activities, its effects may extend to areas connected to transport flows, land use, and regional economic dynamics. Identifying these effects, however, requires distinguishing possibilities raised by territorial analysis from impacts actually demonstrated by environmental studies and specific data.

Acselrad's contribution (2004) helps explain environmental conflicts in terms of the different ways in which territory is appropriated and understood. In large-scale projects, the interests involved do not always coincide: while some stakeholders may prioritize the movement of goods and the expansion of economic activities, other populations associate territory with housing, subsistence, memory, culture, and the continuity of their ways of life. In the case of Ferrogrão, these differing perspectives are an important dimension of the analysis, since assessing the project requires consideration not only of its logistical function but also of the territorial uses and rights that may be involved in decisions about its implementation.

These differing perspectives make the discussion of territorial justice particularly important. In this study, the concept is not understood as the mathematically equal distribution of benefits among all municipalities or individuals, but as a framework for examining how the benefits, costs, and decisions associated with infrastructure are distributed among different groups and territories. This approach considers existing economic, social, environmental, and territorial inequalities; opportunities for participation in decision-making processes; the protection of territorial rights; and actual access to economic opportunities. It therefore makes it possible to question not only the outcomes a project may produce, but also who may benefit from it, who may bear its costs, and which groups may be able to participate in decisions affecting their territories.

This perspective is particularly relevant to the analysis of Indigenous Peoples and traditional communities. For these populations, territory may encompass material and symbolic dimensions associated with subsistence, identity, memory, culture, and collective organization. For this reason, the potential effects of infrastructure cannot be assessed solely through indicators of investment, transport costs, or job creation. It is also necessary to

consider relationships with places, the territorial rights involved, and the conditions required for ways of life to continue.

The territorial distribution of benefits and costs is therefore a decisive issue in assessing the project. The expected logistics gains may affect production chains and markets extending beyond the region, while potential socio-environmental effects may be concentrated in particular municipalities and communities. This difference should not be assumed to be an established outcome; rather, it should be investigated in light of the project's characteristics, the territories concerned, and the available evidence. The relationship between the scale of benefits and the distribution of potential costs is precisely what makes territorial justice a relevant analytical category for the study of Ferrogrão.

From this perspective, the sustainability of Ferrogrão must be examined beyond its economic efficiency and the possibility of shifting freight from road to rail. The analysis must consider the conditions under which the project may interact with the territories concerned, the mechanisms for social participation, environmental protection, and respect for territorial rights. These aspects do not replace logistics assessment; rather, they broaden the criteria needed to determine whether the expected benefits may contribute to regional development without deepening existing inequalities.

2.5 SYNTHESIS OF THE THEORETICAL FRAMEWORK AND ANALYTICAL CATEGORIES

The theoretical framework makes it possible to analyse Ferrogrão through complementary dimensions. The logistics approach helps examine the organization of flows and integration among transport modes; the territorial perspective explains how infrastructure becomes embedded in historically constituted spaces; discussions of regional development and social capabilities guide the analysis of economic opportunities and their distribution; and studies of sustainability and environmental conflicts provide tools for examining the relationships among infrastructure, territorial rights, and socio-environmental protection. Taken together, these contributions allow the project to be assessed beyond its potential cargo-handling capacity, also considering the conditions under which its possible effects may be distributed among the territories and social groups concerned.

On the basis of this integrated approach, the analysis was organized around four interrelated categories: (a) logistics efficiency and the organization of flows; (b) territorial transformation and regional development; (c) the distribution of benefits and potential social and economic impacts; and (d) sustainability, territorial justice, and socio-environmental

governance. These categories guide the examination of the bibliographic, documentary, and cartographic material and structure the discussion of the findings. Although presented separately for analytical purposes, they are examined together, since changes in circulation and infrastructure may be connected to economic opportunities, territorial inequalities, and socio-environmental issues.

Table 1

Theoretical framework and analytical categories of the study.

Theoretical axis	Main references	Guiding analytical question
Logistics and circulation	Christopher (2016)	How may the Ferrogrão contribute to reorganizing freight flows and improving logistical efficiency in the Northern Arc?
Territory and networks	Santos and Silveira (2001)	How does the infrastructure fit into previously established territories, and what spatial transformations may it produce?
Regional development and capabilities	Brandão (2017); Furtado (2019); Sen (2010)	What economic opportunities may be generated, and which groups and territories will have the conditions to access them?
Sustainability and socio-environmental conflicts	Sachs (2009); Acselrad (2004)	What impacts, conflicts, and socio-environmental limits may accompany the territorial transformation associated with the project?
Territorial justice	Synthesis of the theoretical references	How may benefits, costs, opportunities, and decision-making processes be distributed among different groups and territories?

Source: Prepared by the authors.

The categories presented in Table 1 guide an integrated analysis of Ferrogrão. The organization of logistics flows is examined in relation to the territorial transformations and economic opportunities that may arise from the project, while also considering the distribution of potential benefits and costs and the conditions for environmental protection, social participation, and respect for territorial rights. This integrated approach provides the basis for interpreting the findings presented in the following sections.

