

The Transnordestina Railway: Socioeconomic Projections, The Impacts Of Intermodality, And The Benefits For The Development Of The State Of Ceará

Márcio Carneiro Barbosa

(Bachelor's Degree In Military Sciences – Academia Militar Das Agulhas Negras (AMAN); Bachelor's Degree In International Relations – Universidade Do Sul De Santa Catarina (UNISUL); Higher Technology Degree In Foreign Trade – Universidade Do Sul De Santa Catarina (UNISUL); MBA In Business Logistics – Fundação Getulio Vargas (FGV); MBA In Renewable Energy Management – Fbuni / Instituto Euvaldo Lodi (IEL); Postgraduate Degree In Higher Education Teaching – Universidade Federal Do Rio De Janeiro (UFRJ); Postgraduate Degree In Public Administration – Universidade Católica De Brasília (UCB); Specialization In National Logistics – Escola Superior De Guerra (ESG); Specialization In Marketing Management – Universidade Veiga De Almeida (UVA); M. Sc. In Military Sciences – Escola De Comando E Estado-Maior Do Exército., Brazil)

Abstract:

Background: This study examines the construction of the Transnordestina Railway, which will extend for 608 kilometers across the State of Ceará in a north-south direction. The research addresses the historical relationship between rail transportation and economic development, as well as the potential contribution of railway infrastructure to regional productive integration and socioeconomic expansion.

Materials and Methods: The study adopted a qualitative research approach to investigate the extent to which the railway may influence Ceará's socioeconomic indicators by facilitating the circulation of diverse goods produced both within and outside the State. The methodological procedure consisted of a literature and documentary review, including the consultation of sources classified into four categories: (1) studies on railway systems and economic development; (2) studies on productive activities in Ceará potentially benefited by rail transport; (3) studies on the intermodality between the Transnordestina Railway and other transport systems in the State; and (4) studies addressing the advantages of the railway for statewide socioeconomic growth.

Results: The analysis indicates that the railway has the potential to strengthen logistical integration and improve freight transport efficiency through intermodal connections with other transportation systems. The findings also suggest that the expansion of railway infrastructure may contribute to the outflow of production, enhance the organization of productive chains, and stimulate economic activities across different regions of Ceará.

Conclusion: The study concludes that the Transnordestina Railway represents a strategic infrastructure project capable of promoting regional integration, improving logistical performance, and supporting the socioeconomic development of the State of Ceará. By enabling greater connectivity between production areas and export corridors, the railway may contribute to strengthening the State's economic growth and competitiveness.

Key Word: Transnordestina Railway; Intermodality; Freight Terminal; Dry Port; Productive Chain.

Date of Submission: 03-03-2026

Date of Acceptance: 13-03-2026

I. Introduction

With the advent of the First Industrial Revolution, England demonstrated to the world, at the beginning of the nineteenth century, a mode of transportation capable of covering long distances while transporting heavy and/or high-volume cargo. Thus, the railway mode emerged, transforming global parameters of distribution and supply logistics.

From the British Isles, steam locomotives and English railway tracks were exported to continental Europe, which subsequently developed a transportation system that would profoundly transform the economy of the Old World. Whether transporting freight or passengers, trains altered the structure of the industrial production system by ensuring the distribution of goods and products to consumer markets. In Brazil, during the reign of Dom Pedro II, the technological innovation developed by George Stephenson became popularly known as *Maria Fumaça*.

Historically, railways have played a crucial role in national integration, stimulating economic growth, facilitating the transportation of people and goods, and leaving a lasting legacy in territorial organization. This

dynamic was evident, for example, during the Westward Expansion in the United States during the nineteenth century.

Returning to the Brazilian context, the country experienced a significant period of railway expansion, driven by the growing need to transport several agricultural commodities, particularly coffee, which was becoming increasingly important to the national economy. At the same time, government authorities sought to ensure that this railway expansion would contribute to the integration of the country's diverse regions. Major infrastructure projects, such as the Estrada de Ferro Central do Brasil and the Estrada de Ferro Noroeste do Brasil, played a fundamental role in opening new agricultural frontiers and promoting the development and growth of numerous cities located along their routes. In addition to transporting passengers and freight, these railways created new economic and social opportunities for the regions they served.

In pursuit of these socioeconomic objectives, Brazil sought to improve railway infrastructure in the Northeast region. In this context, Transnordestina Logística S.A. became responsible for implementing the Transnordestina Railway, a project expected to transform freight transportation indicators in the State of Ceará by facilitating the distribution of goods to local, regional, and national markets, as well as enabling access to international trade routes.

Regarding the methodology adopted in this research, a qualitative approach was employed. In terms of investigative procedures, the study consisted of bibliographic and documentary research conducted through the analysis of national and international publications, scientific articles, governmental reports, and online sources. The consultation and consolidation of these materials enabled the identification and discussion of the most relevant issues addressed in this study.

The general objective of this research is to analyze the socioeconomic projections, the impacts of intermodality, and the benefits for the development of the State of Ceará arising from the full operationalization of the Transnordestina Railway. Based on this analysis, the study seeks to provide insights for decision-makers, offering greater clarity in the formulation of public policies and business strategies aimed at fostering the economic growth of Ceará.

The specific objectives established for this research are as follows: to present the historical importance and the direct relationship between railway transportation and regional socioeconomic development; to characterize the principal economic scenarios and productive activities benefited by freight transport along the Transnordestina Railway; to describe the main effects of intermodality between the Transnordestina Railway and other transportation systems within the State; and to evaluate the primary advantages resulting from the operationalization of the railway for the development of Ceará.

This article is structured into four sections that collectively provide a comprehensive analysis of the socioeconomic projections, intermodal dynamics, and advantages associated with the Transnordestina Railway in promoting the development of the State of Ceará. The first section, Introduction, presents the central theme of the study. The second section, Methodology, describes the research approach, including the data collection and analytical procedures. The third section, Theoretical Framework, discusses the historical importance and the direct relationship between railway transportation and regional socioeconomic development; examines the economic and productive perspectives stimulated by freight transport along the Transnordestina Railway; analyzes the implications of intermodality between the railway and other transportation systems within the State of Ceará; and evaluates the advantages associated with the operationalization of the railway in the region. Finally, the Conclusions section synthesizes the principal findings of the research, emphasizing the potential of the Transnordestina Railway to become the "new backbone" of the economy of Ceará and the broader Northeast region of Brazil.

