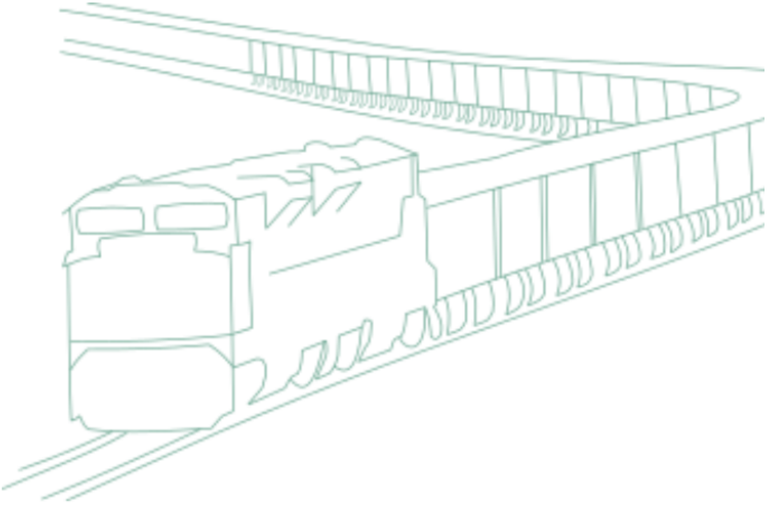

METHODOLOGICAL REPORT

Continental Soybean and Corn Logistics

Transport Routes, Scenario Simulation, and Port Capacity along South American Integration Routes

August 2026

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Presentation

This report describes, in an organized and accessible manner, the methodology used to simulate and evaluate the transport flow of Brazilian soybean and corn in light of the projects that comprise the South American Integration Routes. The text gathers the conceptual framework underlying the work, the data sources used, the modeling procedures and tools, the adopted criteria and assumptions, the construction of scenarios, and the results obtained for each of them.

The core proposal is to treat infrastructure planning as an exercise that can be tested prior to construction. Rather than relying solely on isolated estimates for decision-making, this study builds a representation of the national logistics network and "experiments" with each project on it, measuring its impacts on routes, costs, distances, and port capacity. The goal of this document is to make this process clear enough for the analysis to be understood, discussed, and reproduced.

1 Introduction

The growing demand for physical and economic integration among South American countries has driven the formulation of international logistics routes that directly involve Brazilian territory (SANTOS; FERREIRA, 2025). At the center of this debate lies an enduring feature of the national economy: Brazil’s transport matrix has historically imposed severe constraints on agricultural development, particularly within bulk commodity supply chains such as soybean and corn (CASTRO, 2015). Under this arrangement, port saturation acts as the most restrictive bottleneck in the logistics network, dictating the pace, cost, and strain on the tributary transport grid.

In response to this scenario, Brazil has made considerable efforts to enhance its internal and regional logistics infrastructure, with a special focus on connecting to global markets—particularly Asia (MPO, 2024). It is within this context that rail logistics has gained prominence in national infrastructure debates, accompanied by promises of robust investment and greater private sector participation in concessions. Foreign interest in this process is notable, particularly from Chinese and Arab companies that have already signaled their intent to participate in upcoming concession projects (GLOBO ECONOMIA, 2026; CUSTÓDIO et al., 2026).

The implementation of the South American Integration Routes represents an effort to reorganize the continent's transport infrastructure according to an economic reality distinct from the one that historically guided Brazilian settlement (MPO, 2024; BARROS et al., 2020) (Figure 1). The initiative is organized into five major corridors: the Guiana Islands Route, the Amazon Route, the Rondon Quadrant Route, the Capricorn Bioceanic Route, and the Porto Alegre–Coquimbo Route (Figure 2), with the stated objective of expanding regional trade and reducing both the time and cost of connections with Asia (MPO, 2024).

Figure 1 — Transport infrastructure in South America.

Figure 2 — South American Integration Routes.

At first glance, the economic rationale is compelling. According to data from the Confederation of Agriculture and Livestock of Brazil (CNA, 2023), logistics costs can account for up to 30% of the total value of Brazilian exports. This reality is not confined to agricultural production: the National Confederation of Industry (CNI, 2022) highlights that physical and logistical constraints, along with bottlenecks across different modes of transport, inflate costs and undermine the competitiveness of the productive sector. Road transport—which dominates the Brazilian matrix—is not only expensive and subject to seasonal variations, but also exhibits lower energy efficiency and greater environmental impact. In this sense, bringing Brazilian production centers closer to Pacific ports could shorten part of the maritime journey to the Chinese coast, diversify export channels, and reduce reliance on the ports of Santos, Paranaguá, and the Northern Arc (BARROS; CARNEIRO, 2024).

An important caveat, however, is that a shorter route on the map is not necessarily a cheaper route. To reach the Pacific, freight must cross international borders, Amazonian territories, and, in some cases, the Andes mountain range (BARROS; CARNEIRO, 2024). An example helps to illustrate the scale of this issue: when transporting soybean from Sorriso (MT) to the Port of Chancay in Peru, the recommended vehicle capacity is around 30 metric tons per trip. This quantity is suitable because Peru generally enforces a maximum gross vehicle weight limit of 48 metric tons—including truck, semitrailer, and cargo—alongside specific axle-load restrictions (PERU, 2003). Although certain vehicle combinations in Brazil can reach up to 74 metric tons (CONTRAN, 2021), a heavier configuration would create operational difficulties in Peruvian territory (PERU, 2003). Beyond legal regulations, a configuration of approximately 30 metric tons is better suited to the conditions of the Interoceanic Highway, especially when crossing the Andes, where long steep inclines, steep descents, and sharp curves place higher demands on braking, engine performance, and maneuverability (BARROS; CARNEIRO, 2024; FHWA, 1995).

Among the corridors, the Rondon Quadrant Route emerges as one of the most promising prospects for agribusiness (MPO, 2024; BARROS; CARNEIRO, 2024), as it can link Acre, Rondônia, and western Mato Grosso to Peru and the Port of Chancay (MPO, 2024). The Brazilian government estimates that this alternative could shave roughly ten days off the maritime voyage to Shanghai. However, these savings do not automatically apply to all national production (BARROS; CARNEIRO, 2024). The corridor tends to be more competitive for origins located in western Brazil and for freight capable of absorbing overland transit costs. For municipalities closer to Atlantic ports or already connected to established rail networks, exporting via the Pacific may remain the more expensive option (BARROS; CARNEIRO, 2024).

The Capricorn Bioceanic Route also holds potential for transporting soybean, corn, meats, and manufactured products from Mato Grosso do Sul, Paraná, and neighboring areas (MPO, 2024; BARROS et al., 2020). Its primary advantage lies in crossing regions with consolidated agricultural production and reaching Chilean ports via Paraguay and Argentina (MPO, 2024; BARROS et al., 2020). Nevertheless, overland road transit across the Andes—characterized by high altitudes, geometric constraints, landslide risks, and weather disruptions—limits the continuous movement of large volumes (IDB, 2008; BARROS; CARNEIRO, 2024). Its viability would increase with intermodal terminals, customs harmonization, and rail connections, which would lessen reliance on long-distance trucking (IDB, 2023).

The Porto Alegre–Coquimbo Route can strengthen trade between Brazil, Uruguay, Argentina, and Chile (MPO, 2024), but its advantage is less evident for exports destined for China (BARROS; CARNEIRO, 2024). Southern Brazil already has relatively close Atlantic ports and consolidated logistics supply chains; thus, crossing Argentina and the Andes would only be competitive for specific cargoes, periods, or destinations (BARROS; CARNEIRO, 2024). Its primary value may reside in regional productive integration, intra-South American trade, and the creation of alternative routes (BARROS et al., 2020; MPO, 2024).

The Amazon and Guiana Islands Routes carry strategic significance of a different nature (MPO, 2024). They can improve supply to border cities, expand access to public services, foster the bioeconomy, and promote regional trade. The predominantly fluvial Amazon Route faces constraints regarding bulk volumes of soybean and corn bound for China due to hydrological seasonality, transshipment operations, and the distance separating Amazonian rivers from Pacific ports (SANTOS DE LIMA et al., 2024; BARROS; CARNEIRO, 2024). Meanwhile, the Guiana Islands Route is better suited for regional integration and connections with the Caribbean and the Atlantic than for large-scale grain export flows toward Asia (MPO, 2024; BARROS; CARNEIRO, 2024).

Also noteworthy is the Transoceanic (or Bioceanic) Railway, an ambitious strategic project aimed at establishing a rail link between the Brazilian coast and Pacific ports in Peru, creating an alternative route for trade with Asian markets. The complete corridor remains in the feasibility study and international coordination phase. Key benefits include reduced logistics costs, diversification of export routes, decreased reliance on road transport, and economic development across producing regions in the Center-West. Within Brazilian territory, the project integrates the Center-West Integration Railway (FICO)—whose section between Mara Rosa (GO) and Água Boa (MT) is under construction—and the West-East Integration Railway (FIOL), with ongoing works between Ilhéus, Caetité, and Barreiras in Bahia, forming a major national freight corridor alongside the North-South Railway (ANTT, 2025). Although not formally part of the South American Integration Routes, the Transoceanic Railway would be associated with the Rondon Quadrant Route, connecting areas of western Mato Grosso, Rondônia, and Acre to Peru. Furthermore, integration with FIOL and

FICO would enable regions in Matopiba, Goiás, and Mato Grosso to utilize both Atlantic ports and the Port of Chancay.

2 Conceptual Framework

2.1 The Environmental Dimension

The environmental dimension represents the main constraint to the indiscriminate implementation of these corridors (DCP, 2022; ARGUELHO et al., 2023). In Amazonian routes, new roads do not merely generate impacts within the area directly occupied by infrastructure (FEARNSIDE, 2015; LAURANCE et al., 2009). They alter regional accessibility and can drive unplanned occupation, land speculation, illegal logging, mining, wildfires, and agricultural expansion into previously isolated areas (FEARNSIDE, 2015; KLEINSCHROTH; HEALEY, 2017).

Indirect effects can far exceed the direct impacts of the construction project itself (LAURANCE et al., 2009; KLEINSCHROTH; HEALEY, 2017). Habitat fragmentation, wildlife roadkill, altered drainage systems, soil erosion, and river siltation compound the pressure on conservation units, indigenous lands, and traditional community territories (LAURANCE et al., 2009; KLEINSCHROTH; HEALEY, 2017). When planned solely around export interests, Amazonian infrastructure can heighten socio-environmental vulnerability (DCP, 2022; ARGUELHO et al., 2023).

This does not imply that all infrastructure development in the Amazon is unviable. Properly planned waterways, the rehabilitation of existing roads, and railways implemented along already modified corridors can reduce emissions and consolidate freight flows (VILLEN et al., 2025). Environmental viability, however, hinges on assessing the cumulative impacts across the entire corridor rather than relying on isolated licensing for individual bridges, ports, or highway segments (IFC, 2013; DCP, 2022).

Along routes traversing the Pantanal, the Chaco, and the Andes, risks are equally significant (SCHULZ et al., 2019; CALDAS et al., 2015; TOVAR et al., 2022). The Pantanal relies on the hydrological connectivity of its system (SCHULZ et al., 2019); the Chaco is undergoing rapid land-cover transformation (CALDAS et al., 2015); and the Andes feature fragile ecosystems, steep elevation gradients, and geotechnical risks (TOVAR et al., 2022; BARROS; CARNEIRO, 2024). Consequently, the choice of route alignment and transport mode determines whether a corridor will be environmentally manageable or territorially destructive (ARGUELHO et al., 2023; SEREBRISKY et al., 2018). Indeed, pressures driving deforestation have intensified as a consequence of expansion plans for soybean plantations and other export crops—including biofuels—alongside mining activities, dams, and other anthropogenic interventions (PEREIRA et al., 2020; RONDINELLI; BERRY, 2000), particularly in remote and environmentally sensitive areas surrounding highways and railways (TISLER et al., 2022).

2.2 Conditional Viability

The South American Integration Routes are neither entirely viable nor entirely unviable (ROBERTS et al., 2020; SEREBRISKY et al., 2018). Their viability depends on the territory and the specific conditions of each segment. Certain sections can yield strong economic returns, cause manageable environmental impacts, and deliver social benefits; others may require substantial investment while achieving only marginal transport cost reductions, alongside generating significant environmental and social impacts (ALBERTI; PEREYRA, 2018; BARROS; CARNEIRO, 2024).

For agribusiness, the greatest opportunities lie within the Rondon Quadrant and the Capricorn Bioceanic Route, particularly for origin locations close to the corridors and where efficient rail or waterway transport is available. For other regions of the country, Atlantic ports will remain more competitive (BARROS; CARNEIRO, 2024). Opening access to the Pacific should serve as a complementary alternative rather than an automatic replacement for existing logistics infrastructure (BARROS; CARNEIRO, 2024; MPO, 2024).

The commercial relationship with China strengthens the project's economic rationale, yet it also underscores a strategic risk (MAPA, 2026; MPO, 2024). Concentrating export flows toward a single market can leave infrastructure investments overly dependent on Chinese trade, sanitary, and geopolitical policies (MARQUES; CAMPOS, 2020). Consequently, these routes must also expand trade among South American nations and foster the export of value-added processed products, preventing the continent from serving merely as a supplier of raw materials (MARQUES; CAMPOS, 2020; BARROS et al., 2020).

Responsible implementation will require abandoning the notion that every distance reduction equates to development (SEREBRISKY et al., 2018; DCP, 2022). Success cannot be measured solely by the kilometers built or tons exported, but rather by the capacity to reduce logistics costs without accelerating deforestation, integrate border regions without disrupting local communities, and expand exports without deepening economic dependency (SEREBRISKY et al., 2018; DCP, 2022). The initiative can be viable provided each intervention is selected through multi-criteria analyses that combine logistics costs, effective demand, port capacity, emissions, biodiversity, climate risks, and the equitable distribution of social benefits (SEREBRISKY et al., 2018; ARGUELHO et al., 2023; IFC, 2013). Without these conditions, the routes may shorten the distance goods travel to China while widening the gap between economic growth, environmental protection, and social development (ROBERTS et al., 2020; DCP, 2022).

2.3 The Need to Simulate Before Investing

To evaluate a viability so highly dependent on geography and territory, it is necessary to deploy a system capable of simulating the implementation of infrastructure projects—both individually and in an integrated manner—considering their impacts on regional logistics dynamics and on the performance of feeder routes connected to the new segments. Systematic evaluation of infrastructure requires tools that allow for anticipating impacts and examining different operational scenarios. In this context, computational modeling applied to freight transport enables the prior identification of operational bottlenecks and constraints before physical construction begins (OLIVEIRA, 2021, p. 45). In turn, the capacity and performance of feeder routes serve as decisive factors for transport fluidity and the overall economic viability of the regional logistics corridor (NOVAES, 2019, p. 112).