3 METHODOLOGY

3.1 NATURE AND APPROACH OF THE RESEARCH

This study adopts a qualitative, exploratory, and descriptive approach, combining bibliographic research, documentary research, and the interpretation of cartographic representations. This choice reflects the nature of the research problem: Ferrogrão cannot be analysed solely in terms of its projected transport capacity or economic indicators, since the project involves issues related to circulation, territorial organization, regional development, and socio-environmental relationships.

The exploratory nature of the study is associated with the need to understand a project whose effects cannot yet be fully assessed as established outcomes, while the descriptive dimension makes it possible to characterize its planned configuration, territorial setting, and the issues identified in the documents consulted. The research does not seek to definitively measure the railway's future impacts or produce statistical generalizations. Its purpose is to examine, on the basis of the available sources, the relationships among logistics efficiency, territorial transformation, regional development, and territorial justice.

3.2 BIBLIOGRAPHIC RESEARCH

The bibliographic research brought together works addressing the concepts underlying the analysis of Ferrogrão, including logistics and circulation, territory and networks, regional development and social capabilities, sustainability, socio-environmental conflicts, and territorial justice. The authors whose work informs the study include Christopher (2016), Santos and Silveira (2001), Brandão (2017), Furtado (2019), Sen (2010), Sachs (2009), and Acselrad (2004).

These references were used to underpin the interpretation of the project and guide the development of the analytical categories. The discussion of logistics informed the analysis of flow organization and intermodal integration; the territorial approach guided the examination of how infrastructure is embedded in previously constituted spaces; perspectives on regional development and social capabilities provided a basis for discussing access to opportunities; and studies of sustainability and environmental conflicts contributed to the examination of the relationships among infrastructure, territorial rights, and socio-environmental protection.

3.3 DOCUMENTARY RESEARCH

The documentary research focused on institutional information concerning the Ferrogrão project (EF-170), including its planned configuration, logistical function, published economic parameters, and the legal, regulatory, and socio-environmental issues associated with the project. Information made available by public agencies involved in planning, regulation, oversight, and judicial review of aspects related to the project was considered, particularly material from the National Land Transport Agency (*Agência Nacional de Transportes Terrestres* - ANTT), the Ministry of Transport, the Federal Supreme Court (*Supremo Tribunal Federal* -STF), and the Federal Court of Accounts (*Tribunal de Contas da União* - TCU).

The documents supported the characterization of the project and the analysis of its institutional conditions, logistical objectives, and the controversies surrounding its potential implementation. The information was examined in conjunction with the literature used in the theoretical framework, with an effort to distinguish data concerning the project's planned configuration, institutional estimates and projections, judicial decisions, and interpretations developed by the authors.

The documentary review took into account the nature and purpose of the sources consulted. Information released by agencies responsible for planning and regulating the project was treated as an institutional record of its characteristics and stated prospects, rather than as automatic proof that the projected outcomes would be achieved. Similarly, judicial decisions were considered within the limits of their subject matter and legal effects, without assuming that a decision concerning a particular legal issue constituted full approval of the project or resolved all socio-environmental controversies.

3.4 SPATIAL ANALYSIS AND CARTOGRAPHIC REPRESENTATIONS

The spatial dimension of the research was examined through the reading and interpretation of two cartographic representations related to the Ferrogrão project (EF-170). The first shows the railway's reference alignment in relation to the Indigenous lands and protected areas represented on the map; the second situates the project within the logistics system of the Northern Export Corridor (Arco Norte), highlighting its relationship with the states of Mato Grosso and Pará, highway BR-163, the Tapajós River waterway, and the other features indicated on the maps.

The representations were used in conjunction with the documentary research and the study's analytical categories, helping to contextualize the project's territorial setting and guide the discussion of the relationships among infrastructure, circulation, and territorial protection. However, cartographic interpretation was not used in isolation as proof that the alignment overlaps protected territories, that direct impacts will occur, or that socio-environmental effects will have a particular intensity.

Spatial information must be understood within the limitations of the underlying datasets and representations. Confirming distances, overlaps, and areas of influence requires verification of the original geospatial datasets, including their dates, scales, and accuracy, as well as the technical procedures used to produce the maps. For this reason, the figures are used as tools for territorial contextualization and interpretation, rather than as substitutes for environmental assessments or specific geospatial surveys.

3.5 ANALYTICAL CATEGORIES

The interpretation of the bibliographic, documentary, and cartographic material was guided by the four categories presented in Table 1. Developed from the research problem and theoretical framework, these categories made it possible to organize the analysis of the different dimensions of Ferrogrão and examine the relationships among them.

The first category, logistics efficiency and the organization of flows, guided the analysis of the railway's intended function, its integration with other transport modes, and its relationship with the circulation corridors of the Northern Export Corridor.