II. Material And Methods

The approach adopted in this research was qualitative in nature, as the primary objective was to analyze the socioeconomic projections, the impacts of intermodality, and the benefits for the development of the State of Ceará resulting from the full operationalization of the Transnordestina Railway. This approach is widely recognized in the scientific community for its capacity to provide contextual analyses, enabling a comprehensive perspective on the outcomes associated with the railway's full functionality within the territory of Ceará, with potential implications for the Northeast region, Brazil, and the international market. Moreover, qualitative research emphasizes the interpretation and understanding of complex phenomena, which is particularly relevant in studies involving transportation infrastructure that traverses Ceará longitudinally (North–South), extending from the border of the Pernambuco to the Pecém Industrial and Port Complex on the Atlantic coast, another installation of significant strategic relevance for the economic development of the State (Leite; Silva; Martins, 2017).

Regarding the methodological procedures, the research was classified as bibliographic. This type of procedure is based on the careful analysis of previously published scientific works and constitutes one of the fundamental pillars of scientific knowledge construction. According to Pereira et al. (2018), bibliographic

research enables the consolidation of theoretical and methodological frameworks by gathering and interpreting relevant contributions on a specific subject. Robert K. Yin (2016) further argues that this method enhances the analytical robustness of research by grounding discussions in well-established theoretical perspectives.

For the development of this review, the research sources were selected and classified into four principal categories: (1) sources addressing the interrelationship between railway transportation and regional economic growth; (2) sources in the literature describing prospective scenarios of productive and business activities that may benefit from the full operationalization of the Transnordestina Railway; (3) sources that allow the description of the effects of intermodality between the railway and other transportation systems operating in the State of Ceará; and (4) sources that evaluate the advantages of the Transnordestina Railway for the socioeconomic growth of the State of Ceará.

The classification of these sources enabled a broader and more contextualized understanding of the benefits that may be generated for Ceará through the transportation of diverse categories of freight. The bibliographic and documentary reviews were conducted through the consultation of national and international publications, scientific articles, governmental reports, and online sources, ensuring comprehensive coverage of the most relevant contributions associated with the Transnordestina Railway and its potential role in fostering the socioeconomic development of the State of Ceará (Pereira et al., 2018; Silva; Emmendoerfer; Cunha, 2020).

III. Theoretical Framework

This theoretical framework is organized into four subsections. The first presents the historical importance and the direct relationship between railway transportation and the socioeconomic development of a region. The second seeks to characterize the principal economic scenarios and productive activities that may benefit from the Transnordestina Railway. The third describes the main effects of intermodality between the Transnordestina Railway and other transportation systems operating in the State of Ceará. Finally, the fourth subsection evaluates the advantages associated with the full functionality of the railway for the development of the State.

Historical Importance and the Direct Relationship between Railway Transportation and Regional Socioeconomic Development

In many situations, raw materials, production centers, and consumer markets are not located in close proximity, thereby creating logistical challenges in which transportation assumes a fundamental role. Consequently, transportation infrastructure performs the essential function of promoting integration among societies that produce different goods, enabling access to products that would otherwise be unavailable or available only at significantly higher prices (Machry, 2011).

Within this perspective, the literature consulted indicates the existence of reciprocal relationships between regional socioeconomic development and the operationalization of transportation systems. Neither process can reasonably precede the other for an extended period due to their close interdependence. Improvements in transportation systems tend to stimulate industrial development, while industrial growth, in turn, demands further advancements in transportation infrastructure (Fair & Williams, 1959, as cited in Caixeta-Filho et al., 2009).

Depending on the context, railway transportation may represent a more economical and efficient alternative for freight movement compared with other modes, such as road or maritime transport. This condition may reduce transportation costs and increase corporate competitiveness, enabling firms to offer products at lower prices. Furthermore, railway transportation may also produce positive environmental effects, as it generally consumes less fuel per ton transported when compared with other transportation modes. This characteristic contributes to lower carbon emissions, improved air quality, and reduced environmental impacts associated with transportation activities (Evaristo, 2026).

Under these circumstances, a direct relationship can be observed between railway operations and the socioeconomic development of the regions in which this mode of transport is implemented. Examples include population mobility, the flow of economic production, and the territorial expansion that occurred from east to west in the United States during the nineteenth century (Gomes, 2020).

Historically, the structural transformations associated with the Industrial Revolution in United Kingdom generated the need to transport large volumes of goods. Innovations and technological advances during the eighteenth and nineteenth centuries created the conditions necessary for the development of the steam locomotive, which became the first land-based machine capable of transporting passengers and cargo over relatively long distances. Consequently, railway transportation emerged as a key driver of national progress across the world. Railway technology significantly improved the levels of safety and reliability required for transportation systems (Vasconcelos, 2019).

During the nineteenth century, many countries experienced substantial economic growth stimulated by the expansion of railway networks, which facilitated commercial exchanges between regions and nations (Caixeta-Filho et al., 2009). These developments were also influenced by the limitations of waterway

transportation, which often struggled to carry heavy cargo over long distances or overcome natural barriers such as mountains and mountain ranges (Rodrigues, 2019).

Even today, railway transportation continues to facilitate the exchange of goods between producing and consuming regions (Vasconcelos, 2019). According to the National Geographic Society, between 1840 and 1860 the United States experienced a tenfold increase in railway track length, expanding from 4,828 kilometers to 48,280 kilometers. This expansion contributed to significant reductions in transportation costs and supported the expansion of the country’s agricultural and industrial frontiers.

In this context, railway logistics has become essential for addressing the dual challenge of transportation decarbonization and inclusive economic growth. Railway systems assist countries in reducing emissions while simultaneously supporting competitiveness, job creation, and sustainable development. Freight rail transportation plays a crucial role in facilitating trade, reducing logistical costs, and connecting production centers, ports, and markets (Qian, 2025).

Countries across all continents have recognized the strategic importance of aligning public policies and business investments aimed at socioeconomic development with railway infrastructure. As illustrated in the following table (Table 1), numerous examples demonstrate the strong interrelationship between transportation systems and economic development.