Simulating logistics infrastructure projects using optimization algorithms can reduce the required time and capital investments while increasing the efficiency of available resource utilization (CUNHA, 2022, p. 89). In territorially complex projects—such as bioceanic routes—operational efficiency also hinges on international cooperation across the planning, execution, and infrastructure management stages. Such initiatives demand shared governance mechanisms capable of aligning diverse institutions, streamlining bureaucratic hurdles, and harmonizing national interests to foster integrated regional development (ABREU, 2023, p. 77). Consequently, consolidating bioceanic corridors requires not only physical infrastructure delivery, but also customs procedure harmonization, investment timeline coordination, and ongoing cooperation mechanisms for managing border facilities—key elements to ensure operational continuity, reduce inefficiencies, and strengthen economic and territorial integration among participating countries (IPEA, 2024, p. 15). Furthermore, simulation modeling provides an essential tool to expand understanding of species behavior and transport infrastructure impacts, enabling the quantification of ecological effects on wildlife populations (DORNAS et al., 2019; BEAUDRY et al., 2008; BORDA-DE-ÁGUA et al., 2014; JAEGER et al., 2005).

2.4 Ex-Ante Modeling: Simulating Reality to Evaluate New Projects

In logistics infrastructure projects—such as highways, railways, ports, terminals, and distribution centers—decisions are expensive and difficult, or even impossible, to undo. It is therefore crucial to understand, prior to investing, what is likely to occur. This is the role of ex-ante modeling—a Latin expression meaning "before the event"—which refers to the analysis conducted before a project is implemented, simulating its effects to inform the decision of whether to proceed (DE RUS, 2021). It differs from ex-post evaluation, which is conducted after the infrastructure is built and fully operational. While ex-post evaluation measures actual outcomes, ex-ante modeling works with forecasts and scenarios. The two approaches complement each other, as comparing predicted versus actual results helps refine models and correct the optimism bias common in initial estimates (FLYVBJERG, 2009).

The core of this approach lies in constructing a model that accurately represents current reality and its evolution over time—typically spanning the investment's useful life, which can reach twenty to thirty years (EUROPEAN COMMISSION, 2014). Rather than taking a static "snapshot" of today, the model must function like a "moving picture," capable of replicating how goods and freight move across the network: origins, destinations, volumes, chosen routes, travel times, and costs. In transport analysis, this representation typically follows the classic four-step model: trip generation, trip distribution, modal split, and network assignment (ORTÚZAR; WILLUMSEN, 2011), ensuring that the simulated system behaves like the real-world network.

An essential step is defining the baseline scenario—also termed the "without project" or do-nothing scenario—which describes what would happen if no new interventions were undertaken, accounting for natural demand growth and already contracted works. This baseline serves as the benchmark for comparison: without it, there is no way to measure the true extent to which a new project alters existing conditions (CASCETTA, 2009). Once current reality is simulated and the baseline scenario established, the model acts as a virtual laboratory. At this point, a new project is introduced or an existing one modified—such as adding a railway line, duplicating a highway, or expanding a port—and the simulation is re-run to generate the "with project" scenario. The evaluation derives precisely from comparing the two scenarios. The difference between them represents the true net effect of the investment—the counterfactual—since only the changes directly caused by the project should be attributed to it (DE RUS, 2021).

Among the key metrics typically evaluated are reductions in transport times and costs, shifts in freight volumes and routing, modal shifts (among road, rail, and waterway), and gains in network efficiency, reliability, and capacity, along with broader economic, social, and environmental impacts such as carbon emissions and accidents. These effects can be monetized and weighed against capital and operating costs; indicators such as Net Present Value (NPV) and Internal Rate of Return (IRR) synthesize whether the project is viable and allow for side-by-side comparison of competing alternatives (EUROPEAN COMMISSION, 2014). Because every forecast entails uncertainty, it is good practice to test variations in key assumptions using sensitivity analyses, verifying whether conclusions hold under more or less favorable conditions. In summary, ex-ante modeling allows infrastructure projects to be "tested" in a computational environment before committing resources in the physical world. By following a consistent sequence—simulating baseline conditions across a defined time horizon, defining the "without project" scenario, introducing or modifying projects, and comparing outcomes—investment decisions move away from guesswork toward evidence-based planning, mitigating the risk of costly infrastructure delivering fewer benefits than promised.

3 Objectives

3.1 General Objective

The use of simulation models serves as a methodology for addressing real-world problems, applied to describe and analyze system behavior and to test interventions that support the planning and design of systems representing real-world dynamics (PRITSKER, 1998). In line with this approach, the primary objective of this study is to develop a model capable of simulating and evaluating continental logistics dynamics in response to new infrastructure projects, measuring their economic efficiency and capacity to reduce transport costs.

3.2 Specific Objectives

In greater detail, the study aims to simulate and evaluate each proposed corridor under the South American Integration Routes initiative, both individually and in combination. The Current Scenario represents the existing and operational logistics infrastructure. Each proposed scenario incorporates a specific project into this baseline, assuming it to be fully implemented and operational. These scenarios comprise:

1. Current Scenario
2. Guiana Islands Route
3. Amazon Route
4. Rondon Quadrant Route
5. Capricorn Bioceanic Route
6. Porto Alegre–Coquimbo Route
7. Transoceanic (Bioceanic) Railway

In addition to these scenarios, the projects comprising the South American Integration Routes were simulated under an assumed 20% (twenty percent) reduction in freight costs per project, associated with road paving and geometric improvement works.

4 Scope of the Study

The subject of study is the transport flow of soybean and corn—the two main staple grains in Brazil's agricultural portfolio, harvested in alternating seasons—across the logistics network connecting producing regions to export ports. In practice, grain logistics in Brazil operates as a single system shared by both commodities rather than as two parallel supply chains. The same ports, arterial highways, and much of the same producing regions serve both crops, with the agricultural calendar determining network usage across different times of the year.

The study area is continental in scale, encompassing Brazilian territory and its connections with neighboring countries and Atlantic and Pacific ports included in the South American Integration Routes. For each commodity, the study utilizes the transport demand represented in the origin-destination matrix and assigns it across the transport network, evaluating routes, costs, distances, and port capacity utilization under each scenario. Beyond the seven baseline scenarios, the scope includes a suite of scenarios projecting a 2035 horizon, which evaluates the expansion of port loading capacities alongside scenarios combining investment packages, thereby allowing for a comparison between the individual effects of each isolated project and their joint implementation.

5 Data Sources and Processing

The geographic database serves as the primary dataset for input, processing, and output of spatial and tabular information, providing the framework for the system to retrieve and transform raw data into routing information (BURROUGH, 1989). A simple, structured, well-defined, connected, and documented spatial database unlocks numerous applications for Geographic Information Systems (GIS) and spatial databases (NAZÁRIO et al., 2000).

The database from the National Logistics Plan 2050 (PNL 2050), published by the Ministry of Transport, provided a robust starting point for scenario modeling and simulation. In addition to information such as municipal seats and boundaries, port locations, and agricultural production areas obtained from IBGE, three datasets were particularly valuable: the baseline origin-destination matrix, the representation of transport infrastructure, and the portfolio of future projects.

The origin-destination (OD) matrix describes freight volumes and flow directions between different regions. It serves as the primary input feeding the demand model, translating economic activity into tangible network flows. By adopting the OD matrices from PNL 2050, the study utilizes consolidated volume data, ensuring that the simulation replicates movement patterns consistent with national realities.

The transport infrastructure database represents existing highways, railways, waterways, ports, and terminals, alongside their respective capacities, lengths, and operational conditions. The OD matrix flows are assigned onto this network, enabling the identification of routes, travel times, costs, and, crucially, bottlenecks and saturated corridors. This network representation forms the baseline or "without project" scenario against which proposed interventions are compared.

Finally, the portfolio of future projects aggregates planned infrastructure interventions—such as new rail corridors and port expansions—to be integrated into the model individually or in combinations to form alternative scenarios. Notable project inclusions are the FICO, FIOL, and RUMO Malha Norte railways. By incorporating each project into the network and re-running the simulation, it becomes possible to quantify its effects on transport demand, modal shift, and logistics performance relative to the baseline scenario. Thus, the PNL 2050 databases ensure consistency and standardization throughout the analysis, aligning this *ex-ante* evaluation with official national planning guidelines.

6 Methodology

6.1 Overview of the Approach

The methodology follows the logic of ex-ante evaluation described in the conceptual framework. First, current logistics conditions are represented on a georeferenced network. Next, the "without project" baseline scenario is established. Finally, individual projects are added or modified to generate "with project" scenarios, whose outputs are evaluated against the baseline. Each commodity is modeled independently but over the same shared physical infrastructure, reflecting the fact that soybean and corn share ports, highways, and producing regions.

6.2 Models, systems, and tools used

The operational core of the study is OtimizaInfra, a route modeling and simulation platform that integrates, for each product, the origin-destination matrix, existing and projected transport infrastructure, current or forecasted cargo demand, and port capacity. The objective is to support decision-making in strategic transport planning. Instead of examining each element in isolation, the platform brings them together into a single model and shows, in concrete terms, where freight would pass, how much it would cost, and where bottlenecks would arise.

OtimizaInfra operates based on four databases that jointly represent transport supply and demand. The infrastructure network describes highway, railway, waterway, and maritime segments, along with their costs, distances, and status. The origin-destination matrix details how much of each product moves from each origin to each destination, month by month. The port database provides throughput capacity by product, which functions as a physical constraint to be respected. And the municipal seats supply the origin and destination points that connect demand to the network. The user also selects the product to be analyzed and the output file.

The core component of the platform is the calculation of the best routes between cargo origin and destination. For each flow, the minimum-cost path across the network is sought, obtained through optimization over the graph representing the transport infrastructure, treating ports as transshipment points subject to capacity constraints. Demand is allocated month by month, also via optimization: when a port reaches its limit, the surplus is automatically rerouted to the viable, lowest-cost port that still has available capacity, and any volume that cannot be served is explicitly logged. Thus, the model not only charts routes, but also reveals where installed capacity is insufficient.

Consequently, it becomes possible to evaluate the impact of new projects on territorial logistics dynamics. Corridor studies, macrologistics, and spatial planning gain transparency, comparability, and clarity in strategic communication. The platform projects future scenarios and evaluates agricultural output flow dynamics; by inserting projects under study, trunk railways, new highways, bioceanic corridors, or draft and port terminal expansions, it is possible to assess their systemic impact even before construction begins. The tool addresses critical questions (Table 1), such as cargo diversion, bottleneck relief, and the viability of new segments. It is this capability to transform data into scenarios that makes it a decision-support instrument, bringing investment choices closer to evidence and mitigating the risk of costly, hard-to-reverse decisions.

The results are exported in formats ready for analysis and presentation: CSV tables containing the routes, monthly port throughput summaries, problem audits, and unallocated volumes; a geographic file (GeoPackage) with effective flows per segment, month by month and cumulatively for the year, ready to open in mapping software like QGIS; an animated map in which particles travel the routes from origin to destination, with colors distinguishing domestic freight from export freight; and a report with charts of monthly demand, port capacity utilization, and route alignment maps. The following table summarizes the main capabilities of the platform.

Table 1 — Key capabilities of the OtimizaInfra platform.

Scenario Simulation Compares infrastructure alternatives, route shifts, and flow redistributions across different logistics configurations.	**Bottleneck Identification** Highlights critical segments, freight concentrations, and operational constraints associated with port throughput capacities.
Geospatial Products Generates layers, tables, and auditable records for integration with GIS, technical reports, and institutional presentations.	**Public Decision Support** Translates logistics modeling into actionable information for spatial planning, transport policies, and investment analysis.

6.3 Methodological steps

The analysis of each scenario follows a well-defined sequence. First, the infrastructure network corresponding to the scenario is assembled by selecting its constituent existing or projected segments. Next, the commodity's origin-destination matrix and port capacities are loaded. The minimum-cost routes between origins and destinations are then calculated, and demand is allocated month by month, respecting the limits of each port and redistributing any surplus to the lowest-cost viable port with available capacity. Finally, the results are consolidated into tables, geographic layers, and charts, which feed the comparative analysis across scenarios and between the two commodities.

6.4 Parameters, Assumptions, and Adopted Criteria

Cargo allocation is governed by the criterion of minimum transport cost, subject to the shipping capacity of each port, which is treated as a physical monthly ceiling. In the reference scenarios, this capacity reflects the current terminal infrastructure and is generally the same for both commodities, as it derives from the physical infrastructure of the terminal for the crop. What changes—and changes significantly—is the pressure that each harvest exerts on this shared capacity. In the scenarios with a 2035 horizon, an assumption of investments is adopted that raises the shipping capacity of all ports to 15 million metric tons per month for each commodity. There is also a variation in which a 20% reduction in freight values is considered, associated with geometric improvements, road paving, among others. In all cases, future projects are introduced as infrastructure already implemented and operational, so that the measured effect corresponds to the contrast between the scenario with the project and the baseline scenario.

6.5 Scenario Construction

Scenarios were constructed incrementally based on the Current Scenario. Each route or railway from the South American Integration Routes is added individually to the network, allowing its isolated effect to be determined. Ultimately, combinations encompassing the entire investment package are also evaluated. The suite of scenarios projecting a 2035 horizon repeats this logic under the assumption of expanded port capacity. Furthermore, the "all investments implemented" scenarios—both with and without the complete Transoceanic Railway—allow for observing systemic behavior when interventions operate concurrently. This incremental construction is what makes comparisons between scenarios informative: because only one variable changes at a time, any observed difference can be directly attributed to the corresponding project.

6.6 Evaluation Indicators

The evaluation of each scenario is supported by a set of indicators that summarize logistics performance and enable side-by-side comparisons between soybean and corn, as well as among the scenarios themselves. Key metrics include the total transported volume per commodity and the proportion handled by ports; the number of ports actively utilized; the average distance weighted by transported volume; the average transport cost per ton; throughput volume; transshipment share and costs per port; and the average and maximum capacity utilization rates for each terminal, highlighting seasonal pressure on the network. These indicators are supplemented by the identification of overland export corridors operating without port usage and an assessment of the socio-environmental impacts associated with each route.

7 Results

For each scenario, a Consolidated Report was generated to provide a comparative analysis between the two commodities. The soybean and corn networks feature distinct spatial designs, geographic ranges, and corridors. For this reason, each commodity is presented on its own map, where line thickness indicates flow intensity for each segment, accompanied by route tables, port movement data, GeoPackage layers, and maps that can be integrated into Geographic Information Systems (GIS).

In practice, grain logistics in Brazil operates as a single system shared by soybean and corn rather than as two parallel supply chains. The same ports, arterial highways, and much of the same producing regions serve both crops, with the agricultural calendar determining network usage across different times of the year.

Within its network, each commodity may reveal a logistics corridor that crosses international borders without being associated with any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than to a single transport pattern. In this study, these routes are designated as orphan corridors.