The second category, territorial transformation and regional development, guided the discussion of potential changes in spatial relationships, economic activities, and the position of municipalities associated with the logistics corridor.

The third category, the distribution of benefits and social and economic impacts, made it possible to examine the difference between expected economic opportunities and the conditions required to access them, while also considering the possibility that costs and adverse effects may be concentrated in particular territories and social groups.

The fourth category, sustainability, territorial justice, and socio-environmental governance, guided the analysis of issues related to environmental protection, territorial rights, social participation, and the institutional conditions required to take the different interests involved into account.

The categories were examined in an integrated manner. The analysis considered that changes in logistics organization may affect territorial relationships; that access to economic opportunities may be unequal; and that the project's potential benefits and costs must be assessed in conjunction with the environmental, social, and institutional conditions of the territories concerned.

3.6 ANALYTICAL PROCEDURES

The analysis was conducted through an integrated reading of the bibliographic, documentary, and cartographic material, using the four analytical categories established in the study as its framework. Initially, the information was organized according to its contribution to understanding Ferrogrão's planned configuration, logistical function, potential territorial transformations, and the socio-environmental issues associated with the project.

In interpreting the material, an effort was made to distinguish documented information about the project from institutional estimates and projections, as well as from inferences developed by the authors on the basis of the theoretical framework. This distinction was particularly important when examining expected economic benefits and potential territorial, social, and environmental effects, thereby avoiding the treatment of forecasts as outcomes already observed.

The discussion of the findings was organized to relate the railway's intended logistical function to the territorial and social conditions in which the project may be situated. This approach made it possible to examine not only the potential reorganization of cargo flows but also issues concerning the distribution of economic opportunities, territorial protection, and the participation of the groups involved.

3.7 RESEARCH LIMITATIONS

The main limitation of this study arises from the stage of development of the Ferrogrão project. Since the effects associated with the potential implementation and operation of the railway cannot yet be fully examined as established outcomes, part of the discussion is based on institutional projections, possibilities identified in the literature, and interpretations of the available information.

The spatial analysis also has limitations. The cartographic representations used help contextualize the project's territorial setting, but they do not replace the verification of official

geospatial datasets, field surveys, environmental assessments, or specific technical procedures intended to confirm distances, overlaps, and areas of influence.

These limitations define the scope of the conclusions but do not prevent the proposed analysis. The study seeks to understand the conditions and asymmetries that must be considered when assessing the project, without claiming to predict its future effects definitively. Further research could deepen this discussion through updated geospatial datasets, municipal socioeconomic indicators, fieldwork, interviews with directly involved groups, and monitoring of the project's institutional, regulatory, and environmental stages.

3.8 USE OF GENERATIVE ARTIFICIAL INTELLIGENCE AND SCIENTIFIC INTEGRITY

During the preparation of this article, generative artificial intelligence (GAI) tools, including ChatGPT, were used as supplementary resources to support text organization, language revision, improvements in clarity of exposition, and consideration of possible approaches to structuring the manuscript. Their use was limited to supporting the writing process and did not replace the formulation of the research problem, the selection of methodological procedures, the analysis of bibliographic and documentary sources, or the interpretation of cartographic representations.

The use of these tools took place under the authors' supervision, and the authors remain responsible for selecting and verifying information, developing arguments, assessing the appropriateness of interpretations, and preparing the final version of the article. Suggestions generated by GAI were critically assessed, and their incorporation into the manuscript was subject to the authors' evaluation. The tools are not considered authors of the work, and their use does not transfer responsibility for the scientific content to them.

This declaration of GAI use is grounded in the principles of transparency, responsibility, and scientific integrity, in accordance with the guidelines of the National Council for Scientific and Technological Development (*Conselho Nacional de Desenvolvimento Científico e Tecnológico* - CNPq), which recommend disclosing the use of these tools at different stages of research, specifying their purpose, and assigning responsibility for the final content to the authors. The study also takes into account the recommendation of the United Nations Educational, Scientific and Cultural Organization (UNESCO) concerning human oversight, transparency, and accountability in the use of artificial intelligence systems (CNPq, 2026; UNESCO, 2022).

In this study, the use of GAI did not replace bibliographic and documentary research, did not constitute an independent source of evidence about the Ferrogrão project, and was not employed to validate geospatial datasets or establish territorial and socio-environmental impacts. Statements concerning the project must be supported by the bibliographic and documentary sources identified in the article, while the analytical inferences remain grounded in the methodological procedures described.

Accordingly, GAI was used as an auxiliary resource in the preparation of the scientific manuscript, while responsibility for theoretical and methodological decisions, analysis of the material consulted, verification of references, and the final version of the manuscript remains with the authors.

4 RESULTS AND DISCUSSION

4.1 FERROGRÃO AND THE REORGANIZATION OF LOGISTICS FLOWS

The analysis of the documents consulted and the specialized literature indicates that Ferrogrão was conceived to reorganize part of the agricultural cargo flows originating in Brazil's Central-West region, particularly from Mato Grosso, toward the export corridors of the Northern Export Corridor (*Arco Norte*). The project envisages a railway connection between Sinop, in northern Mato Grosso, and Miritituba, in Pará, with the possibility of integration with the Tapajós River waterway and the region's port terminals.