Table 1: Interrelationship between the Railway System and Socioeconomic Benefits

Country	Socioeconomic Benefits of the Railway Mode
India	- Between 2011 and 2024, 1,200 km of new railway lines were constructed (for freight transport), reducing logistics costs by up to US\$ 58 million and decreasing CO ₂ emissions by 55,000 tons from fossil-fuel combustion gases.
Cameroon	- Improvements in railway infrastructure along the Douala–N’Djamena corridor reduced container transportation costs by more than 7% between 2012 and 2022. - The modernization of 17 railway crossings, the installation of signaled level crossings, and the rehabilitation of 55 railway bridges enabled smoother and faster freight transportation.
Uzbekistan	- From 2015 to 2020, a new mixed-use railway line reduced freight costs for essential goods by up to 80%. - The Pap–Angren Railway Project established a vital rail connection between the isolated Fergana Valley and the rest of the country, significantly improving regional connectivity.
Serbia	- The Railway Sector Modernization Project will strengthen institutional capacity, contribute to railway governance, and integrate digital technologies to improve safety and efficiency. - An increase in travel speed is expected, making railway transportation more attractive and competitive. - Fundamentally, the project is projected to reduce accidents at level crossings involving vehicles and pedestrians by 23%.

Source: World Bank (Qian, 2025).

Railway infrastructures, by establishing connections that enable the exchange of goods among countries within a region, have significantly stimulated trade across the vast and diverse region of Africa. The improvement of railway lines facilitates the transportation of cargo across borders, allowing landlocked countries to access international trade through nations with maritime outlets. This dynamic benefits regional commerce as a whole by expanding business opportunities and strengthening commercial exchanges. The TAZARA Railway, which connects Tanzania and Zambia, is currently undergoing modernization supported by substantial investment from China. This investment aims to upgrade railway infrastructure and improve operational efficiency, thereby optimizing the transportation of both freight and passengers across the region.

The railway system has also played a fundamental role in fostering local trade and economic development in Kenya. This progress has substantially reduced travel time and transportation costs between Nairobi and Mombasa. Recently, Kenya Railways reported that in 2023 it transported approximately five million tons of freight, a milestone demonstrating the strategic importance of railway transportation for business activities and commercial expansion in the country. Through this dynamic, trade has continued to expand in Kenya, highlighting the strategic role of railway infrastructure in the national economy (Barham, 2024).

In Asia, transportation connectivity—particularly the railway system—represents a strategic instrument for promoting economic growth, strengthening regional resilience, and deepening integration among the countries of the Greater Mekong Subregion, including Cambodia, China, Laos, Myanmar, Thailand, and Vietnam (Wanli, 2025).

In Russia, railway transportation constitutes a significant branch of the national economy, ensuring the continuous operation of various economic sectors. It plays a crucial role in the Russian Federation by exerting a substantial influence on national development. The importance of the railway industry is further amplified by the country’s vast territorial extension. Consequently, passenger and freight transportation functions as a central link in a complex production chain involving numerous related industries (Kirsanova, 2019).

In other regions of the world, railway transportation meets the demands associated with the movement of agricultural commodities such as corn, cotton, and soybean, as well as steel products, mineral resources, and petroleum derivatives, typically transported in large volumes while reducing freight costs (Alves et al., 2020).

Therefore, it may be partially concluded that railway transportation directly influences the political, economic, and social circulation of nations. It facilitates the distribution of production, stimulates economic development, and supports national capabilities in strengthening state sovereignty within their respective regions.

The Main Scenarios and Productive Activities Benefited by Freight Transport on the Transnordestina Railway

It has become widely recognized worldwide that transportation systems are designed to achieve both economic and non-economic objectives. Economic purposes include the exploitation of natural resources, the increase of agricultural productivity, and the distribution of industrialized products. Non-economic objectives involve promoting territorial integration and encouraging the settlement of populations in areas with lower demographic density (Caixeta-Filho et al., 2009).

Railway transportation is generally characterized as a long-distance freight carrier operating at relatively low speeds, particularly suitable for raw materials and manufactured products. In most cases, railways transport full cargo loads, reflecting a tendency toward the movement of large volumes. Consequently, railway systems enable a wide range of services, including the transportation of bulk commodities, coal, grains, and refrigerated products (Alves et al., 2020).

At the national level, Brazil has implemented initiatives aimed at both modernizing and expanding its railway infrastructure. These initiatives include the construction of new railway lines and the concession of existing segments to private operators. Freight rail transportation, particularly for commodities such as agricultural and mineral products, has experienced renewed expansion across the country.

Historical Background and General Considerations of the Transnordestina Railway

From a historical perspective, in 1872, during the reign of Dom Pedro II, the State of Ceará already possessed preliminary studies concerning a railway that would cross its territory in a North–South direction. This proposal became known as the “Fortaleza–Pacatuba–Baturité–Crato Railway Project,” which aimed to establish a transportation corridor connecting strategic regions within the State (Alencar, 2021).

Figure 1 – Fortaleza–Pacatuba–Baturité–Crato Railway Project.



Source: Assis (2011), as cited in Alencar (2021).

At that time, the intention of the political and economic authorities was to ensure that flows of products and cargo originating from the interior of the State of Ceará would be transported to the capital. Under this plan, goods would cross the hinterland, departing from the southern regions of the Cariri Region, passing through the central hinterland of the province, including municipalities such as Quixadá and Quixeramobim, until reaching the capital, Fortaleza (Figure 1).

It was believed that the expansion of railway tracks into the hinterland would create opportunities to improve the precarious living conditions in areas severely affected by drought, while also enabling faster transportation of cotton and other agricultural products to the capital of the Province of Ceará (Alencar, 2021).

Decades later, it was envisioned that once the railway reached the extreme southern portion of Ceará, particularly the Cariri Region, it would be possible to extend a railway branch toward the banks of the São Francisco River in Petrolina, in the State of Pernambuco (Figure 2).

This new project would align with the national integration objectives envisioned during the Brazilian Empire, which proposed the interconnection of the country's hydrographic basins through railway corridors (Brazil, 1974, as cited in Alencar, 2011).

Figure 2 – Project to extend railway tracks from Ceará to the São Francisco River (1892).