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors. Consequently, each commodity is mapped individually, with line thickness representing segment flow intensity.

Each Consolidated Report aggregates the following information:

1. Overall Transport Overview;
2. Transport Route Maps (soybean, corn, and port volume/cost);
3. Port Dynamics and Shipping Capacity;
4. Transport Seasonality (soybean and corn);
5. Orphan Corridors;
6. Socio-Environmental Impacts (soybean and corn);
7. Final Remarks.

The following sections present the reports for each scenario.

Consolidated Report – Current Baseline Scenario

1. Overall Transport Overview

Soybean moved 142 million metric tons during the analyzed cycle, of which 103 million metric tons (72%) passed through one of the 14 mapped ports.

On average, soybean travel 15,734.86 km (weighted by transported volume), compared to 12,143.34 km for corn, and cost proportionally more per metric ton (R$ 908.93 vs. R$ 757.79)—a difference that reflects the relative weight of each commodity on long-distance export routes (Table 2).

Table 2– Baseline Scenario – General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87 Mt
Volume via ports	103 Mt (72%)	58 Mt (67%)
No. of mapped ports	14	N/D
Top origin state (UF)	Mato Grosso (~38 Mt)	N/D
Weighted average distance	15,734.86 km	12,143.34 km
Weighted average cost	R$ 908.93/t	R$ 757.79/t

2. Transport Route Maps

The soybean and corn networks feature distinct spatial layouts, geographic reaches, and overland export corridors operating independently of ports. Consequently, each commodity is mapped individually, with line thickness representing segment flow intensity.

2.1 Soybean

The following figure (Figure 3) was built from the geospatial database and illustrates the layout of the soybean transport network. A remarkably dense network is evident in the Center-South region of the country, reflecting the proximity between production areas, highways, and the ports of Santos, Paranaguá, and Rio Grande. In contrast, transport flows heading toward Belém and São Luís in the Northern Arc appear as longer, less branched corridors linking the Center-West directly to the northern coast via long-distance routes that continue to gain importance as alternatives to Southern and Southeastern ports.

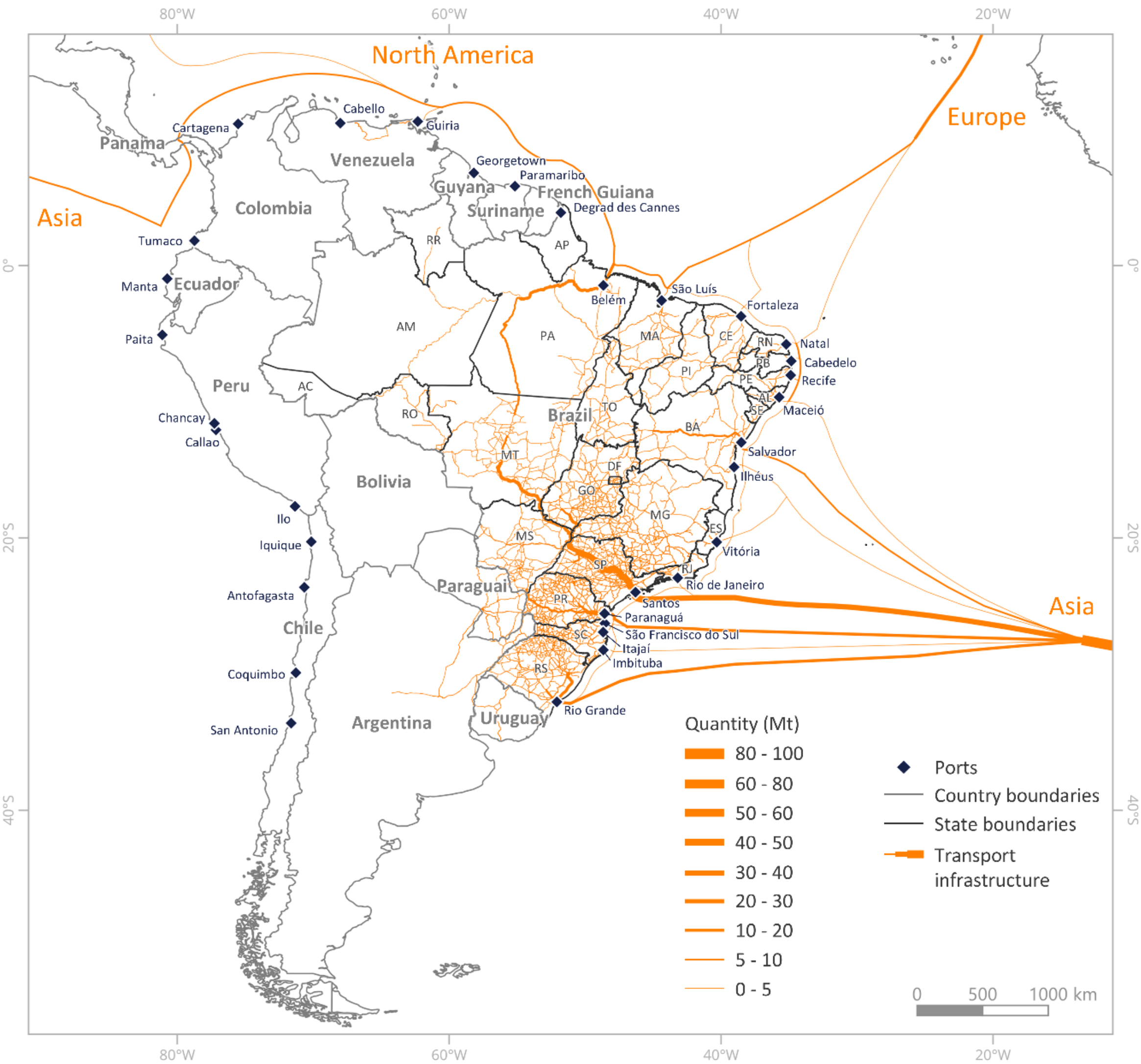

Figure 3 – Baseline Scenario – Soybean transport routes to ports.

2.2 Corn

The following map (Figure 4) illustrates the transport network for corn.

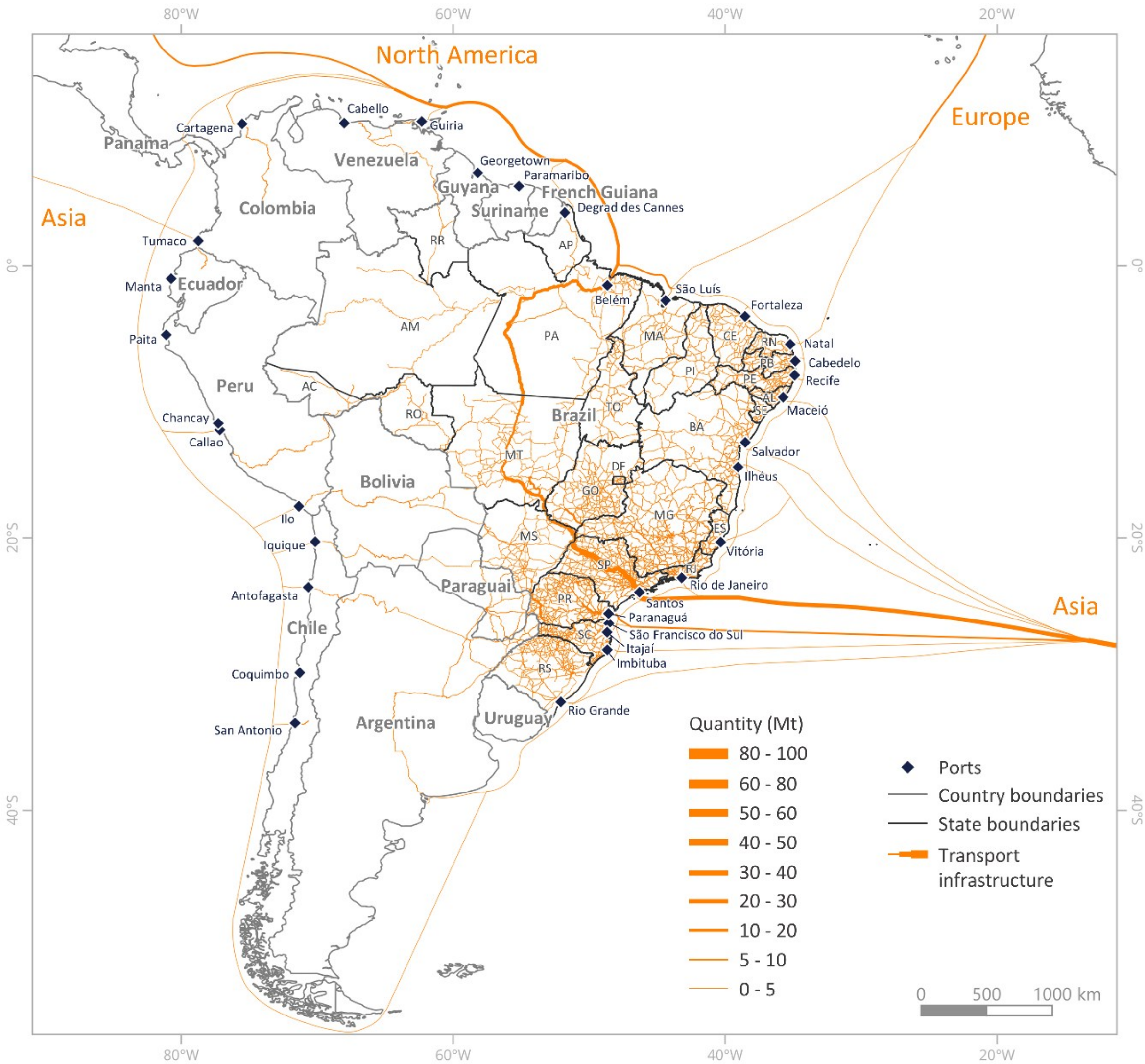

Figure 4 – Baseline Scenario – Corn transport routes to ports.

2.3 Volume and Cost by Port

The following table (Table 3) aggregates, for the main ports of each commodity, the total annual volume handled, the share of total exports handled through the port network, and the average transport cost per metric ton, displaying soybean and corn side by side. The symbol "—" indicates that the port does not appear individually in the source table for that commodity, being included under "Other ports."

Table 3 – Baseline Scenario - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	40.9	39.7%	577	30,6	52,5%	631
Belém	16.8	16.3%	860	15,0	25,6%	631
Rio Grande	16.0	15.6%	695	0,9	1,5%	916

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Paranaguá	13.4	13.0%	852	7,0	12,0%	733
Salvador	6.2	6.0%	718	0,4	0,8%	392
São Luís	3.9	3.8%	740	1.7	3.0%	394
Vitória	3.7	3.6%	654	1.9	3.3%	428
Other ports	3.0	2.0%	700 to 1,170	0.8	1.4%	—

Santos leads the transport flow for both commodities, though with varying degrees of concentration: it handles 39.7% of all soybean and 52.5% of all corn.

By itself, Santos concentrates nearly 40% of total port-bound volume, consolidating its status as the nation's primary export outlet. It offers the lowest average transport cost among major terminals, reflecting both its proximity to Center-South producing regions and the robust highway infrastructure serving it. Conversely, while Belém and Paranaguá handle high volumes, they present higher average costs per metric ton—an expected result given that they draw from more distant origin points and routes combining longer overland and maritime legs.

3. Port Dynamics and Shipping Capacity

Monthly shipping capacity at each port is identical for both commodities. It is the physical structure of the terminal that imposes the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each harvest exerts on this shared capacity (Table 4).

Table 4 – Baseline Scenario – Installed (shared) capacity and monthly utilization by port and commodity.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Santos	7,137	47.7%	81.3%	35.8%	78.9%
Belém	2,928	47.8%	83.9%	42.6%	93.7%
Paranaguá	2,843	39.4%	66.2%	20.5%	45.8%
Rio Grande	2,456	54.4%	92.8%	2.9%	6.7%
São Luís	2,157	14.9%	25.5%	6.7%	15.0%
Salvador	747	69.4%	100%	4.9%	11.5%
Vitória	720	43.2%	73.2%	22.3%	49.7%
Imbituba	202	48.6%	82.7%	—	—
São Francisco do Sul	946	—	—	1.5%	3.4%

Belém represents the clearest case of a port under dual pressure: it reaches 83.9% of its capacity at the peak of the soybean harvest and 93.7% at the peak of the corn harvest—making it the most critical terminal in the network for both crops, albeit during different windows of the year. Salvador operates, in practice, as a dedicated single-commodity port: reaching 100% utilization during the soybean peak while barely exceeding 12% for corn. Santos and Paranaguá, two of the largest terminals in absolute capacity, maintain relative operational buffer across both commodities and serve as safety valves for the national system.

For soybean, the picture reveals a network with significant average annual buffer, yet with highly contrasting behaviors among individual ports. Santos, despite being the largest in absolute volume, operates with a comfortable margin relative to its capacity, reflecting infrastructure sized for throughput levels even higher than those observed. Rio Grande, on the other hand, operates above 92% of capacity during peak months, indicating a much narrower operational margin and heightened sensitivity to delays or concentrated shipments. Salvador, despite handling a comparatively small volume, hits 100% capacity in certain months, signaling that its facilities operate at their limit when regional demand spikes. Smaller ports, such as Itajaí, Rio de Janeiro, and Recife, appear technically saturated throughout most of the year. This condition, however, stems from their low capacity and marginal handling volumes, causing them to function as complementary or spot routes rather than central links in the export chain.

4. Transport Seasonality

The charts below illustrate, for each commodity, the total monthly volume handled across all ports (left) and the evolution of capacity utilization rates at the primary terminals throughout the year (right).

4.1 Soybean

The total volume handled across the port network follows a highly pronounced seasonal pattern linked to the soybean harvest calendar. The charts below (Figure 5) illustrate, on the left, total monthly volume handled across all ports and, on the right, the evolution of capacity utilization rates at primary terminals throughout the year.

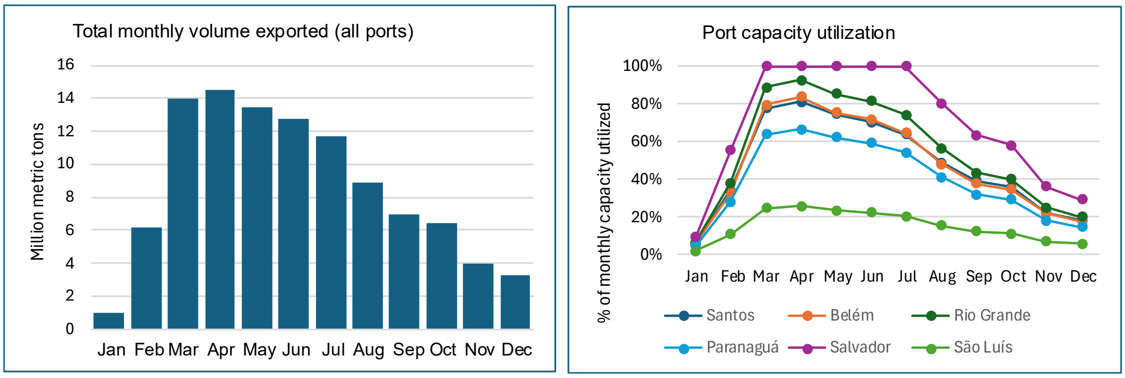

Figure 5 – Baseline Scenario - Total monthly volume of soybean exported and capacity utilization of main ports.