Ferrogrão's logistical significance is not limited to the construction of a new railway; it is also associated with the possibility of integrating different transport modes within a single transport chain. Under the proposed configuration, agricultural cargo would be transported by rail to Miritituba and could then proceed along the Tapajós River waterway toward port terminals. This arrangement places the project within an integrated logistics framework in which roads, railways, waterways, and port facilities perform complementary functions in the movement of goods.

Christopher's discussion (2016) helps explain this configuration by emphasizing the importance of coordination among the different stages and flows that make up a logistics chain. Applied to Ferrogrão, this approach makes it possible to examine the railway's potential to expand transport options for agricultural commodities and connect production areas, transhipments terminals, and export ports. This potential, however, is associated with the project's design, and its effectiveness will depend on the operating conditions and integration of the logistics corridor.

The introduction of a rail alternative may change the relative share of different transport modes in agricultural freight transportation. For products such as soybeans and corn, which are transported in large volumes, combining rail and waterway transport may offer operational advantages along certain sections of the route and create conditions for reducing some transportation costs. This possibility, however, does not derive solely from the cargo capacity of the transport modes. Its realization will depend on operating costs, the distances actually covered, transhipments facilities, integration with road access routes, and the operating conditions of the terminals and ports involved.

The assessment of Ferrogrão must therefore distinguish the advantages envisaged in the project's planning from the outcomes that may be observed if the railway is built and enters operation. Potential cost reductions, competitiveness gains, changes in transportation time, and shifts in the relative use of transport modes cannot yet be treated as demonstrated effects. These outcomes will depend on the conditions under which the railway is implemented and operated and on its effective integration with the other components of the logistics network.

The analysis of Ferrogrão thus leads to a discussion of the relationship between infrastructure and territory. Although potential improvements in transportation conditions may change the organization of cargo flows and strengthen the logistics integration of the Northern Export Corridor, their consequences will also depend on the characteristics of the areas concerned and on the relationships that the new infrastructure establishes with existing territorial dynamics. This perspective guides the analysis of the potential spatial transformations associated with the project.

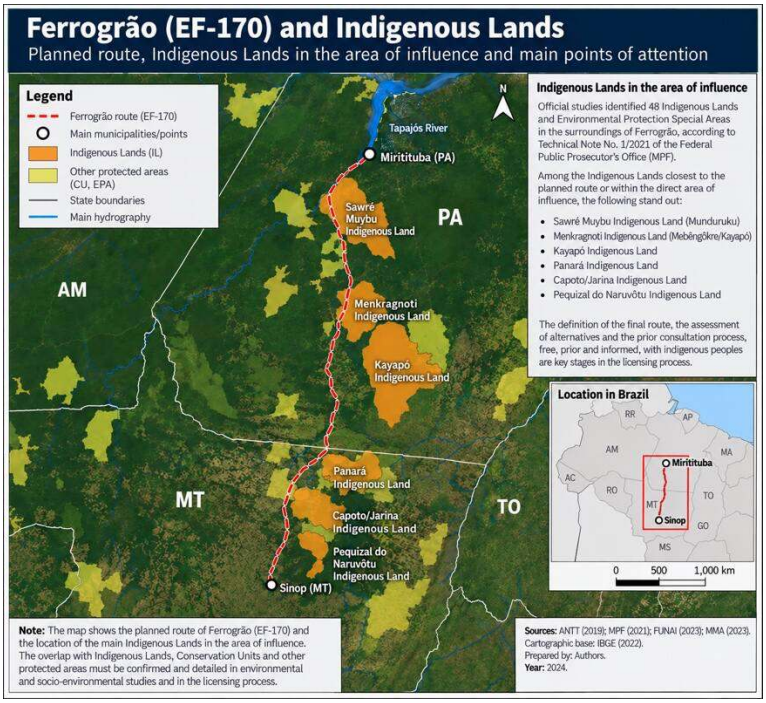
4.2 FERROGRÃO, TERRITORY, AND THE SPATIAL REORGANIZATION OF THE NORTHERN EXPORT CORRIDOR

The analysis of Ferrogrão requires consideration of the characteristics of the territories in which the project may be implemented. The region encompasses productive activities, transport networks, protected areas, Indigenous lands, traditional communities, water resources, and different forms of territorial appropriation and land use. In this context, the potential implementation of the railway may affect existing territorial relationships, an understanding of which is essential for assessing the possible effects of the infrastructure beyond its transport function.

Figure 1 helps situate the EF-170 reference alignment in relation to the Indigenous lands and protected areas represented in the cartography. The territories identified on the map include the Sawré Muybu, Menkragnoti, Kayapó, Panará, Capoto/Jarina, and Pequizal do Naruvôtu Indigenous Lands. The representation illustrates the region's territorial diversity and provides a basis for discussing the relationship between infrastructure planning and the presence of areas subject to different forms of territorial protection and use.