Source: Cartography of the Fundação Biblioteca Nacional (adapted by Alencar, 2021).

It was believed that the combination of steam navigation and railway transportation would facilitate communication and encourage the occupation of areas that were either uninhabited or characterized by low population density (Sousa Neto, 2012, as cited in Alencar, 2021).

More than a century later, during the 1990s, the project of the Transnordestina Railway emerged, currently regarded as one of the most significant structural infrastructure projects in Northeastern Brazil and the largest railway project in the country. It is noteworthy that the railway route envisioned during the Brazilian Empire (Figure 1) bears remarkable similarities to the present-day alignment of the Transnordestina Railway (Figure 3).

When fully completed, with completion expected in 2028, the Transnordestina Railway will extend approximately 1,200 kilometers. The project aims to connect productive regions located in the interior of the country directly to seaports situated along the coast, thereby increasing the competitiveness of transportation logistics. Furthermore, the railway is expected to contribute to reducing the costs associated with freight transportation, which may consequently stimulate economic development in the regions affected by the project. In addition to strengthening strategic productive chains, the initiative is also expected to play an important role in creating new employment opportunities and generating income for local populations. Moreover, this infrastructure project is considered fundamental for reducing regional inequalities, thereby promoting more balanced and equitable development (MIDR, 2026).

As illustrated in Figure 3, the railway will cross a total of 53 municipalities in Brazil, connecting Eliseu Martins, located in the State of Piauí, to the Port of Pecém in the State of Ceará and to the Port of Suape in the State of Pernambuco. According to the Ministério dos Transportes do Brasil, 608 kilometers of the railway are located within Ceará, crossing 28 municipalities in the State. Historically, the railway has been considered an essential infrastructure project for the industrial future of Ceará, as it creates favorable conditions for attracting new investments and strengthening productive chains already established in the region (FIEC, 2026).

Figure 3 – Transnordestina Railway Project



Source: Secretaria de Desenvolvimento e Infraestrutura do Ceará (2017).

Considered the largest linear infrastructure project currently under construction in Brazil, the Transnordestina railway is reshaping the logistics map of the Northeast by connecting agricultural and mineral-producing areas in the interior of Piauí, Ceará, and Pernambuco. The project was designed to transport high-volume cargo such as grains, cotton, minerals, gypsum, and containers (MIDR, 2025).

Scenarios and Productive Activities Benefiting from the Transnordestina in Ceará

The railway will play an important role in supplying the industrial sector, as well as supporting the transportation of minerals, fuels, and grains, while also strengthening the dairy production basin in the region (Lemos, 2025). This infrastructure is expected to function as a driver of industrial production in Ceará, operating in close synergy with the railway system. As a result, it may benefit the state’s economy by reducing input costs and improving logistics efficiency (FIEC, 2026).

With construction advancing along the Ceará segment, the state’s logistics map is being redesigned, generating significant impacts on freight transport and the industrial sector (CearáAgora, 2026).

In the municipality of Quixeramobim, the planned dry port has attracted interest from several economic institutions willing to invest in local infrastructure and logistics. These include companies from the fuel sector, wholesale retail (Assaí), distribution centers (Mercado Livre and Shopee), as well as businesses related to fertilizers, animal feed, meat processing, and dairy production. Consequently, the city could become a regional distribution hub capable of reducing business costs both within the state and across the Northeast. This potential stems from its strategic geographic location in the Central Sertão region and its position at a major road junction (Rodrigues, 2025).

Cargo transported from the state of Piauí would include soybeans, soybean meal, corn, and limestone, moving from cargo terminals toward the south-central region of Ceará. These products originate from the grain-producing area that spans the states of Maranhão, Tocantins, Piauí, and Bahia, collectively known as MATOPIBA. Studies conducted by the Ministry of Agriculture and Livestock and the Brazilian Agricultural Research Corporation project a significant increase in agricultural productivity in MATOPIBA, expanding from 9.4 million hectares planted in 2022–2023 to 11.1 million hectares by 2032–2033. The Transnordestina railway is expected to play a key role in transporting this agricultural production (RF, 2025).

However, as shown in Table 2 below, the diversity of transported cargo is considerable. For this reason, the railway has been technically designed to accommodate the specific requirements associated with different types of freight movement.

Table 2 – Projected Cargo Transported by the Transnordestina in Ceará.

Type of Cargo	Cargo Description	Origin/Destination/Notes
Agricultural production	- Vegetable bulk commodities (sorghum, soybeans, soybean meal, corn, others).	- From MATOPIBA to Ceará; - Supply to poultry producers in Ceará; - Supply of the new poultry production hub (grain consumer) in Quixadá (Central Sertão region).
	- Fruits (bananas, mangoes, grapes, melons and others).	- Originating from the São Francisco River Valley (Petroliana–PE and Juazeiro–BA) and Ceará; - Export through the Port of Pecém (CE).
Mineral resources	- Limestone.	- From MATOPIBA.
	- Iron ore.	- From Eliseu Martins (PI) to the Port of Pecém (CE).
Hazardous cargo	- Ammonia-based fertilizers (green ammonia – NH ₃).	- From the Green Hydrogen Hub (Pecém–CE) to the national consumer market; - Distribution to agricultural producers in MATOPIBA.
Fuels	- Gasoline, diesel and liquefied petroleum gas (LPG).	- From the Port of Pecém (CE) to the national consumer market.
Automotive industry	- Automotive vehicle parts and assemblies.	- Unloading at the Port of Pecém (CE); - Vehicle assembly in the city of Horizonte (CE); - Transportation of vehicles to the national consumer market.
Chemical industry	- Asphalt products; - Recycled PET packaging; - Cleaning and sanitation products; - Plastics and industrial inputs.	- From the Industrial Hub of Guaiúba and Maracanaú (industrial cluster); - Demand for chemical products from Quixeramobim; - Demand for chemical products from southern Piauí and the Central-West region of Brazil.
Footwear industry	- Footwear.	- From the footwear cluster in Quixeramobim to the Port of Pecém (CE) for export.
Electro-metal-mechanical industry	- Steel-based products; - Manufactured products; - Machinery and equipment.	- From the Pecém Industrial and Port Complex (ArcelorMittal steel plant); - From the Industrial Hub of Maranguape.

Source: Revista Ferroviária (2025).