Total volume surges from around 1 million metric tons in January to a peak of 14.5 million metric tons in April—the timeframe that concentrates the harvest across major producing regions—before gradually tapering off through December. Port capacity utilization tracks this movement precisely: between March and July, directly within the peak harvest window, Salvador operates practically at full capacity, while Rio Grande, Belém, and Santos hit their highest occupancy levels of the year.

This pattern demonstrates that pressure on port infrastructure is not uniform throughout the year, but concentrated within a tight multi-month window. This concentration tends to trigger truck queues, extended vessel wait times, and heightened competition for storage capacity precisely when the overall network faces its highest load. Santos, boasting the largest absolute capacity among analyzed ports, functions as a systemic safety valve—absorbing seasonal spikes without approaching its operational ceiling.

4.2 Corn

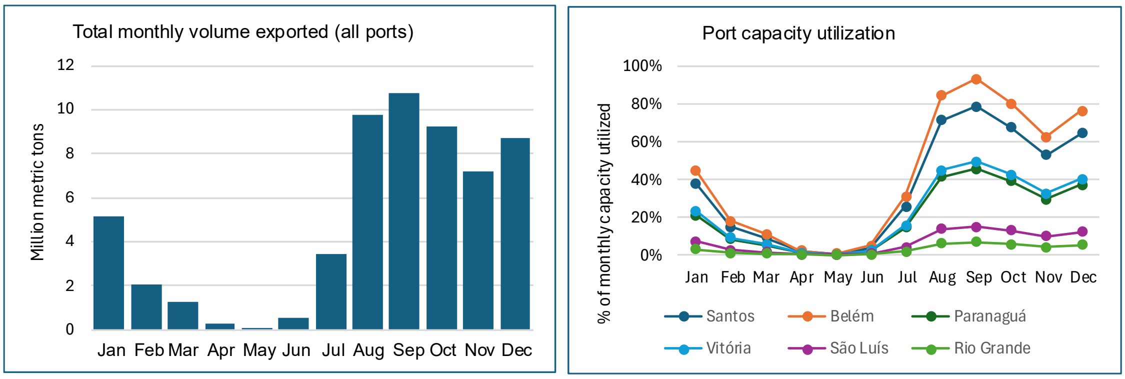

Figure 6 – Baseline Scenario - Total monthly volume of corn exported and capacity utilization of main ports.

Because harvest peaks rarely overlap between the two commodities, the same ports generally serve both crops throughout the year without pressure accumulating in a single period—one of the key hidden strengths of the current infrastructure from a network planner's perspective.

5. Orphan Corridors

The orphan corridors identified in this analysis warrant additional attention, as they generally represent international routes spanning multiple countries. Their eventual future expansion could alter the total distance traveled by freight and, consequently, transport's overall environmental footprint. These impacts could prove positive if they yield shorter routes to final destination markets, or negative if they entail constructing new highways through environmentally sensitive areas—such as Amazon rainforest tracts or indigenous territories that these routes may cross.

6. Social and Environmental Impacts

Each product was evaluated separately regarding its social and environmental impacts in the original reports. The summaries below preserve this level of detail by crop, as the affected routes, peak months, and most sensitive ports differ between soybean and corn.

6.1 Soybean

The way soybean is transported to ports has relevant environmental implications, which warrant attention alongside the logistics analysis. The transport network connecting the producing regions of the Midwest to the ports in the South and Southeast is predominantly road-based—a mode that consumes more fuel and emits more greenhouse gases per ton transported than rail or waterway alternatives, especially over distances as long as those observed in the data. In this regard, strengthening routes such as those of the Northern Arch (*Arco Norte*), which combine shorter road stretches with river transport to Belém and São Luís, represents a potentially more environmentally efficient alternative by reducing the road distance traveled from farms in northern Mato Grosso and Pará.

The seasonal concentration of outflow between March and July also has environmental and social ramifications in port cities. The significant increase in truck traffic during this period elevates local pollutant emissions, intensifies wear and tear on urban road infrastructure, and increases pressure on areas surrounding terminals—many of which are located in ecologically sensitive estuarine or coastal regions, such as Santos, Paranaguá, and Belém. The operation of ports near their maximum capacity during certain months, as observed in Rio Grande and Salvador, reinforces the importance of logistics planning that better distributes flows throughout the year and across different corridors, thereby mitigating congestion peaks and their associated environmental impacts. Overall, the scenario depicted by the data suggests that environmental efficiency gains in the soybean supply chain are likely to stem less from the simple expansion of port capacity and more from modal diversification and a better temporal and spatial distribution of transport flows.

7. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities, when featured in Table 4, warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Consolidated Report – Amazon Route

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (72%) passed through one of the 14 mapped ports. Corn moved 87.4 million metric tons, of which 58.3 million metric tons (67%) went through one of the 18 ports in its network—14 Brazilian ports plus 4 international terminals (Cartagena (Colombia), Callao (Peru), San Antonio (Chile), and Bahía Blanca (Argentina))—which have already been incorporated into the grain's export routes.

Mato Grosso is the dominant origin for both commodities, accounting for approximately 38 million metric tons of soybean and 37 million metric tons of corn, making the state the most critical starting point of the continental network.

Soybean travels an average weighted distance of 15,734.86 km based on the volume transported, compared to 12,143.35 km for corn, and costs proportionally more per metric ton (BRL 908.93 vs. BRL 757.79). This difference reflects the relative weight of each product in long-distance export routes (Table 5).

Table 5 – Amazon Route - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87.4 Mt
Volume via ports	103 Mt (72%)	58.3 Mt (67%)
No. of mapped ports	14	18
Top origin state (UF)	Mato Grosso (~38 Mt)	Mato Grosso (~37 Mt)
Weighted average distance	15,734.86 km	12,143.35 km
Weighted average cost	R$ 908.93/t	R$ 757.79/t

2. Transport Route Maps

2.1 Soybean

The following figure (Figure 7) was constructed from the geospatial database and illustrates the design of the soybean transport network, with line thickness representing the flow intensity of each stretch. An extremely dense network can be observed in the Center-South region of the country, reflecting the proximity among producing areas, highways, and the ports of Santos, Paranaguá, and Rio Grande. Meanwhile, flows heading toward Belém and São Luís, in the so-called Northern Arch (*Arco Norte*), appear as longer and less branched corridors, directly connecting the Midwest to the northern coast via long-distance routes that have been gaining relevance as an alternative to Southern and Southeastern ports.

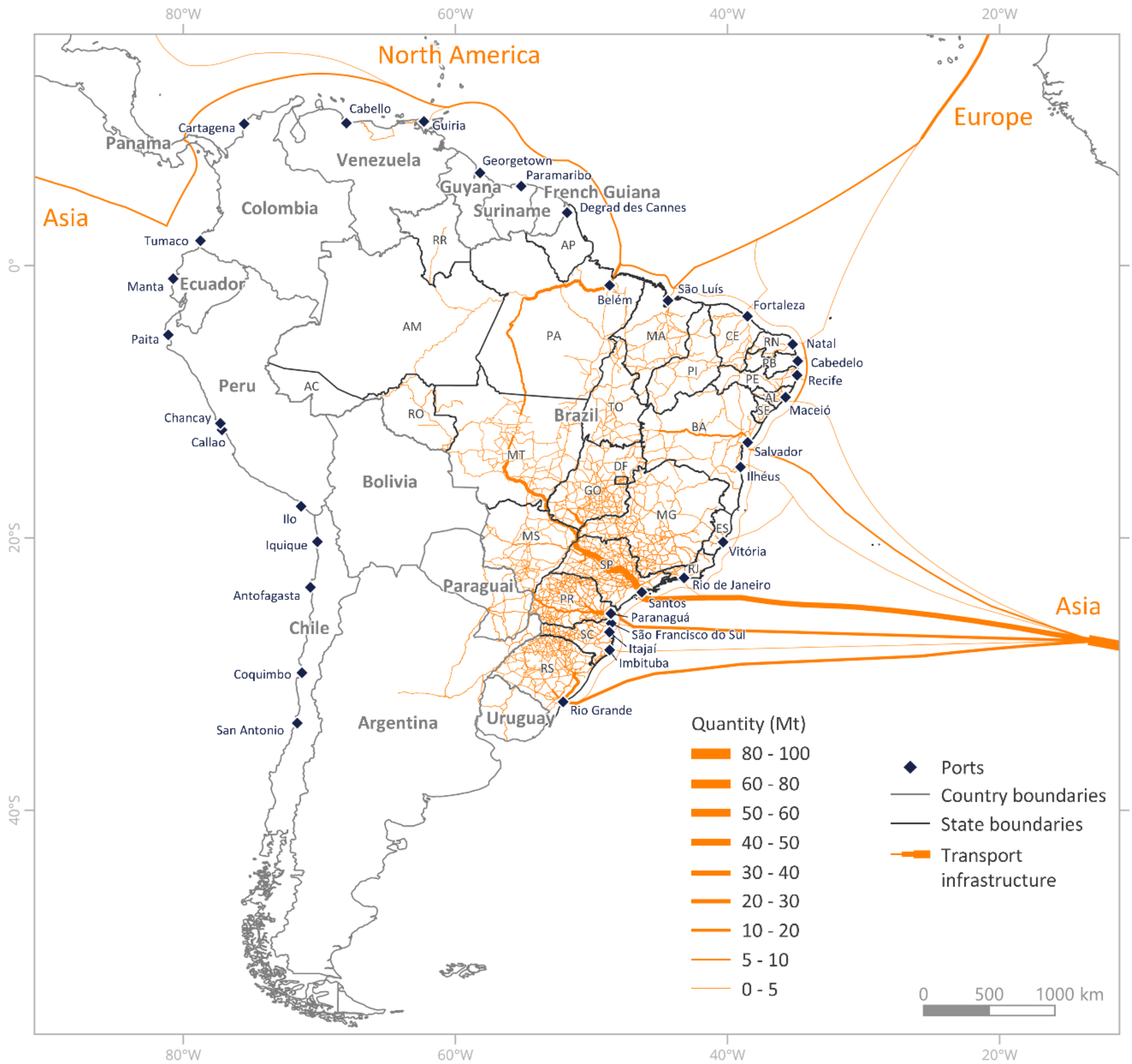

Figure 7 – Amazon Route - Soybean shipment routes to ports.

2.2 Corn

The following figure (Figure 8) was constructed from the geospatial database and illustrates the design of the corn transport network. As with soybean, a dense network is observed in the Center-South converging toward Santos and Paranaguá, along with a longer corridor heading toward Belém in the Northern Arch (*Arco Norte*). Routes extending beyond Brazil's borders also appear, reaching ports on the Pacific (Callao in Peru and San Antonio in Chile), in the Colombian Caribbean (Cartagena), and on the Argentine coast (Bahía Blanca). Although they move small volumes compared to major Brazilian ports, these routes highlight the existence of international logistics corridors already in operation, connecting the Brazilian Midwest to alternative export outlets in other South American countries.

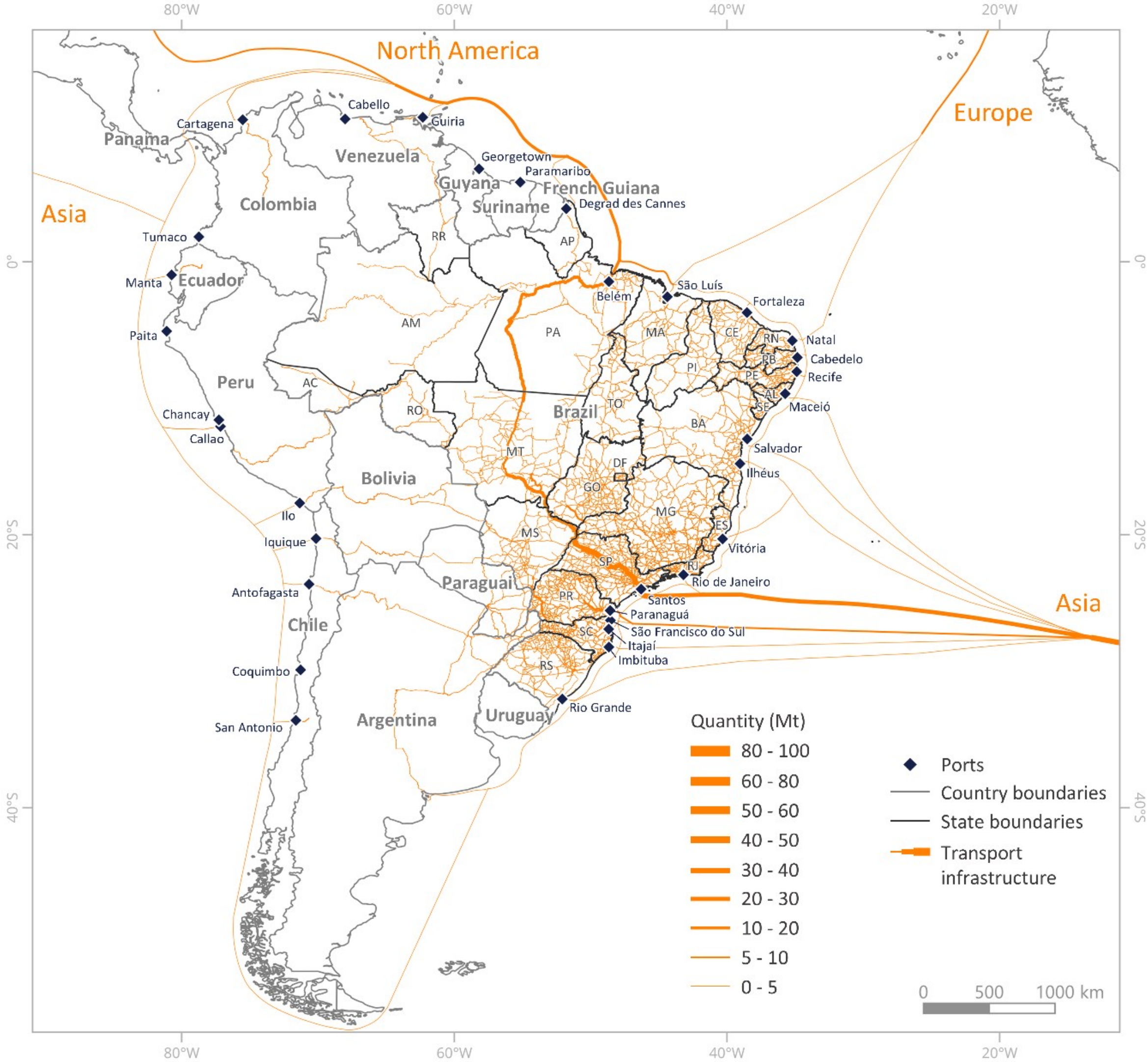

Figure 8 – Amazon Route - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The following table (Table 6) brings together, for the main ports of each product, the total volume moved during the year, the share of the total exported by the port network, and the average transport cost per metric ton, with soybean and corn side by side. The symbol "—" indicates that the port does not appear individually in the source table for that product, being included in the total for "Other ports".