Figure 1

Reference alignment of the Ferrogrão railway (EF-170) and its spatial relationship with Indigenous lands and protected areas in Mato Grosso and Pará.



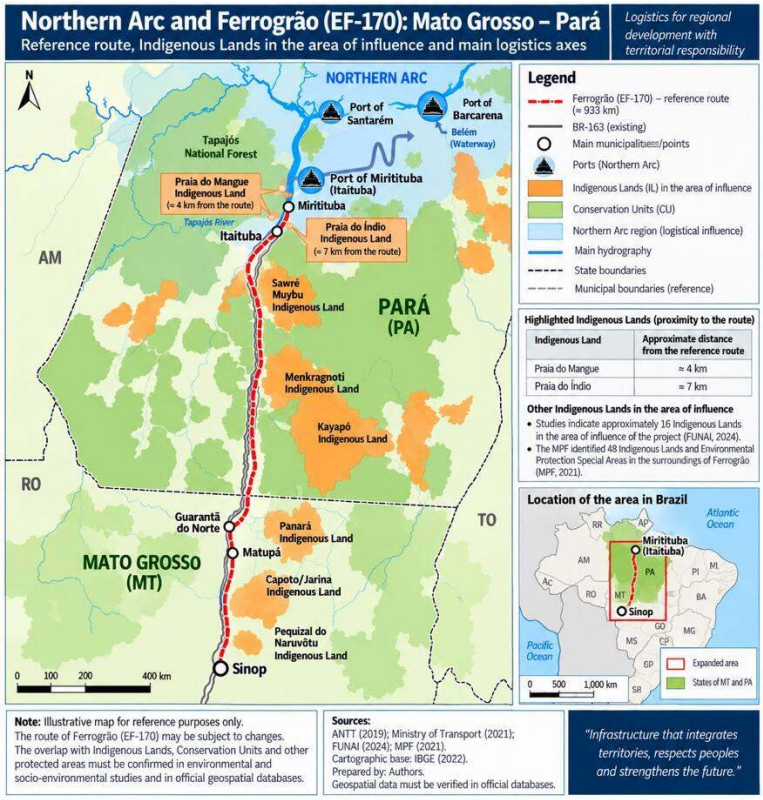
Source: Cartographic work prepared by the authors based on data from the National Land Transport Agency (ANTT, 2019), the Federal Public Prosecutor's Office (MPF, 2021), the National Foundation for Indigenous Peoples (FUNAI, 2023), and the Ministry of the Environment (MMA, 2023). Cartographic base: Brazilian Institute of Geography and Statistics (IBGE, 2022).

Cartographic interpretation alone cannot determine whether future impacts will occur or establish their extent or intensity. Its contribution lies in highlighting spatial relationships relevant to the analysis and demonstrating that the project cannot be assessed solely in terms of the distance between the points of origin and destination of cargo. The territories along and around the reference alignment must also be considered, without assuming that geographical proximity necessarily implies the occurrence of direct impacts.

Figure 2 broadens the spatial scale of the analysis by situating Ferrogrão within the logistics system of the Northern Export Corridor, showing the relationship among Mato Grosso, Pará, Miritituba, the Tapajós River waterway, the main transport routes, and the Indigenous and conservation areas represented. This broader view helps demonstrate that the project is associated with a transport network connecting production areas, transport infrastructure, and export terminals, while also being located in a region characterized by different forms of territorial occupation and protection.

Figure 2

Ferrogrão (EF-170) within the logistics system of the Northern Export Corridor: territorial connections between Mato Grosso and Pará.



Source: Cartographic work prepared by the authors based on data from the National Land Transport Agency (ANTT, 2019), the Ministry of Transport (2021), the National Foundation for Indigenous Peoples (FUNAI, 2024), and the Federal Public Prosecutor's Office (MPF, 2021).

The interpretation of the figures can be related to the approach developed by Santos and Silveira (2001), which understands territory in terms of historically constituted uses, techniques, and networks. From this perspective, Ferrogrão should not be understood merely as a new transport structure, but as a project whose potential implementation may change

circulation patterns and the relative importance of certain places within regional organization. These changes, however, will depend on how the infrastructure becomes integrated into existing networks and the economic and social dynamics of the territories concerned.

In this context, the Northern Export Corridor occupies an important position in discussions about the diversification of Brazil's export routes. The proposed connection between production areas in Mato Grosso and the terminals at Miritituba may strengthen cargo flows toward the North and change the relative share of the corridors used to transport agricultural production. The potential territorial effects of Ferrogrão are therefore not limited to the area occupied by the infrastructure itself. Depending on the conditions under which the logistics system is implemented and operated, they may extend to relationships among production, circulation, storage, transhipment, and exports.

Infrastructure should therefore be understood both in terms of its transport function and in terms of the changes it may introduce into the relationships among places, economic agents, and the territories concerned.