Another relevant development will occur once the Green Hydrogen Hub, located at the Pecém Industrial and Port Complex, becomes operational. This initiative will enable the production of fertilizers based on green ammonia (NH₃), which can be transported and marketed to agricultural producers in the interior of Ceará and, particularly, to those located in the MATOPIBA region (RF, 2025).

Since the final route of the Transnordestina railway ends at the Pecém Industrial and Port Complex, projections indicate that once the railway is fully operational it may double the port’s annual cargo throughput through freight arriving by rail. Not coincidentally, the Port of Pecém is expected to gain two additional berths, one at Pier 2 and another at the Multipurpose Terminal (TMUT) (CIPP, 2024).

The latter, known as the Private Use Port Terminal of Nordeste Logística S.A. (TUP Nelog), represents a strategic project focused on handling grains, minerals, fertilizers, and containers, with full operational capacity expected by 2026. By 2057, projections estimate that approximately 33 million tons of grains, minerals, and general cargo will be handled at the terminal (Vargas, 2023).

Partially, therefore, it can be concluded that cargo projections for the state of Ceará indicate an intensification in production flows, ensuring the safe transportation of goods and commodities from the MATOPIBA region to international markets and vice versa. This process is also expected to strengthen several regional production chains and directly influence the state’s socioeconomic indicators. Particular emphasis is placed on the commercialization of fertilizers produced from green ammonia (NH₃) at the Green Hydrogen Hub in Pecém, which may supply both MATOPIBA and the interior of Ceará.

Main Effects of Intermodality Between the Transnordestina Railway and Other Transport Systems in the State of Ceará

The State Government considers the Transnordestina railway the most significant logistics project in Ceará’s history due to its potential contribution to economic development, with direct impacts on job creation, logistics strengthening, and the decentralization of economic growth (Barreto, 2026).

The railway crosses the state from north to south, connecting the Cariri region (beginning in the first municipality within Ceará’s territory, Missão Velha) to the Pecém Industrial and Port Complex on the Atlantic coast. The railway extends for 608 km within the state and passes through 28 municipalities in Ceará (Araújo et al., 2024).

Within Ceará alone, six cargo terminals are planned, strategically located along the highway network and connected to the railway. This configuration is expected to expand the state’s logistical capacity through intermodal transportation combining railways and highways.

For this reason, infrastructure improvements have already been planned for several state highways, including CE-253, CE-257, CE-564, CE-282, CE-375, and CE-060. These upgrades will allow increased heavy vehicle traffic and greater economic activity in the Central Sertão region of Ceará (Lemos, 2025).

Additionally, the cargo terminal at the Port of Pecém will also connect the railway networks operated by Ferrovia Transnordestina Logística (FTL), which links the Port of Itaqui in Maranhão to the ports of Pecém and Mucuripe in Fortaleza, and TISA (Barreto, 2026). In terms of complementarity, which is essential for the circulation of goods, the potential integration between the Transnordestina railway and the North–South Railway is particularly significant. This integration would enable the transportation of grain production from Brazil’s Central-West region to the Northeast (RF, 2025).

Table 3 – Intermodality of the Transnordestina Railway in Ceará.

Cargo Terminal (Municipality)	Intermodality	Characteristics and Economic Potential
Missão Velha (dry port)	- State Highway CE-153; - State Highway CE-292; - State Highway CE-293.	- Strategic location (first municipality in Ceará along the railway route); - Large banana production.
Quixeramobim (dry port)	- State Highway CE-060; - State Highway CE-166; - State Highway CE-265; - State Highway CE-266.	- Grain distribution center (Central Sertão region); first dry port in Ceará and the second in the Northeast (supported by the Ceará Export Processing Zone – ZPE – and a Multipurpose Cargo Terminal); - Footwear hub and dairy production basin; - Fuel terminal, feed companies, and grains.
Iguatu (Iguatu/TIPI Integrating Terminal)	- Federal Highway BR-404; - State Highway CE-060; - State Highway CE-375.	- Planned Multipurpose Cargo Terminal; - Footwear, furniture, and textile industries.
Maranguape	- Federal Highway BR-116; - Federal Highway BR-020; - Federal Highway BR-222; - State Highway CE-455; - State Highway CE-060; - State Highway CE-065.	- Strategic location for integration with the Pecém Industrial and Port Complex; - Highly competitive terminal; - Storage, cargo handling, consolidation, and unloading.

Cargo Terminal (Municipality)	Intermodality	Characteristics and Economic Potential
Quixadá	- State Highway CE-060; - State Highway CE-265.	- Planned Multimodal Cargo Terminal; - Strong production of cattle, sheep, goats, and poultry (grain consumers).
Port of Pecém (Atlantic coast)	- Ferrovia Transnordestina Logística (FTL) rail network (from the Port of Itaquí-MA to the ports of Mucuripe in Fortaleza and Pecém); - Transnordestina Logística S.A. (TLSA).	- Private-use port terminal of Nordeste Logística S.A. (TUP Nelog).

Source: Araújo et al. (2024); RF (2025); Rodrigues (2025); CearáAgora (2026); FIEC (2026).

The possibility of transporting commercial goods through more than one mode of transport provides significant flexibility for both producers and consumers. Under such circumstances, the integration of the transportation system as a whole ensures better connections between raw material areas and industrial centers, between production centers and consumer markets, and between these areas and seaports (Castro, 1994).

These conditions are clearly applicable in the state of Ceará with the integration of the Transnordestina Railway with the existing federal and state highway networks and with the Port of Pecém (Table 3).

Figure 4 – Intermodal Cargo Terminal (Piauí)



Source: Movimento Econômico (Brandão, 2026).

The state of Ceará will have six cargo terminals and additional dry ports. The installation of dry ports has a positive impact on the productive sector, as it facilitates access to imported inputs and specialized equipment, increases speed and competitiveness in exports, and attracts investments from different sectors to the state (Araújo et al., 2024).

Another advantage is the proximity of Maranguape, where a cargo terminal is planned, to the Port of Pecém (approximately 50 km). The existing infrastructure is expected to contribute to reduced freight costs and, consequently, to a positive impact on final consumer prices (CearáAgora, 2026).