Table 6 – Amazon Route - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	**Share**	**Custo (R$/t)**	**Vol. (Mt)**	**Share**	**Custo (R$/t)**
Santos	40.9	39.7%	577	30.6	52.5%	631
Belém	16.8	16.3%	861	15.0	25.6%	631
Rio Grande	16.0	15.6%	695	0.9	1.5%	916

Port	Soybean			Corn		
	Vol. (Mt)	**Share**	**Custo (R$/t)**	**Vol. (Mt)**	**Share**	**Custo (R$/t)**
Paranaguá	13.4	13.1%	851	7.0	12.0%	733
Salvador	6.2	6.0%	718	—	—	—
São Luís	3.9	3.8%	735	1.7	3.0%	394
Vitória	3.7	3.6%	655	1.9	3.3%	428
International ports	—	—	—	0.21	0.4%	453 to 806
Other ports	2.0	2.0%	424 to 1,172	0.9	1.7%	88 to 949

Santos leads the outflow for both products, though with different weights: it accounts for 39.7% of soybean and 52.5% of corn. Salvador appears only in the soybean network, whereas international ports appear only in the corn network.

Santos alone accounts for nearly 40% of the total volume passing through ports, establishing itself as the country's main export channel with the lowest average transport cost among major terminals—a reflection of its proximity to producing regions in the Center-South and the more consolidated road infrastructure servicing it. On the other hand, Belém and Paranaguá, despite moving high volumes, present a higher average cost per metric ton, which is expected given that they serve more distant origins and routes that combine longer land and maritime segments.

Together, Santos and Belém account for roughly 78% of all corn exported through ports, an even higher concentration than that observed for soybean. The proportional weight of Belém in corn exports is noteworthy. While the port represents about 16% of the exported volume for soybean, its share rises to over 25% for corn. This suggests that the Northern Arch (*Arco Norte*) plays an especially critical role in exporting the second corn crop (*safrinha*), which is grown predominantly in northern Mato Grosso—a region closer to the Amazon basin than to the ports in the South and Southeast.

3. Port Dynamics and Shipping Capacity

A port's monthly shipping capacity is generally the same regardless of the product. It is the terminal's physical infrastructure that imposes the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each crop exerts on this shared capacity (Table 7).

Table 7 – Amazon Route - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Santos	7,137	47.7%	81.2%	35.8%	78.9%
Belém	2,928	47.8%	83.9%	42.6%	93.7%
Paranaguá	2,843	39.4%	66.4%	20.5%	45.8%
Rio Grande	2,456	54.4%	92.8%	2.9%	6.7%
São Luís	2,157	14.9%	25.5%	6.7%	15.0%
Salvador	747	69.4%	100%	4.9%	11.5%
Vitória	720	43.2%	73.3%	22.3%	49.7%
Imbituba	202	48.6%	82.6%	16.1%	36.2%

Belém is the most obvious case of a port under dual pressure, as it reaches 83.9% of its capacity during the soybean peak and 93.7% during the corn peak—making it the most critical terminal in the network for both crops, albeit during different windows of the year. In practice, Salvador functions as a single-product port: it reaches 100% utilization during the soybean peak and barely exceeds 12% for corn. Santos and Paranaguá, two of the largest terminals in absolute capacity, maintain a relative capacity buffer across both products and act as safety valves for the system.

For soybean, the picture shows a network with significant capacity headroom on an annual average, but with very different behaviors across ports. Santos, despite being the largest in absolute volume, operates with a comfortable margin relative to its capacity—reflecting an infrastructure sized for an even higher handling threshold than observed. Rio Grande, on the other hand, operates above 92% of capacity during its peak months, indicating a much narrower operational margin and greater vulnerability to any delays or shipment concentrations. Salvador, despite its comparatively small volume, reaches 100% capacity in some months, signaling that its infrastructure is already operating at its limit when regional demand intensifies. Smaller ports, such as Itajaí, Rio de Janeiro, and Recife, appear technically saturated for most of the year. This condition, however, stems from their low capacity and marginal operational volumes, causing them to function more as complementary or ad hoc routes rather than central links in the export chain.

For corn, average capacity utilization is considerably lower than that recorded for soybean across virtually all ports—a direct result of the outflow being concentrated into a shorter window of the year. Even so, at the peak of the season, Belém reaches nearly 94% of its monthly capacity, the highest level among the major ports analyzed, indicating that the Northern Arch (*Arco Norte*) infrastructure operates very close to its limit precisely at the time of highest demand. Santos, despite handling a larger absolute volume, reaches a more moderate peak utilization (79%), supported by its considerably larger installed capacity. Rio Grande and São Luís, which play prominent roles in soybean exports, show low utilization for corn, reinforcing that port choice is linked both to the location of crops and to the time of year when each grain becomes available for export.

4. Transport Seasonality

The charts below show, for each product, the total volume exported per month across all ports (on the left) and the evolution of the capacity utilization rate at the main terminals throughout the year (on the right).

4.1 Soybean

The total volume handled by the port network follows a highly distinct seasonal pattern associated with the soybean harvest calendar. The charts below (Figure 9) show, on the left, the total volume exported per month across all ports and, on the right, the evolution of the capacity utilization rate at the main terminals throughout the year.

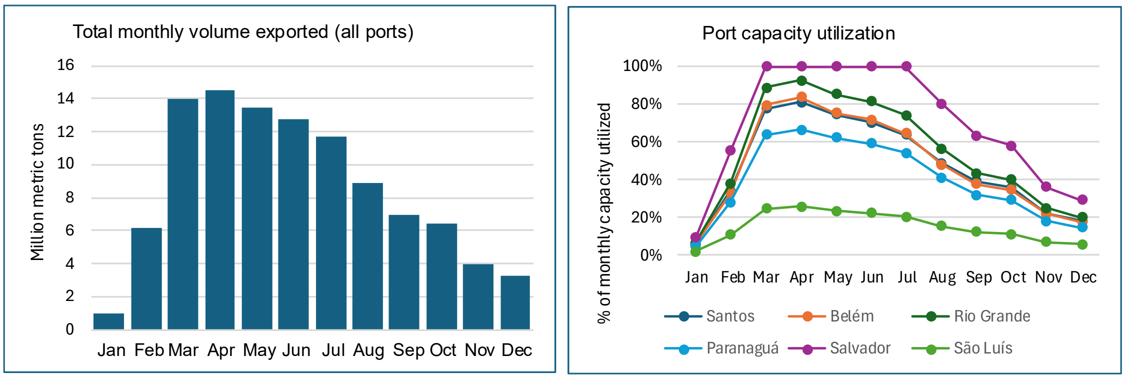

Figure 9 – Amazon Route - Total monthly volume of soybean exported and capacity utilization of main ports.

Total volume surges from around 1 million metric tons in January to a peak of 14.5 million metric tons in April—a period that concentrates the harvest across major producing regions—and gradually declines through December. Port capacity utilization follows this movement precisely. Between March and July, right in the peak harvest window, Salvador operates practically at its capacity limit, while Rio

Grande, Belém, and Santos reach their highest occupancy levels of the year. This behavior demonstrates that pressure on port infrastructure is not constant throughout the year, but rather concentrated into a window of a few months. This tends to generate truck queues, longer wait times, and greater competition for storage space precisely when the system as a whole is most strained. Santos, having the highest absolute capacity among the analyzed ports, acts as a sort of safety valve for the system, absorbing part of the seasonal pressure without approaching its operational ceiling.

4.2 Corn

The seasonal pattern for corn is markedly different from that observed for soybean. The charts below (Figure 10) show, on the left, the total volume exported per month across all ports and, on the right, the evolution of the capacity utilization rate at the main terminals throughout the year.

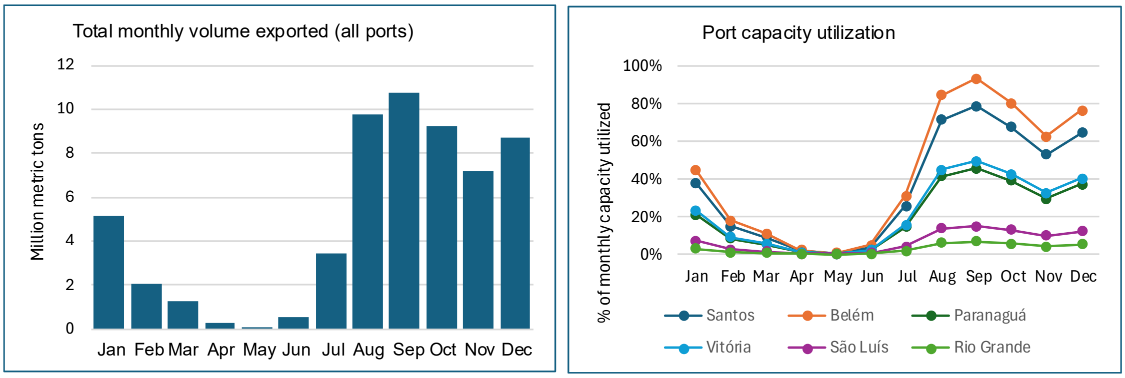

Figure 10 – Amazon Route - Total monthly volume of corn exported and capacity utilization of main ports.

While soybean exports are concentrated between March and July, corn exports experience their weakest period during precisely these months. Between April and June, the volume moved is nearly zero, before intensifying sharply between August and December, peaking in September. This behavior is a direct reflection of the second crop (*safrinha*) calendar. Planted following the soybean harvest early in the year and harvested between June and August, its availability for export materializes only in the second half of the year. As a consequence, the pressure exerted by the two grains on port infrastructure occurs in virtually complementary windows throughout the year. This helps explain why the same ports (such as Santos and Belém) are able to serve both crops without their peak periods fully overlapping, even though a partial overlap exists between the end of the soybean cycle and the beginning of the corn peak.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being associated with any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

An additional finding of this scenario is a corridor originating in the extreme south of Rio Grande do Sul and continuing to the vicinity of Montevideo, in Uruguayan territory, accounting for nearly 45,000 metric tons of cumulative annual flow.

An overland corridor traverses the entire continent: originating at the border between Mato Grosso do Sul and Paraguay, it crosses Paraguayan territory and northern Argentina to reach the Chilean coast around Antofagasta, totaling approximately 450 metric tons of flow per year. This route broadly corresponds to the so-called Bioceanic Highway Corridor (*Corredor Rodoviário Bioceânico*), an integration project connecting the Brazilian Midwest to Chilean Pacific ports without crossing the Bolivian Andes. Unlike the four international ports already cataloged in the tabular database, this corridor is not linked to any specific port, suggesting an incipient flow that aligns with a real infrastructure corridor widely discussed in the debate on Brazilian agribusiness export logistics.

Neither corridor appears in the network of the other product, reinforcing that the final destination—Uruguay for soybean, Chile for corn—depends on the geographic origin of each shipment. In terms of volume, the soybean corridor is significantly more substantial than that for corn (45,000 tonnes compared to 450 tonnes), suggesting distinct stages of maturity between the two routes.

6. Social and Environmental Impacts

6.1 Soybean

The way soybean is transported to ports has relevant environmental implications, which warrant attention alongside the logistics analysis. The transport network connecting the producing regions of the Midwest to the ports in the South and Southeast is predominantly road-based—a mode that consumes more fuel and emits more greenhouse gases per ton transported than rail or waterway alternatives, especially over distances as long as those observed in the data. In this regard, strengthening routes such as those of the Northern Arch (*Arco Norte*), which combine shorter road stretches with river transport to Belém and São Luís, represents a potentially more environmentally efficient alternative by reducing the road distance traveled from farms in northern Mato Grosso and Pará. The corridor identified leading toward Uruguay reinforces this same logic on a different scale: for producers in the extreme south of Rio Grande do Sul, exporting production through a nearby Uruguayan port can represent a shorter distance traveled than the route to Brazilian terminals in the South, offering potential gains in logistics and environmental efficiency.

The seasonal concentration of outflow between March and July also has environmental and social ramifications in port cities. The significant increase in truck traffic during this period elevates local pollutant emissions, intensifies wear and tear on urban road infrastructure, and increases pressure on areas surrounding terminals—many of which are located in ecologically sensitive estuarine or coastal regions, such as Santos, Paranaguá, and Belém. The operation of ports near their maximum capacity during certain months, as observed in Rio Grande and Salvador, reinforces the importance of logistics planning that better distributes flows throughout the year and across different corridors, thereby mitigating congestion peaks and their associated environmental impacts. Overall, the scenario depicted by the data suggests that environmental efficiency gains in the soybean supply chain are likely to stem less from the simple expansion of port capacity and more from modal diversification and a better temporal and spatial distribution of transport flows.

6.2 Corn

Just as with soybean, corn transport to ports relies heavily on highways over very long stretches between the Midwest and the coast. This translates into higher fuel consumption and greater greenhouse gas emissions per metric ton transported when compared to rail or waterway alternatives. The prominent role of the port of Belém in corn export flows reinforces the relevance of the Northern Arch (*Arco Norte*) as a route that combines shorter road segments with river transport along Amazonian rivers. This reduces the total distance traveled by truck from farms in northern Mato Grosso and Pará, yielding significant potential environmental gains compared to traditional routes to the South and Southeast. The corridor identified leading toward Antofagasta adds another dimension to this discussion: by shortening the distance between the Brazilian Midwest and the Pacific Ocean, a fully consolidated bioceanic corridor could significantly reduce total transport distance to Asian markets, with potential economic and environmental gains relative to the traditional route via Santos.

The concentration of outflow between August and December tends to generate, during this period, a significant increase in truck traffic on access highways to ports and greater pressure on port operations in cities such as Belém and Santos, impacting local pollutant emissions and urban infrastructure wear and tear. The existence of international routes to Pacific and Argentine ports, combined with the bioceanic corridor identified in the geospatial mapping, signals a trend toward logistics corridor diversification. If consolidated, this trend can contribute to a better distribution of environmental and operational pressure across different regions and countries, rather than concentrating it exclusively in traditional Brazilian ports. Overall, just as observed for soybean, the most consistent environmental gains tend to arise from modal diversification and a more balanced distribution of flows throughout the year, rather than solely from expanding installed port capacity.