4.3 INFRASTRUCTURE, ECONOMIC OPPORTUNITIES, AND REGIONAL DEVELOPMENT

The implementation of large-scale infrastructure may create economic opportunities in the territories associated with its area of influence. During construction, demand may arise for materials, equipment, transportation, food services, accommodation, and other services. If the railway enters operation, activities related to railway maintenance, storage, and cargo handling may become more significant. The scale of these effects will depend on the characteristics of the construction project, operating conditions, and the participation of local economic agents in activities associated with the undertaking.

Brandão's contribution (2017) helps explain regional development in terms of relationships among different territorial scales. In the case of Ferrogrão, decisions concerning the movement of agricultural production from Mato Grosso are linked to logistics networks and markets that extend beyond the boundaries of the municipalities associated with the corridor. This relationship raises a central question: to what extent can the opportunities associated with infrastructure of national and international significance be translated into economic and social benefits in the territories where its effects will be experienced most directly?

Furtado's perspective (2019) broadens this discussion by emphasizing the social and economic conditions that shape development processes. Applied to Ferrogrão, this approach makes it possible to examine the conditions under which territories may participate in economic activities associated with the potential implementation and operation of the railway. Accordingly, the movement of investment and goods must be considered in relation to local economic dynamics and the capacity to incorporate new activities into regional development processes.

Sen's approach (2010) adds another dimension by shifting attention from economic growth to people's actual capabilities to take advantage of available opportunities. In the case of Ferrogrão, this perspective makes it possible to ask which groups may participate in the economic activities potentially stimulated by the project. Professional training, access to information, the availability of services, and the institutional conditions of municipalities are factors that may influence this participation and the extent to which the benefits associated with the infrastructure reach different segments of society.

These issues are also related to local governments' planning capacity. Depending on the scale and distribution of activities associated with the construction and future operation of the railway, new demands may arise for housing, mobility, healthcare, education, public services, and professional training. Municipal preparedness to respond to these changes will be important for service provision and for expanding the population's opportunities to participate in the economic activities associated with the project.

The analysis of Ferrogrão must therefore consider both the economic activities that may be stimulated and the conditions that will enable territories and different social groups to participate in the potential benefits. This approach guides the following discussion, which examines the territorial distribution of opportunities and potential impacts associated with the project.

4.4 TERRITORIAL DISTRIBUTION OF BENEFITS AND IMPACTS

The analysis of the potential effects of Ferrogrão raises a question that goes beyond identifying its possible economic benefits: how might the gains and costs associated with the project be distributed among the different social groups and territories concerned? This question is central to understanding whether the expansion of logistics infrastructure may contribute to regional development or tend to reproduce inequalities already present in the areas associated with the corridor.

The potential reduction in logistics costs and the strengthening of the export corridor may benefit economic agents operating at different scales, including agricultural producers, transport companies, and logistics operators. The territorial effects associated with infrastructure implementation, in turn, may follow a different distribution, affecting certain municipalities, communities, and areas near the planned alignment more directly. This difference between the scales at which benefits may emerge and the places that may experience more immediate changes is an important aspect of the analysis of Ferrogrão.

This difference in scale makes it possible to examine potential territorial asymmetries associated with the project. While the benefits related to commodity flows may reach economic agents and markets operating at different geographical scales, some of the potential social, environmental, and territorial effects may be concentrated in areas directly associated with the railway's implementation and operation. The issue, therefore, is not to assume that outcomes will be unequally distributed, but to investigate which planning, governance, and participation mechanisms may influence their distribution among the social groups and territories concerned.

Table 2 organizes the main groups and territories associated with the project, bringing together potential economic opportunities, possible impacts, and issues requiring attention in the planning and assessment of Ferrogrão. This systematization does not seek to anticipate the findings of specific impact assessments; rather, it highlights that the effects of logistics infrastructure may vary according to the territorial, economic, and social conditions of the groups concerned. The distribution of these effects is therefore a necessary dimension in assessing the relationship between logistics efficiency and regional development.

Table 2

Potential benefits, impacts, and research issues by group and territory.

Group or territory	Potential benefits	Potential impacts or risks	Research question
Large agricultural producers	Potential reduction in logistics costs and expansion of export alternatives	Unequal distribution of economic gains among agents of different sizes	How might logistics gains be distributed among actors in the agricultural value chain?
Workers	Potential job opportunities during the construction and operation phases	Temporary nature of jobs and need for skill qualification	Which workers will be able to access the opportunities generated?
Family farmers	Potential access to markets and services associated with the logistics dynamics	Changes in land use and land value, and difficulties in economic adaptation	Under what conditions will family farmers be able to participate in the opportunities?
Municipalities in the area of influence	Potential economic dynamism and expansion of activities related to the project	Pressure on public services, urban infrastructure and planning capacity	How will municipalities be able to absorb and distribute the economic and social effects?
Indigenous peoples	Possible opportunities, according to their interests and decisions; without assuming automatic benefits	Potential territorial, cultural and socio-environmental interferences	How will territorial rights, participation and the protection of these populations be ensured?
Traditional communities	Possible opportunities, according to their interests and decisions; without assuming automatic benefits	Possible changes in ways of life and in the relationship with the territory	How will participation and the rights of these communities be ensured?
Environment	Potential reduction in part of road transport, conditioned by effective modal substitution	Possible impacts from implementation and indirect effects of expanded occupation	What prevention, mitigation and monitoring measures will be necessary?