It is also worth noting that the dry port in Quixeramobim would contribute to decentralizing Ceará's economy, which is currently highly concentrated in the Fortaleza Metropolitan Region (Rodrigues, 2025). With the advancement of the Transnordestina railway construction in Ceará, the state is approaching a new logistics milestone capable of integrating highways and railways, reducing transportation costs, and strengthening regional industrial activity (CearáAgora, 2026).

Therefore, it can be inferred that the transportation system in Ceará, considering the Transnordestina as the backbone of cargo movement along the state (North–South axis), combined with its connection to several federal and state highways and the Port of Pecém (Table 3), ensures a broad economic area of influence. This includes raw material sources, industrial centers, production hubs, and consumer markets throughout Ceará and the broader Northeast region.

Advantages and Benefits Derived from the Operation of the Transnordestina Railway for the Development of the State of Ceará

From the analyses and assessments presented, there is a clear perspective regarding the effects generated by the construction and integration of the Transnordestina Railway with federal and state highways in Ceará and the Port of Pecém. This multimodal transportation system (Table 3) has the potential to stimulate Ceará's economy through the movement of diverse types of cargo, reaching and benefiting millions of Brazilians.

However, beyond economic gains, the operation of the railway will also generate numerous political and social benefits. Characterized as the backbone of Ceará's economy, the Transnordestina is expected to consolidate multimodal transportation, distribution logistics, and supply logistics within the state.

From the initiatives that began during the Second Reign of the Brazilian Empire with the “Fortaleza–Pacatuba–Baturité–Crato Railway Project,” Ceará now has the opportunity to strengthen and expand its various production chains beyond its internal boundaries, reaching both Northeast regional markets and international markets.

In the short and medium term, improvements in Ceará’s socioeconomic indicators are expected as a result of increased cargo movement. In this context, the information presented in Table 4 anticipates the impacts of this major infrastructure project on the state of Ceará.

Table 4 – Benefits and Advantages of the Transnordestina Railway for Ceará.

Activity	Benefits and Advantages
Political dimension	- Strengthening of sovereignty by the State of Ceará over the geographic space under its jurisdiction; - Greater integration among the states of Northeastern Brazil, especially Ceará, Piauí, and Pernambuco; - Increased political, economic, and social interaction.
Economic dimension	- Greater economic development; - Economic dynamization and encouragement of entrepreneurship; - Integration of the Northeast’s productive structure with other Brazilian regions; - Increased cargo movement at the Port of Pecém; - Intermodality between the road system (state and federal highways), the railway system (Ferrovia Transnordestina Logística – FTL, Transnordestina Logística S.A. – TLISA, and the North–South Railway), and the river system (São Francisco River); - Capacity to create new production and consumer markets; - Promotion of exports of Ceará’s products; - Development of Ceará’s production chains; - Decentralization of economic growth within the state; - Reduction in costs, freight rates, and product prices; - Greater economic activity in the Central Sertão region of Ceará; - Strengthening of Ceará’s industrial activity; - Improvements in transportation infrastructure; - Greater competitiveness for exports; - Increased attraction of investments.
Social dimension	- Job and income generation; - Reduction of social inequalities; - Settlement and professional qualification of the workforce in the region; - Occupation of demographic gaps.
Agricultural sector	- Increased competitiveness of Ceará’s agricultural sector.
Taxation	- Increase in tax revenue collection.

Source: Araújo et al. (2024); Revista Ferroviária (2025); Rodrigues (2025); Ceará Agora (2026); Federação das Indústrias do Estado do Ceará (2026).

At a time when the state of Ceará has been emerging as a leading actor in the generation of renewable energy (wind and solar), internationally recognized for its role in the global process of economic decarbonization through the production and export of green hydrogen, and benefiting from a natural and strategic position as an entry point for several submarine cables as well as a potential hub for the construction of data centers, it is reasonable to argue that the contributions, advantages, and benefits resulting from the construction of the Transnordestina Railway, combined with these energy and digital perspectives, may create distinctive and competitive conditions capable of placing the state of Ceará at a new political and socioeconomic level at the regional, national, and international scales.

In this context, it becomes possible to foresee how the Transnordestina Railway could transform the reality of the state by stimulating development for both the productive sector and the population of Ceará.

IV. Final Considerations

Rail transport, throughout history since the Industrial Revolution in England and across geographic space in countries on every continent, has been considered one of the most effective means of promoting economic growth and regional development. With the capacity to move large volumes and heavy cargo over long distances, railways act as catalysts for progress.

The aspiration to build a railway crossing Ceará from north to south dates back to the period of the Second Reign of the Brazilian Empire. At that time, the goal was to physically integrate the state with its capital, Fortaleza, whose port allowed access to international markets. More than a century later, this objective is expected to be achieved around 2027–2028, when the Transnordestina Railway becomes fully operational.

Beyond tracks, locomotives, and freight wagons, the Transnordestina Railway will include multimodal cargo terminals, dry ports, and extensive integration with the Port of Pecém and numerous federal and state highways, thereby strengthening freight transportation logistics.

In this context, the objective of this article was to analyze the socioeconomic projections, the impacts of intermodality, and the benefits for the development of the state of Ceará once the Transnordestina Railway becomes fully operational. Based on this analysis, the study also sought to provide insights for decision-makers that may help improve the formulation of public policies and business strategies aimed at fostering economic growth in the state.

The research demonstrated that its objectives were achieved by providing a clearer and broader understanding of the potential short-, medium-, and long-term consequences in the political, economic, social,

and logistical spheres once the railway becomes fully capable of driving economic activity and supporting Ceará's production chains. These findings may contribute to the development of public policies and encourage business initiatives that further stimulate the state economy.

The study also confirmed the direct and reciprocal relationship between railway infrastructure and the socioeconomic development of Ceará. It highlighted the projected productive scenarios resulting from the transportation of numerous goods, including raw materials, agricultural commodities, and industrial products, as well as the logistical reach enabled by a comprehensive multimodal transport system.

Within these scenarios, the state of Ceará would benefit from numerous advantages associated with the production and distribution of goods through the Transnordestina Railway, extending beyond its territorial boundaries and reaching regional, national, and global markets. Examples of these gains include the strengthening of rail–road–maritime integration, the expansion of grain transportation from Brazil's semi-arid region, reductions in transportation costs and freight rates, lower product prices, and the decentralization of economic growth within the state.