In common, both diagnostics point toward the same strategic direction: road reliance over long distances is the main driver of environmental pressure in the supply chain; the Northern Arch emerges as the currently available alternative with lower relative impact; and the seasonal concentration of outflow—occurring in distinct windows for each crop—requires tailored traffic planning and mitigation during each peak, rather than investment in port capacity alone.

7. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities, when featured in Table 5, warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—

both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Consolidated Report – Capricorn Route

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 14 mapped ports. Corn moved 87.4 million metric tons, of which 58.5 million metric tons (67%) went through one of the 18 ports in its network.

Mato Grosso is the dominant origin for both commodities, accounting for approximately 38 million metric tons of soybean and 37 million metric tons of corn, making the state the most critical starting point of the continental network.

Soybean travels an average weighted distance of 15,726.29 km based on the volume transported, compared to 12,137.18 km for corn, and costs proportionally more per metric ton (BRL 906.15 vs. BRL 755.43). This difference reflects the relative weight of each product in long-distance export routes (Table 8).

Table 8 – Capricorn Route - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87.4 Mt
Volume via ports	103 Mt (73%)	58.5 Mt (67%)
No. of mapped ports	14	18
Top origin state (UF)	Mato Grosso (~38 Mt)	Mato Grosso (~37 Mt)
Weighted average distance	15,726.29 km	12,137.18 km
Weighted average cost	R$ 906.15/t	R$ 755.43/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors. For this reason, each product is presented on its own map, with line thickness indicating the flow intensity of each stretch.

2.1 Soybean

The following figure (Figure 11) was constructed from the geospatial database and illustrates the design of the soybean transport network, with line thickness representing the flow intensity of each stretch and the size of the red dots representing the total volume handled at each port. An extremely dense network can be observed in the Center-South region of the country, reflecting the proximity among producing areas, highways, and the ports of Santos, Paranaguá, and Rio Grande. Meanwhile, flows heading toward Belém and São Luís, in the so-called Northern Arch (*Arco Norte*), appear as longer and less branched corridors, directly connecting the Midwest to the northern coast via longer-distance routes.

Along this route, the corridor identified in previous rounds reappears, originating in the extreme south of Rio Grande do Sul and continuing to the vicinity of Montevideo, in Uruguayan territory, accounting for nearly 45,000 metric tons of cumulative annual flow—practically the same volume observed previously. The recurrence of this route, with the same geographical extent and flow magnitude, reinforces the hypothesis that this is a real export corridor.

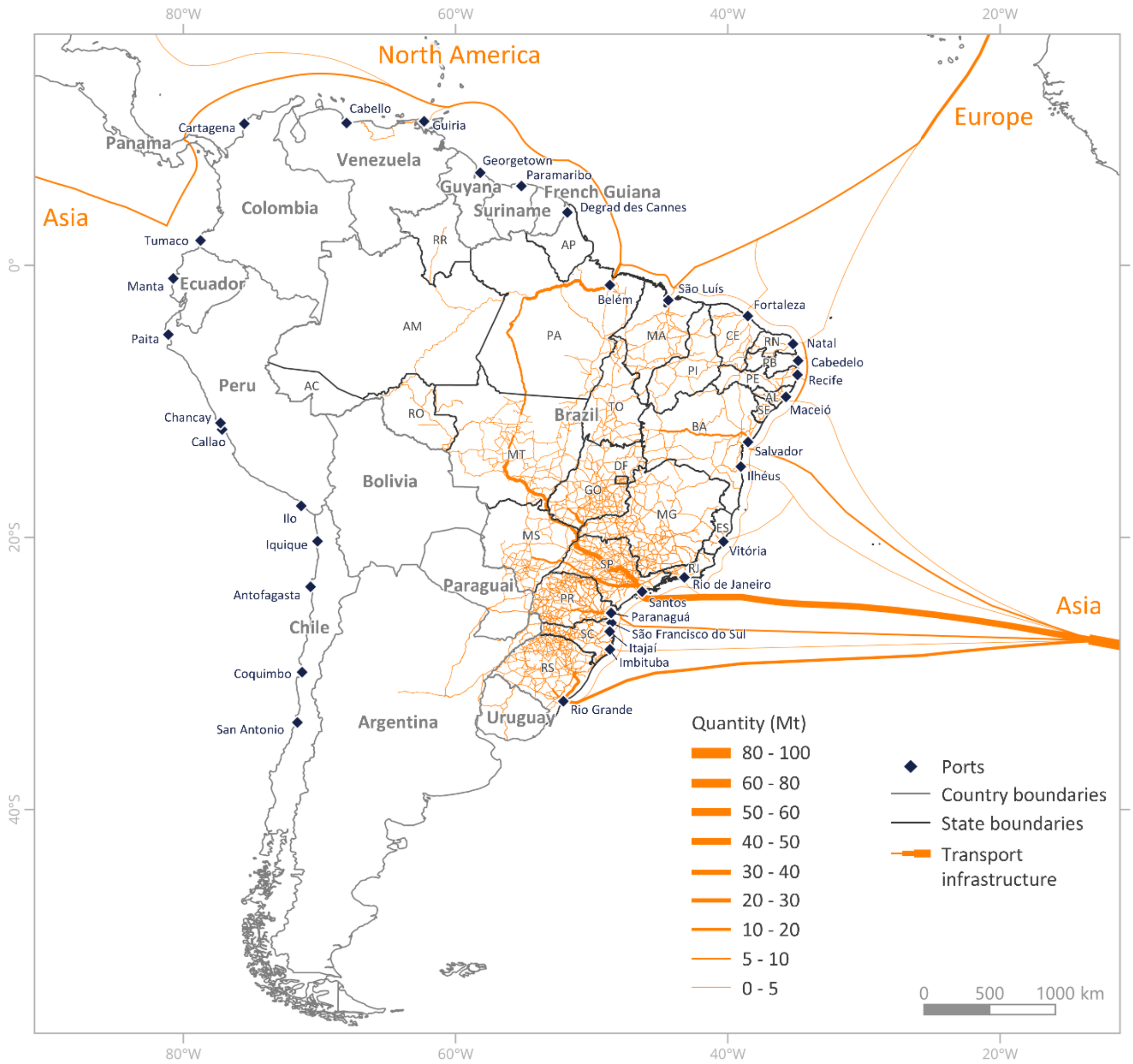

Figure 11 – Capricorn Route - Soybean export routes to ports.

2.2 Corn

Figure 12 shows a dense network in the Center-South converging toward Santos and Paranaguá, alongside a longer corridor heading toward Belém in the Northern Arch (*Arco Norte*). Routes extending beyond Brazil's borders also appear, reaching ports on the Pacific (Callao in Peru and San Antonio in Chile), in the Colombian Caribbean (Cartagena), and on the Argentine coast (Bahía Blanca). Although they move small volumes compared to major Brazilian ports, these routes highlight the existence of international logistics corridors already in operation, connecting the Brazilian Midwest to alternative export outlets in other South American countries.

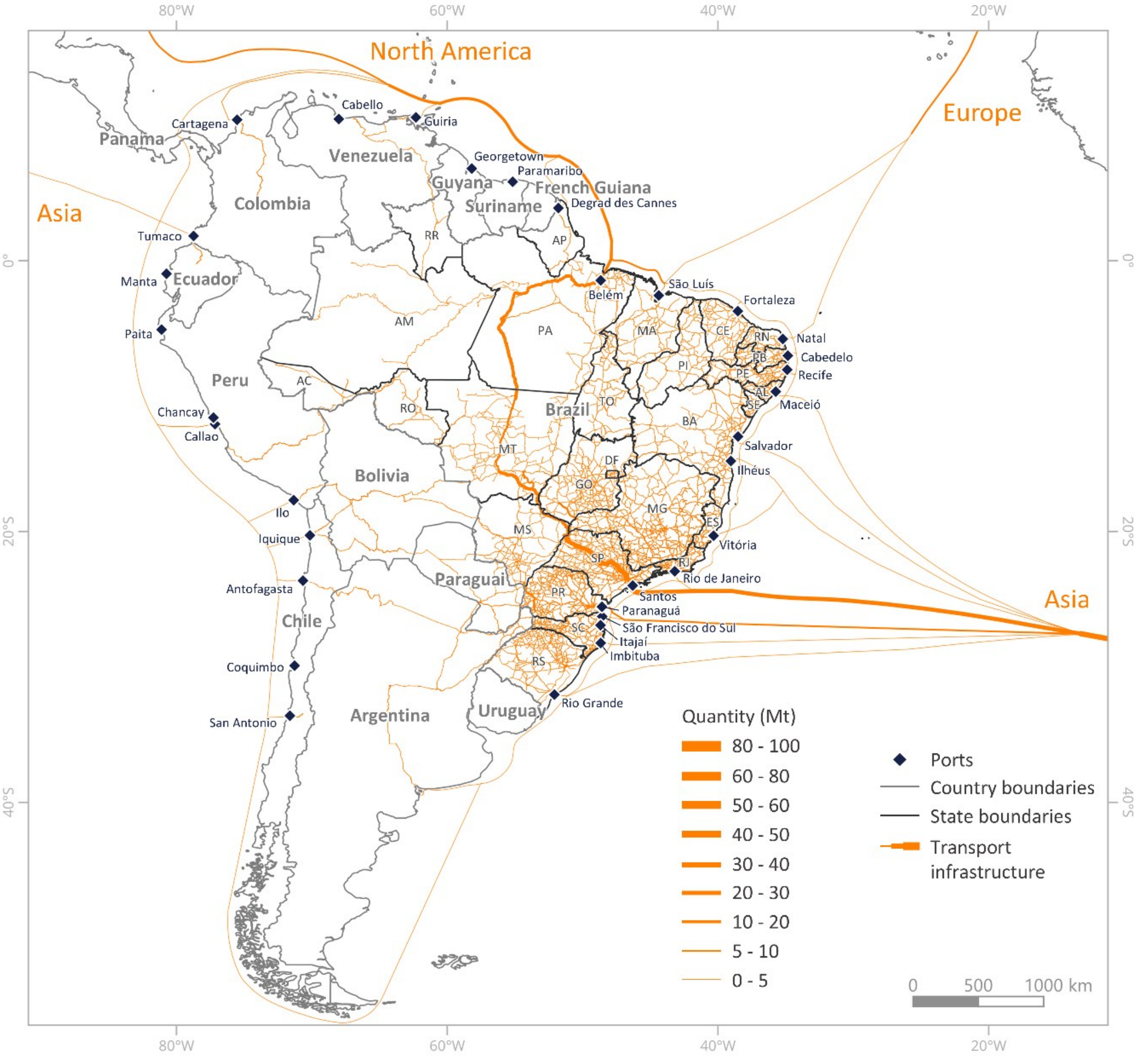

Figure 12 – Capricorn Route - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The following table (Table 9) brings together, for the main ports of each product, the total volume moved during the year, the share of the total exported by the port network, and the average transport cost per metric ton, with soybean and corn side by side. The symbol "—" indicates that the port does not appear individually in the source table for that product, being included in the total for "Other ports".

Table 9 -— Capricorn Route - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	44.7	43.4%	530	31.2	53.3%	627
Belém	16.8	16.3%	855	15.0	25.6%	629
Rio Grande	15.8	15.3%	893	0.9	1.5%	919
Paranaguá	9.5	9.2%	810	6.5	11.2%	693
Salvador	6.2	6.0%	701	—	—	—
São Luís	3.9	3.8%	727	1.7	3.0%	393
Vitória	3.7	3.6%	645	1.9	3.3%	425
International ports	—	—	—	0.21	0.4%	453 to 801
Other ports	1.4	1.4%	424 to 1,149	0.7	1.2%	88 to 931

Santos leads the outflow of both products, but with a different weight between them: it concentrates 43.4% of soybeans and 53.3% of corn. Salvador appears only in the soybean network, while international ports appear only in the corn network.

In this round, Santos concentrates 43% of all volume passing through ports, an even higher share than observed in previous analyses, when the port accounted for about 40% of the total. The counterpoint is Paranaguá, whose share drops to 9.2%, practically half of what had been previously recorded. This flow reallocation between the two Southeast and South ports, while keeping the other terminals relatively stable, suggests a change in how the logistics network is directing cargo in this version of the data, possibly reflecting cost differences, capacity availability, or routing criteria among the terminals.

Santos and Belém together concentrate about 79% of all corn shipped via ports, an even higher concentration than observed for soybeans. The proportional weight of Belém in corn is noteworthy. While in soybeans the port accounts for about 16% of the exported volume, in corn this share rises to over 25%, suggesting that the Northern Arc plays an especially relevant role in shipping the second crop (*safrinha*), grown mostly in northern Mato Grosso, a region closer to the Amazon basin than to the Southern and Southeastern ports.

3. Port Dynamics and Shipping Capacity

A port's monthly shipping capacity is generally the same regardless of the product. It is the terminal's physical infrastructure that imposes the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each crop exerts on this shared capacity (Table 10).

Table 10 – Capricorn Route - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Santos	7,137	52.1%	88.7%	36.4%	80.3%
Belém	2,928	47.8%	83.9%	42.6%	93.7%
Paranaguá	2,843	27.8%	47.2%	19.2%	43.0%
Rio Grande	2,456	53.5%	90.8%	2.9%	6.7%
São Luís	2,157	15.0%	25.5%	6.7%	15.0%
Salvador	747	69.4%	100%	4.9%	11.5%
Vitória	720	43.2%	73.3%	22.2%	49.4%
Imbituba	202	43.6%	74.0%	17.2%	38.4%

Belém is the most obvious case of a port under dual pressure. It reaches 83.9% of its capacity during the soybean peak and 93.7% during the corn peak—making it the most critical terminal in the network for both crops, albeit during different windows of the year. In practice, Salvador functions as a single-product port: it reaches 100% utilization during the soybean peak and barely exceeds 12% for corn. Santos and Paranaguá, two of the largest terminals in absolute capacity, maintain a relative capacity buffer across both products and act as safety valves for the system.

For soybean, Table 9 confirms the pattern identified in the previous section, where Santos now operates with an average utilization of 52% and reaches 88.7% of its capacity during its peak month—the highest level recorded for this port across all rounds analyzed thus far. Paranaguá, by contrast, operates with a much larger buffer, utilizing on average less than 28% of its monthly capacity. Rio Grande maintains a tighter operational pattern, exceeding 90% capacity at the peak of the harvest. Salvador continues to reach 100% capacity in certain months, while

Imbituba, despite its small size, now operates with an average utilization above 43%, higher than observed in previous rounds.

For corn, average capacity utilization is considerably lower than that recorded for soybean across virtually all ports—a direct result of the outflow being concentrated into a shorter window of the year. Even so, at the peak of the season, Belém reaches nearly 94% of its monthly capacity, the highest level among the major ports analyzed, indicating that the Northern Arch (*Arco Norte*) infrastructure operates very close to its limit precisely at the time of highest demand. Santos, despite handling a larger absolute volume, reaches a more moderate peak utilization (80%), supported by its considerably larger installed capacity. Rio Grande and São Luís, which play prominent roles in soybean exports, show low utilization for corn, reinforcing that port choice is linked both to the location of crops and to the time of year when each grain becomes available for export.