Source: Prepared by the authors.

4.5 INDIGENOUS PEOPLES, TRADITIONAL COMMUNITIES, AND TERRITORIAL JUSTICE

The presence of Indigenous Peoples and traditional communities in the territories associated with Ferrogrão introduces an analytical dimension that cannot be reduced to the project's economic or environmental aspects. For these populations, territory is associated with identity, culture, memory, subsistence, and social organization, constituting a space for the reproduction of collective life and the continuity of their historical relationships with the environment. For this reason, potential changes resulting from large-scale infrastructure must be examined beyond the area directly occupied by the construction works, taking into account their possible repercussions for the social, cultural, and territorial relationships established in these spaces.

The documentary records analysed indicate that, during the 2024 State Mobilization Meeting on the Ferrogrão EF-170 project, held in Mato Grosso, institutional representatives and civil society members discussed the project's possible interference with Indigenous villages and an Indigenous cemetery. According to the record considered in this study, these statements pointed to the need to examine the planned alignment and conduct anthropological studies. This episode illustrates that discussion of Ferrogrão involves issues

extending beyond the infrastructure's logistical performance and requires attention to the territorial and cultural relationships of potentially affected populations.

In this context, Indigenous Peoples and traditional communities should be understood as territorial subjects whose rights, knowledge, forms of organization, and relationships with space must be considered in planning and decision-making processes. This perspective makes it possible to move beyond a simplistic opposition between economic development and territorial protection, redirecting the discussion toward the conditions under which infrastructure projects can be assessed and implemented in ways that respect the rights of potentially affected populations.

Territorial justice is, in this sense, an important dimension of regional development. It does not imply that all groups must receive identical benefits; rather, it requires their different social, economic, cultural, and territorial circumstances to be considered when assessing the project. This entails examining participation in decision-making processes, potential exposure to impacts, and the incorporation of territorial and cultural rights into planning. It also requires that prevention, protection, mitigation, and monitoring measures, where appropriate, be grounded in specific studies and in the characteristics of the territories and populations concerned.

The central issue, therefore, is not to presume which impacts will occur, but to understand how they will be identified and assessed and under what conditions potentially affected populations will be able to participate in decision-making. The analysis of Ferrogrão must consequently consider not only the project's logistical and economic feasibility but also the institutional mechanisms required to ensure respect for territorial and cultural rights throughout the assessment, planning, and potential implementation processes.

4.6 SUSTAINABILITY AND SOCIO-ENVIRONMENTAL GOVERNANCE

The sustainability of Ferrogrão cannot be assessed solely in terms of the possibility of partially replacing road transport with rail transport. Although diversification of the transport system may offer logistical and environmental advantages, the extent of these benefits will depend on the actual conditions under which the infrastructure is implemented and operated. Furthermore, the construction of a railway approximately 933 kilometers long in a region of considerable environmental and sociocultural diversity requires consideration of the potential effects of the construction works themselves and the territorial transformations associated with possible implementation.

The documentation examined records revisions to studies concerning the project's engineering, demand, operations, environmental aspects, and economic and financial model. It also mentions issues relating to emissions and socio-environmental mitigation and compensation programs. These records demonstrate that the project's assessment involves various technical and institutional dimensions, but they do not, in themselves, establish that all risks have been controlled or that the proposed measures are sufficient to ensure its sustainability.

Acselrad's contribution (2004) helps deepen this discussion by addressing conflicts arising from different forms of territorial appropriation. The same space may serve distinct economic, environmental, cultural, and social functions that are not always compatible. In the case of Ferrogrão, this perspective makes it possible to examine potential tensions among the organization of the logistics corridor, environmental conservation, and the social and cultural relationships established in the territories associated with the project.

Socio-environmental governance plays a central role in this context because the actors involved do not have equal opportunities to influence decisions concerning the project. Public authorities, the private sector, municipalities, producers, workers, Indigenous Peoples, traditional communities, and civil society organizations have different interests, responsibilities, and capacities for participation. Therefore, the formal existence of spaces for dialogue is not, by itself, sufficient to ensure effective participation. It is necessary to consider how information is made available, which groups are able to express their views, and how their demands are incorporated into planning and assessment processes.

Assessing the sustainability of Ferrogrão therefore requires linking the technical analysis of potential impacts and prevention, mitigation, and compensation measures to the institutional capacity to incorporate different territorial perspectives into project planning and monitoring. This integration of environmental assessment, social participation, and protection of the rights of potentially affected populations is an important condition for examining the extent to which the project's logistical objectives may be reconciled with socio-environmental responsibility.