The qualitative approach adopted in this study, based on literature review and documentary analysis, proved essential for understanding the potential of the Transnordestina Railway to improve Ceará's socioeconomic indicators and contribute to the advancement of society in the state.

Finally, future research is recommended to examine how agricultural and industrial sectors have increased their productivity due to the improved transportation provided by the railway. Further studies may also investigate the number of jobs created in municipalities served by the railway and analyze the economic relationship between rail transportation and port activities at Pecém in relation to international markets.

References

- [1]. Alencar, I. C. F. Backlands In Sight: The Plans And Railway Tracks Of Ceará During The Second Reign. Federal University Of Paraíba (Ufpb). *Geografias Journal*, V. 17, N. 2, Jul./Dec. 2021. Issn 2237-549x. <https://doi.org/10.35699/2237-549x.2021.29162>. Accessed: Feb. 16, 2026.
- [2]. Alves, E. G. De C.; Ramos, R. B. Da S.; Silva, C. R. Rail Transport In Brazil: Challenges And Opportunities. *Revista Conecta*, São Paulo, Brazil, V. 3, P. 15–27, 2020. <https://doi.org/10.0000/Rc.V3i.18>. Available At: <https://www.fatecl.edu.br/revistaconecta/index.php/rc/article/view/18>. Accessed: Feb. 2026.
- [3]. Araújo, D.; Nascimento, H. R.; Mendes, W.; Rodrigues, L. Ceará May Have At Least Three Dry Ports Along The Transnordestina Route: Structures Will Be Dedicated To The Sale And Processing Of Railway Cargo As Well As Other Economic Activities. *Diário Do Nordeste*. Published Nov. 25, 2024. Available At: <https://diariodonordeste.verdesmares.com.br/negocios/ceara-pode-ter-pelo-menos-tres-portos-secos-no-caminho-da-transnordestina-veja-locais-1.3583131>
- [4]. Assis, R. J. S. De. Paper Railways: Projects Of Territorial Domination In Ceará (1864–1880). 2011. Master's Dissertation (Geography) – Center Of Sciences, Federal University Of Ceará. Fortaleza, 2011.
- [5]. Barham, D. How Modern Rail Networks Can Boost Economic Growth And Regional Trade In Africa. Published Sept. 18, 2024. Available At: <https://wearevuka.com/insights/mobility/how-modern-rail-networks-can-boost-economic-growth/> Accessed: Feb. 12, 2026.
- [6]. Barreto, F. Ceará Will Have Six Cargo Terminals For The Transnordestina. *Opinião Ce*, Economy Section. Published Feb. 10, 2026. Available At: <https://www.opinioce.com.br/ceara-vai-contar-com-seis-terminais-de-cargas-para-a-transnordestina/> Accessed: Feb. 17, 2026.
- [7]. Brandão, B. Transnordestina Leaves Testing Phase And Begins Provisional Freight Operations. *Movimento Econômico*. Published Jan. 12, 2026. Available At: <https://movimentoeconomico.com.br/geral/infraestrutura/ferrovia/2026/01/12/transnordestina-deixa-etapa-de-testes-e-inicia-operacoes-provisorias-de-carga/> Accessed: Feb. 12, 2026.
- [8]. Brazil. Ministry Of Transport. National Transport Council. Transportation Plans: Historical Evolution (1808–1973). Rio De Janeiro: The Council Press, 1974.
- [9]. Brazil. National Department Of Transport Infrastructure (Dnit). *Railway Infrastructure Atlas*. Brasília, 2024. Available At: https://www.gov.br/dnit/pt-br/assuntos/ferrovias/copy_of_atlascompleto202409103.pdf Accessed: Jan. 12, 2026.
- [10]. Brazil. Ministry Of Integration And Regional Development (Midr). Transnordestina Has 100% Of The Lots Contracted. Published Dec. 11, 2025. Available At: <https://www.gov.br/mdr/pt-br/noticias/transnordestina-tem-100-dos-lotes-contratados> Accessed: Feb. 13, 2026.
- [11]. Brazil. Ministry Of Integration And Regional Development (Midr). Transnordestina Railway Advances And Transports Sorghum In A New Operational Test. Published Jan. 11, 2026. Available At: <https://www.gov.br/mdr/pt-br/noticias/ferrovia-transnordestina-avanca-e-transporta-sorgo-em-novo-teste-operacional> Accessed: Jan. 22, 2026.
- [12]. Caixeta-Filho, J. V.; Martins, R. S. *Logistics Management Of Freight Transportation*. São Paulo: Atlas Publishing, 2009.
- [13]. Castro, T. C. De. *Geographical Spaces: Study Systematics*. Army Library Publishing House. 2nd Edition. Rio De Janeiro, 1994.
- [14]. Ceará. Government Of The State Of Ceará. Ceará Already Has More Than 200 Continuous Kilometers Released For The Construction Of The Transnordestina. Published Sept. 15, 2011. Available At: <https://www.ceara.gov.br/2011/09/15/ceara-ja-tem-mais-de-200-km-continuos-liberados-para-as-obras-da-transnordestina/> Accessed: Feb. 19, 2026.
- [15]. Ceará Agora. Transnordestina In Ceará: Integration Between Railway And Highways May Reduce Product Prices. Published Feb. 9, 2026. Available At: <https://cearaagora.com.br/transnordestina-no-ceara-integracao-entre-ferrovia-e-rodovias-pode-reduzir-preco-de-produtos/> Accessed: Feb. 15, 2026.
- [16]. Pecém Industrial And Port Complex (Cipp). Fuel Storage Terminal At The Port Of Pecém Should Expand Fuel Distribution Logistics And Increase Competitiveness In Ceará. Published Dec. 5, 2024. Available At: <https://www.complexodopecem.com.br/terminal-de-tancagem-do-porto-do-pecem-deve-ampliar-logistica-de-distribuicao-de-combustiveis-e-aumentar-competitividade-no-ceara/> Accessed: Jan. 5, 2026.
- [17]. Evaristo, L. How To Understand The Correlation Between Railways And A Country's Economy? *Brasil Ferroviário*, 2026. Available At: <https://www.brasilferroviario.com.br/como-entender-a-correlacao-entre-ferrovia-e-economia-de-um-pais/> Accessed: Feb. 8, 2026.
- [18]. Fair, M. L.; Williams Jr., E. W. *Economics Of Transportation*. New York: Harper & Brothers Publishers, 1959.