4. Transport Seasonality

The charts below show, for each product, the total volume exported per month across all ports (on the left) and the evolution of the capacity utilization rate at the main terminals throughout the year (on the right).

4.1 Soybean

The total volume handled by the port network follows a highly distinct seasonal pattern associated with the soybean harvest calendar. The charts below (Figure 13) show, on the left, the total volume exported per month across all ports and, on the right, the evolution of the capacity utilization rate at the main terminals throughout the year.

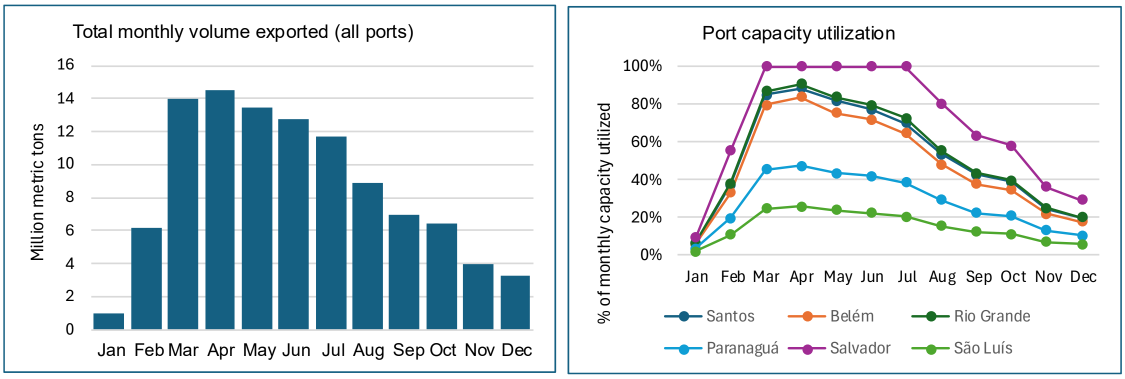

Figure 13 – Capricorn Route - Total monthly volume of soybean exported and capacity utilization of main ports.

Total volume surges from around 1 million metric tons in January to a peak of approximately 14.5 million metric tons in April—a period that concentrates the harvest across major producing regions—and gradually declines through December. Port capacity utilization follows this movement, but now with Santos assuming a more pronounced role. Between March and July, the port consistently operates above 70% capacity, approaching Rio Grande as one of the most strained terminals during the peak harvest. This behavior indicates that, under this data configuration, Santos no longer functions merely as a system safety valve as observed in previous rounds, but instead operates with a narrower margin during peak months, though without reaching critical saturation levels.

4.2 Corn

The seasonal pattern for corn is markedly different from that observed for soybean. The charts below (Figure 14) show, on the left, the total volume exported per month across all ports and, on the right, the evolution of the capacity utilization rate at the main terminals throughout the year.

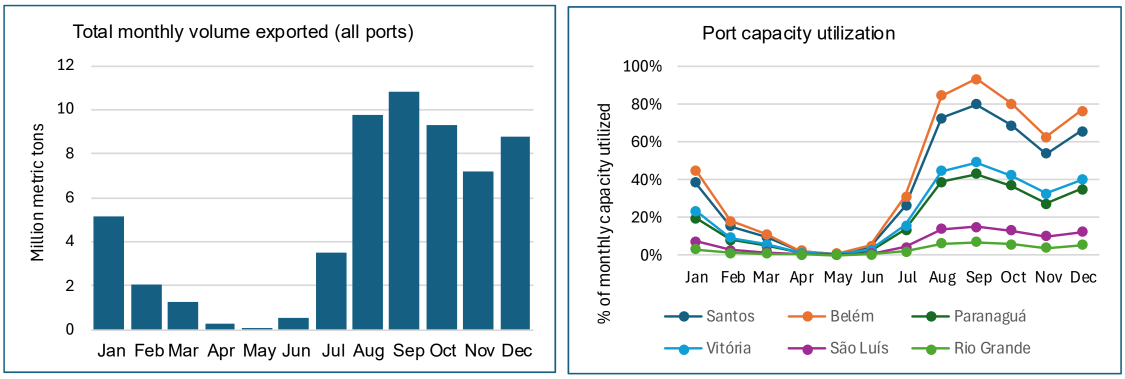

Figure 14 – Capricorn Route - Total monthly volume of corn exported and capacity utilization of main ports.

While soybean exports are concentrated between March and July, corn exports experience their weakest period during precisely these months. Between April and June, the volume moved is nearly zero, before intensifying sharply between August and December, peaking in September. This behavior is a direct reflection of the second crop (*safrinha*) calendar. Planted following the soybean harvest early in the year and harvested between June and August, its availability for export materializes only in the second half of the year. As a consequence, the pressure exerted by the two grains on port infrastructure occurs in virtually complementary windows throughout the year. This helps explain why the same ports (such as Santos and Belém) are able to serve both crops without their peak periods fully overlapping, even though a partial overlap exists between the end of the soybean cycle and the beginning of the corn peak.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being associated with any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

The methodology consisted of cross-referencing each port code across the three databases to standardize names, calculating each port's monthly capacity utilization rate (the ratio between volume moved and available capacity in a given month), and aggregating volumes by port, month, and state of origin based on the municipality code (IBGE) reported for each route. During this verification, the same uncataloged corridor identified in previous rounds was re-encountered, extending from southern Rio Grande do Sul to the vicinity of Montevideo, Uruguay, without being associated with any port. It is also worth noting that the distance traveled associated with export routes reflects the complete logistics journey to the destination market, including the inland transport segment to the port and the subsequent international maritime segment.

The methodology followed the same procedure applied in previous analyses: cross-referencing each port code across the three databases, calculating the monthly capacity utilization rate (the ratio between volume moved and available capacity in a given month), and aggregating volumes by port, month, and state of origin based on the municipality code (IBGE) for each route. As usual, the database includes four cataloged ports outside Brazil: Cartagena (Colombia), Callao (Peru), San Antonio (Chile), and Bahía Blanca (Argentina). In this round, detailed inspection of the geospatial network revealed no additional orphan corridors beyond the international stretches already included in the tabular database, reinforcing consistency between the geographic mapping and the capacity records used in the remainder of the report.

Neither corridor appears in the network of the other product, reinforcing that the final destination—Uruguay for soybean, Chile for corn—depends on the geographic origin of each shipment.

6. Social and Environmental Impacts

6.1 Soybean

The way soybean is transported to ports has relevant environmental implications, which warrant attention alongside the logistics analysis. The road network connecting producing regions in the Midwest to ports in the South and Southeast is predominantly highway-based—a mode that consumes more fuel and emits more greenhouse gases per metric ton transported than rail or waterway alternatives. The higher concentration of flow through Santos in this round reinforces the importance of monitoring access infrastructure to the port—highways, terminals, and storage facilities in the Baixada Santista, an ecologically sensitive estuarine region that is likely to experience growing environmental pressure as its share of exports increases. The corridor identified toward Uruguay maintains the same interpretation as in previous rounds: for producers in extreme southern Rio Grande do Sul, exporting production through a nearby Uruguayan port may represent a shorter travel distance than the journey to Brazilian terminals in the South, offering potential gains in logistics and environmental efficiency.

The seasonal concentration of outflow between March and July also has environmental and social ramifications in port cities. The significant increase in truck traffic during this period elevates local pollutant emissions and intensifies wear and tear on urban road infrastructure—particularly in Santos, which receives an even larger share of total flow in this round. Conversely, the reduced share for Paranaguá suggests a potential easing of environmental and operational pressure on that terminal and its estuarine region, the Paranaguá Bay. Overall, the scenario depicted by the data suggests that environmental efficiency gains in the soybean supply chain are likely to stem less from the simple expansion of port capacity and more from modal diversification and a more balanced distribution of flows among available terminals.

6.2 Corn

Just as with soybean, corn transport to ports relies heavily on highways over very long stretches between the Midwest and the coast. This translates into higher fuel consumption and greater greenhouse gas emissions per metric ton transported when compared to rail or waterway alternatives. The prominent role of the port of Belém in corn export flows reinforces the relevance of the Northern Arch (*Arco Norte*) as a route that combines shorter road segments with river transport along Amazonian rivers, reducing the total distance traveled by truck from farms in northern Mato Grosso and Pará, with significant potential environmental gains compared to traditional routes to the South and Southeast.

The concentration of outflow between August and December tends to generate, during this period, a significant increase in truck traffic on access highways to ports and greater pressure on port operations in cities such as Belém and Santos, impacting local pollutant emissions and urban infrastructure wear and tear. The existence of consolidated international routes to Pacific and Argentine ports signals a diversification of logistics corridors that, if expanded, can contribute to a better distribution of environmental and operational pressure across different regions, rather than concentrating it exclusively in traditional Brazilian ports. Overall, just as observed for soybean, the most consistent environmental gains tend to arise from modal diversification and a more balanced distribution of flows throughout the year, rather than solely from expanding installed port capacity.

In common, both diagnostics point toward the same strategic direction: road reliance over long distances is the main driver of environmental pressure in the supply chain; the Northern Arch emerges as the currently available alternative with lower relative impact; and the seasonal concentration of outflow—occurring in distinct windows for each crop—requires tailored traffic planning and mitigation during each peak, rather than investment in port capacity alone.

7. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Consolidated Report – Porto Alegre–Coquimbo Route

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 14 mapped ports. Corn moved 87.4 million metric tons, of which 58.3 million metric tons (67%) went through one of the 18 ports in its network.

Mato Grosso is the dominant origin for both commodities, accounting for approximately 38 million metric tons of soybean and 37 million metric tons of corn, making the state the most critical starting point of the continental network.

Soybean travels an average weighted distance of 15,735.49 km based on the volume transported, compared to 12,142.63 km for corn, and costs proportionally more per metric ton (BRL 908.76 vs. BRL 757.73). This difference reflects the relative weight of each product in long-distance export routes (Table 11).

Table 11 – Porto Alegre–Coquimbo Route - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87.4 Mt
Volume via ports	103 Mt (73%)	58.3 Mt (67%)
No. of mapped ports	14	18
Top origin state (UF)	Mato Grosso (~38 Mt)	Mato Grosso (~37 Mt)
Weighted average distance	15,735.49 km	12,142.63 km
Indicator	R$ 908.76/t	R$ 757.73/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors; for this reason, each product is presented on its own map.

2.1 Soybean

In Figure 15, an extremely dense network can be observed in the Center-South region of the country, reflecting the proximity among producing areas, highways, and the ports of Santos, Paranaguá, and Rio Grande. Meanwhile, flows heading toward Belém and São Luís, in the so-called Northern Arch (Arco Norte), appear as longer and less branched corridors.

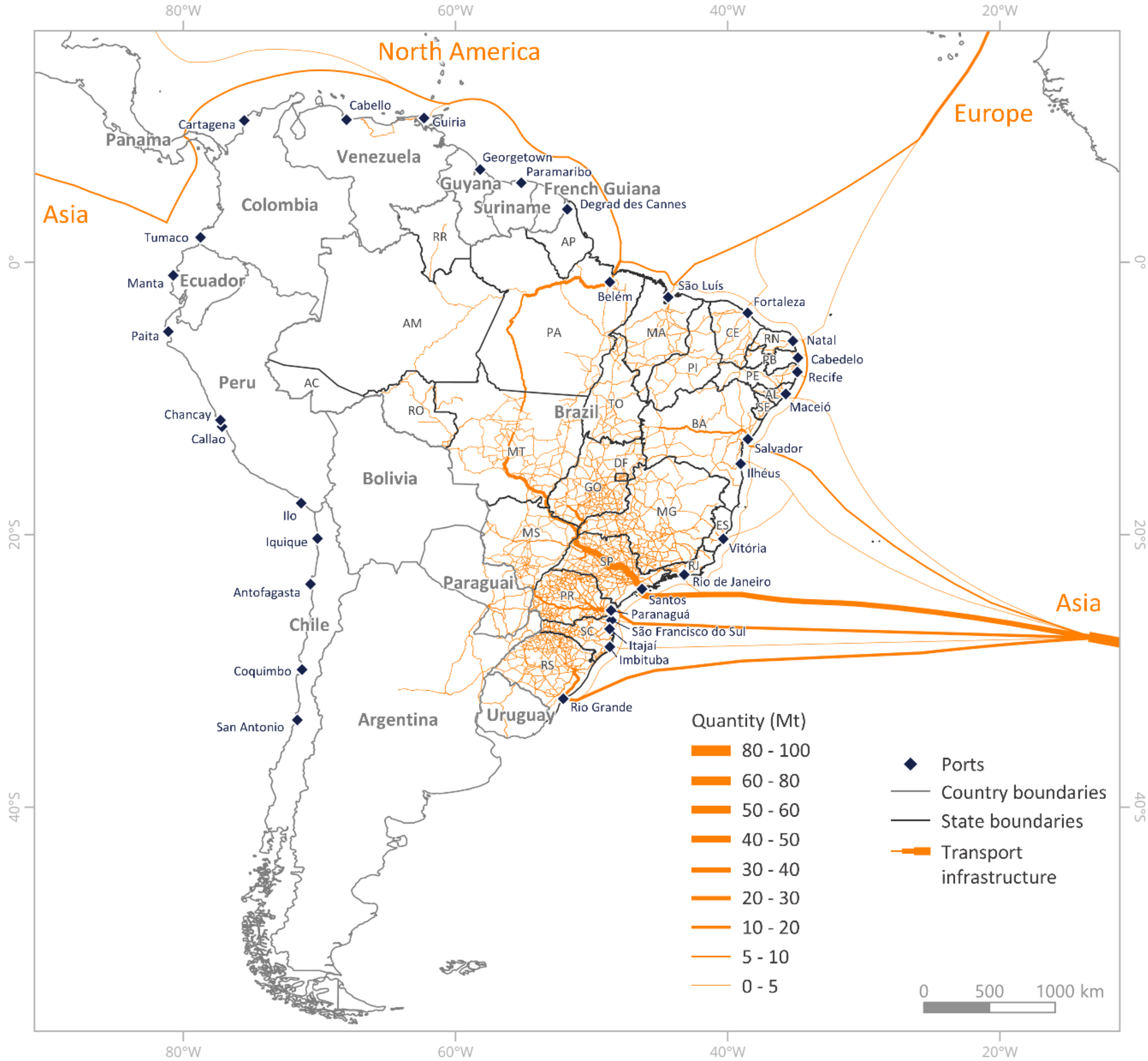

Figure 15 – Porto Alegre–Coquimbo Route - Soybean shipment routes to ports.