4.7 FROM LOGISTICS EFFICIENCY TO TERRITORIAL JUSTICE: A SYNTHESIS OF THE FINDINGS

The analysis indicates that Ferrogrão is a project whose significance extends beyond its function of transporting cargo. Its logistics potential is associated with the reorganization

of agricultural commodity flows from Mato Grosso and the strengthening of the Northern Export Corridor's integration. However, the potential territorial and economic transformations associated with its implementation do not justify assuming that gains in logistics efficiency will automatically translate into socially equitable regional development.

The economic opportunities potentially associated with the railway's construction and operation may reach different activities and economic agents, but the extent to which they can be accessed will depend on the economic, institutional, and social conditions of the territories concerned. Similarly, benefits linked to production chains and markets operating at national and international scales may be distributed differently from the costs and risks potentially associated with local transformations. This possibility is an important issue for analysis, although it does not, in itself, prove that outcomes will be unequally distributed.

In this context, territorial justice helps connect logistics efficiency with the conditions for social participation, environmental protection, and respect for the territorial and cultural rights of potentially affected populations. The analysis thus highlights the need to assess the project not only in terms of its projected cargo-handling capacity but also in terms of the conditions under which its potential opportunities and effects may be distributed among different territories and social groups.

The synthesis of the findings indicates that Ferrogrão's potential contribution to regional development depends on the integration of infrastructure, local economic conditions, socio-environmental governance, and territorial justice. This interpretation informs the concluding remarks, which revisit the research question, the study's contributions, and the limitations of the approach adopted.

5 FINAL CONSIDERATIONS

This study examined the Ferrogrão railway project (EF-170) and its potential relationships with logistics efficiency, territorial transformations, and regional development in Brazil's Northern Export Corridor (*Arco Norte*). The research addressed the question of how the project, conceived as a strategic corridor for transporting agricultural production from Mato Grosso, may promote logistical and economic changes without reproducing or deepening territorial, social, and environmental inequalities in the areas concerned.

The analysis suggests that Ferrogrão's potential contribution to regional development will not result solely from increased transport capacity or the reorganization of export flows. Although the project may strengthen the logistics integration of the Northern Export Corridor

and create economic opportunities associated with its potential implementation and operation, translating these possibilities into socially distributed benefits will depend on the economic, institutional, social, and environmental conditions of the territories concerned. Logistics efficiency is therefore a relevant but insufficient dimension for assessing the project's regional significance.

The main contribution of this study lies in connecting the analysis of transport infrastructure with discussions of territorial transformation, regional development, and territorial justice. This approach shifts the assessment of the project away from a perspective focused predominantly on the movement of goods toward an analysis of the conditions under which opportunities, costs, risks, and decisions may be distributed among different territories and social groups. From this perspective, the issue extends beyond the capacity to integrate markets and also involves public participation in decision-making processes, local governments' planning capacity, environmental protection, and respect for territorial and cultural rights, particularly those of Indigenous Peoples and traditional communities.

The cartographic interpretation helped contextualize Ferrogrão's reference alignment and its position within the logistics system of the Northern Export Corridor, situating the project in relation to the territories and protected areas represented in the datasets used. This contribution must, however, be understood within the limitations of the procedures adopted. Cartographic representations do not, in themselves, constitute proof of territorial overlap, direct impacts, or the intensity of potential socio-environmental effects.

From a methodological standpoint, the qualitative, exploratory, and descriptive nature of the research, based on bibliographic and documentary research and cartographic interpretation, made it possible to discuss the project's potential territorial implications but not to measure its future impacts or determine the actual distribution of its benefits and costs. The findings should therefore be understood as an interpretive analysis of the issues surrounding the project, rather than as a definitive prediction of its effects. Further development of these conclusions depends on verifying the documentary and geospatial datasets used and producing specific evidence concerning the territories and populations potentially affected.

Future research could advance this discussion through the use of updated official geospatial datasets, analysis of socioeconomic indicators for municipalities associated with the corridor, and fieldwork and interviews with representatives of public authorities, the private sector, Indigenous Peoples, traditional communities, and other groups involved. It will also

be important to monitor the institutional, regulatory, and environmental stages of the project in order to examine how decisions, prevention and mitigation measures, and social participation mechanisms are implemented in practice.

In conclusion, assessing Ferrogrão as a potential driver of regional development requires an integrated consideration of logistics efficiency, territorial development conditions, and socio-environmental responsibility. The aim is not to presume positive or negative outcomes in advance, but to recognize that the project's contribution will depend on the actual conditions under which its opportunities, risks, and decision-making processes interact with the territories and populations concerned. By highlighting territorial justice as an analytical perspective, this study contributes to broadening the debate on large-scale infrastructure projects, emphasizing that logistics and economic integration must also be examined in light of their potential social, environmental, and territorial implications.

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