- [19]. Federation Of Industries Of The State Of Ceará (Fiec). Fiec, The Municipality Of Maranguape And Transnordestina Discuss Strategies For Industrial Development Around The Railway. Published Feb. 12, 2026. Available At: <https://www1.sfipec.org.br/fiec-noticias/search/170769/fiec-prefeitura-de-maranguape-e-transnordestina-discutem-estrategias-para-desenvolvimento-industrial-do-municipio-em-torno-da-ferrovia> Accessed: Feb. 14, 2026.
- [20]. Gomes, E. E. The Study Of The Railway Transport Mode In The Center-South Regional Complex Of Brazil And The Possibilities For Strategic Displacement In The Event Of A Conflict In South American Territory. Army Command And General Staff School. Rio De Janeiro, 2020. Available At: <https://bdex.eb.mil.br/jspui/bitstream/123456789/8729/1/Mo%206343%20-%20eloi.pdf> Accessed: Jan. 7, 2026.
- [21]. Kirsanova, N. Influence Of The Railroad Industry On The Social And Economic Development Of Russia. Saint Petersburg Mining University, 2019. Doi: 10.5593/Sgem2019/5.3/S21.053. Available At: https://www.researchgate.net/publication/334754263_influence_of_railroad_industry_on_social_and_economic_development_of_russia Accessed: Feb. 11, 2026.
- [22]. Leite, M. C. Da S. R.; Silva, A. J. P.; Martins, E. S. Qualitative Research In Doctoral Dissertations: An Analysis Of The 2013–2015 Triennium. *Revista Expressão Católica*, V. 6, N. 1, P. 43–53, Jan./Jun. 2017.
- [23]. Lemos, M. Four State Highways Connected To The Transnordestina Railway Receive Construction Works In Ceará. *Diário Do Nordeste*. Published June 24, 2025. Available At: <https://diarionordeste.verdesmares.com.br/negocios/quatro-rodovias-estaduais-com-conexao-a-ferrovia-transnordestina-recebem-obras-no-ceara-veja-locais-1.3662160> Accessed: Jan. 5, 2026.
- [24]. Lucas, E. History Of The Railway In Brazil. *Brasil Ferroviário*. Available At: <https://www.brasilferroviario.com.br/historia-da-ferrovia-no-brasil/> Accessed: Jan. 5, 2026.
- [25]. Machry, T. R. Overview Of Freight Transportation In Brazil. Logistics And National Mobilization Course. Fluminense Federal University. Rio De Janeiro, 2011.
- [26]. Mesquita, C. Transnordestina Railway Should Partially Operate In 2025 To Serve The Agricultural Sector In Ceará. *Diário Do Nordeste*. Published May 24, 2023. Available At: <https://diarionordeste.verdesmares.com.br/negocios/ferrovia-transnordestina-deve-funcionar-parcialmente-em-2025-para-atender-setor-agro-no-ceara-1.3372648> Accessed: Jan. 22, 2026.
- [27]. National Geographic Society. Effects Of Transportation On The Economy. Available At: <https://education.nationalgeographic.org/resource/effects-transportation-economy/> Accessed: Jan. 20, 2026.
- [28]. Qian, J. World Bank Group (Wbg). Transforming Logistics: The Power Of Rail Investment. Published Sept. 2, 2025. Available At: <https://www.worldbank.org/en/results/2025/08/28/transforming-logistics-the-power-of-rail-investment> Accessed: Jan. 29, 2026.
- [29]. *Revista Ferroviária*. Transnordestina Is Projected As The Backbone Of The Northeast Economy. *O Povo Newspaper*. Published Jan. 10, 2025. Available At: <https://revistaferroviaria.com.br/2025/01/transnordestina-se-projeta-como-a-espinha-dorsal-da-economia-do-nordeste/> Accessed: Feb. 9, 2026.
- [30]. Rodrigues, P. R. A. Introduction To Transportation Systems In Brazil And International Logistics. 5th Ed. São Paulo: Aduaneiras, 2014.
- [31]. Rodrigues, L. Quixeramobim Projects Doubling Gdp In 10 Years With The Transnordestina And A Dry Port. *Diário Do Nordeste*. Published July 21, 2025. Available At: <https://diarionordeste.verdesmares.com.br/negocios/quixeramobim-projeta-dobrar-pib-em-10-anos-com-transnordestina-e-porto-seco-1.3670568> Accessed: Feb. 15, 2026.
- [32]. Silva, J. L.; Emmendoerfer, M. L.; Cunha, N. R. Illustrated Documentary Analysis In Public Administration: An Operational And Replicable Proposal. *Teoria E Prática Em Administração*, Jul.–Dec. 2020. Doi: <http://dx.doi.org/10.21714/2238-104x2020v10i2-51394>.
- [33]. Sousa Neto, M. F. Plans For The Empire: Transportation Plans During The Second Reign (1869–1889). São Paulo: Alameda Publishing, 2012.
- [34]. Vargas, P. With The Transnordestina, The Port Of Pecém Will Double Cargo Movement And Handle 40 Million Tons Per Year. *Diário Do Nordeste*. Published Dec. 9, 2023. Available At: <https://diarionordeste.verdesmares.com.br/negocios/com-transnordestina-porto-do-pecem-vai-dobrar-movimentacao-e-escoar-40-mi-de-toneladas-por-ano-1.3453248> Accessed: Feb. 17, 2026.
- [35]. Vasconcelos, G. H. D. The Brazilian Railway System As A Factor Of Integration And Development. Brazilian War College. Rio De Janeiro, 2019. Available At: <https://repositorio.esg.br/bitstream/123456789/813/1/George%20henrique%20duarte%20de%20vasconcelos.pdf> Accessed: Feb. 11, 2026.
- [36]. Wanli, Y. Railway Set To Boost Growth Across Southeast Asia. *China Daily*. Updated Aug. 20, 2025. Available At: <https://global.chinadaily.com.cn/a/202508/20/ws68a52492a310b236346f2887.html> Accessed: Jan. 4, 2026.