2.2 Corn

The following figure (Figure 16) was constructed from the geospatial database and illustrates the design of the corn transport network. A dense network can be observed in the Center-South region, converging toward Santos and Paranaguá, alongside a longer corridor heading toward Belém in the Northern Arch (*Arco Norte*). Routes extending beyond Brazil's borders also appear, reaching ports on the Pacific (Callao in Peru and San Antonio in Chile), in the Colombian Caribbean (Cartagena), and on the Argentine coast (Bahía Blanca).

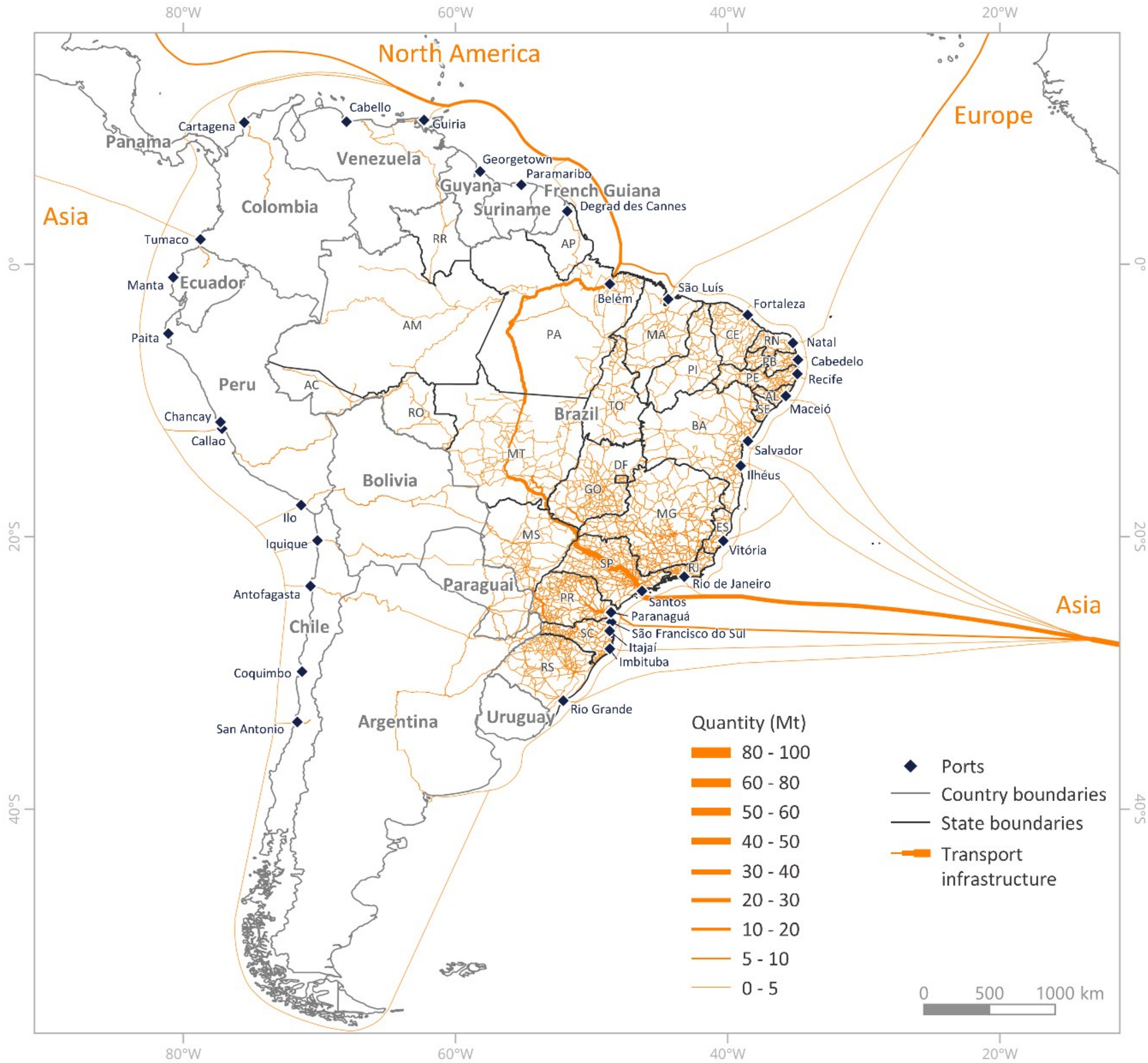

Figure 16 – Porto Alegre–Coquimbo Route - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The following table (Table 12) brings together, for the main ports of each product, the total volume moved during the year, the share of the total exported by the port network, and the average transport cost per metric ton, with soybean and corn side by side. The symbol "—" indicates that the port does not appear individually in the source table for that product, being included in the total for "Other ports".

Table 12 – Porto Alegre–Coquimbo Route - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	**Share**	**Cost (R$/t)**	**Vol. (Mt)**	**Share**	**Cost (R$/t)**
Santos	41.1	39.9%	496	30.7	52.7%	613
Belém	16.8	16.3%	861	15.0	25.7%	629
Rio Grande	15.7	15.3%	946	0.9	1.5%	813
Paranaguá	13.5	13.1%	837	7.0	12.0%	711
Salvador	6.2	6.0%	602	—	—	—
São Luís	3.9	3.8%	736	1.7	3.0%	394
Vitória	3.7	3.6%	653	1.9	3.3%	428
International ports	—	—	—	0.15	0.3%	483 to 805
Other ports	2.1	2.0%	424 to 1,131	0.7	1.2%	88 to 930

Santos leads the export of both commodities, but with different relative weight between them: it accounts for 39.9% of soybean and 52.7% of corn. Salvador appears only in the soybean network, whereas international ports appear only in the corn network.

In this round, the distribution of volumes among major ports returns to the pattern observed in initial analyses: Santos accounts for approximately 40% of the total exported, and Paranaguá regains a share of around 13%, well above the 9% observed in the previous round. This oscillation between different versions of the database—at times with Santos dominating even more heavily, and at times with a more balanced split between Santos and Paranaguá—suggests that the data may represent distinct scenarios or parameterizations of the same logistics system, rather than a single linear trend toward concentration.

Together, Santos and Belém account for approximately 78% of all corn exported by port, maintaining the pattern observed in previous rounds. Bahía Blanca in Argentina stands out for moving only about 30,000 metric tons in this round—considerably less than the values between 80,000 and 105,000 metric tons recorded in earlier analyses—indicating some variation in the attractiveness of this Argentine port from one round to another, without altering its marginal position within the overall network.

3. Port Dynamics and Shipping Capacity

A port's monthly shipping capacity is generally the same regardless of the product. It is the terminal's physical infrastructure that imposes the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each crop exerts on this shared capacity (Table 13).

Table 13 – Porto Alegre–Coquimbo Route - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Santos	7.137	48,0%	81,6%	35,9%	78,9%
Belém	2.928	47,8%	83,9%	42,6%	93,7%
Paranaguá	2.843	39,4%	67,1%	20,5%	45,8%
Rio Grande	2.456	53,4%	90,6%	3,0%	6,6%
São Luís	2.157	14,9%	25,5%	6,7%	15,0%
Salvador	747	69,4%	100%	4,9%	11,5%
Vitória	720	43,2%	73,2%	22,3%	49,7%
Imbituba	202	36,0%	61,0%	11,1%	32,6%

Belém is the most obvious case of a port under dual pressure: it reaches 83.9% of its capacity during the soybean peak and 93.7% during the corn peak—making it the most critical terminal in the network for both crops, albeit during different windows of the year. In practice, Salvador functions as a single-product port: it reaches 100% utilization during the soybean peak and barely exceeds 12% for corn. Santos and Paranaguá, two of the largest terminals in absolute capacity, maintain a relative capacity buffer across both products and act as safety valves for the system.

For soybean, the picture confirms a return to a more balanced pattern between Santos and Paranaguá. Santos operates at an average utilization of 48%—an intermediate level between the values observed in the two previous rounds (between 47.7% and 52.1%)—while Paranaguá recovers an average utilization of 39.4%, very close to the initial analysis. Rio Grande maintains the tightest operational pattern among the major ports, exceeding 90% capacity at the peak of the harvest, while Salvador continues to reach 100% capacity in certain months. Taken together with previous rounds, these results suggest that the network possesses a structural capacity buffer at Paranaguá that can be mobilized with relative flexibility, depending on the routing conditions adopted in each scenario.

For corn, average capacity utilization remains considerably lower than that recorded for soybean across virtually all ports—a direct reflection of the outflow being concentrated into a shorter window of the year. At the peak of the season, Belém remains the most strained port, operating at nearly 94% of its monthly capacity, the highest level among the major terminals. Santos, despite handling a larger absolute volume, reaches a more moderate peak utilization (79%), supported by its considerably larger installed capacity. Imbituba shows a lower average utilization than in previous rounds (11% compared to values around 16–17%), reinforcing that the fine distribution of volumes among smaller ports can vary from one round to another without altering the overall network picture.

4. Transport Seasonality

The charts below show, for each product, the total volume exported per month across all ports (on the left) and the evolution of the capacity utilization rate at the main terminals throughout the year (on the right).

4.1 Soybean

The total volume handled by the port network follows a highly distinct seasonal pattern associated with the soybean harvest calendar. The charts below (Figure 17) show, on the left, the total volume exported per month across all ports and, on the right, the evolution of the capacity utilization rate at the main terminals throughout the year.

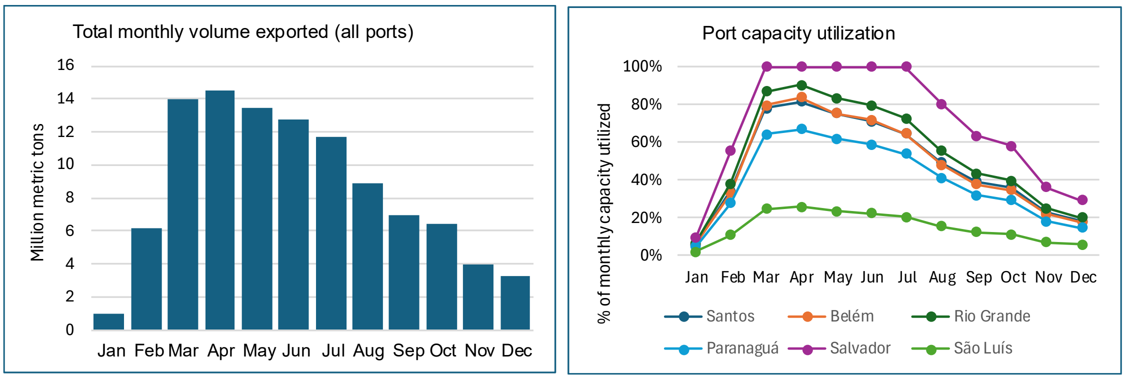

Figure 17 – Porto Alegre–Coquimbo Route - Total monthly volume of soybean exported and capacity utilization of main ports.

Total volume surges from around 1 million metric tons in January to a peak of approximately 14.5 million metric tons in April—a period that concentrates the harvest across major producing regions—and gradually declines through December. Port capacity utilization follows this movement, with Salvador, Rio Grande, and Belém among the most strained terminals during the peak harvest. Santos, with its large installed capacity, returns to functioning as a system safety valve in this round, absorbing a significant share of the seasonal pressure without approaching its operational ceiling as closely as it did in the previous version of the database.

4.2 Corn

The seasonal pattern for corn is markedly different from that observed for soybean. The charts below (Figure 18) show, on the left, the total volume exported per month across all ports and, on the right, the evolution of the capacity utilization rate at the main terminals throughout the year.

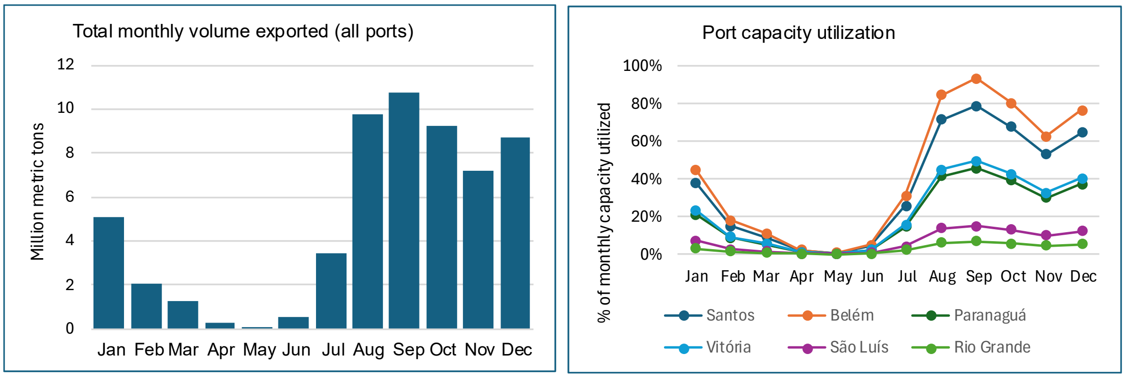

Figure 18 – Porto Alegre–Coquimbo Route - Total monthly volume of corn exported and capacity utilization of main ports.

While soybean exports are concentrated between March and July, corn exports experience their weakest period during precisely these months. Between April and June, the volume moved is nearly zero, before intensifying sharply between August and December, peaking in September. This behavior is a direct reflection of the second crop (*safrinha*) calendar. Planted following the soybean harvest early in the year and harvested between June and August, its availability for export materializes only in the second half of the year. As a consequence, the pressure exerted by the two grains on port infrastructure occurs in virtually complementary windows throughout the year. This helps explain why the same ports (such as Santos and Belém) are able to serve both crops without their peak periods fully overlapping.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being associated with any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

The combined analysis of transport routes, network geographic design, and port operational capacity allows for an integrated view of soybean logistics in the country. Compared to the immediately preceding round, this version of the data shows a return to a more balanced distribution between Santos and Paranaguá, while Rio Grande and Belém maintain stable roles as key complementary terminals across all versions analyzed thus far. Harvest seasonality continues to translate into port occupancy peaks, and the recurrence of the orphan corridor toward Uruguay—now observed for the third time with virtually identical routing and magnitude—reinforces the importance of considering this route as an effective part of the regional logistics network, alongside established diversification strategies such as the Northern Arch (*Arco Norte*).

The methodology followed the same procedure applied in previous analyses: cross-referencing each port code across the three databases, calculating the monthly capacity utilization rate (the ratio between volume moved and available capacity in a given month), and aggregating volumes by port, month, and state of origin based on the municipality code (IBGE) for each route. The database includes the four international ports observed in previous rounds: Cartagena (Colombia), Callao (Peru), San Antonio (Chile), and Bahía Blanca (Argentina). During this verification, the overland orphan corridor was also re-encountered—crossing the Brazilian Midwest, Paraguay, and northern Argentina to the Chilean coast near Antofagasta—with routing and volume virtually identical to those identified in the previous round, a finding consistent with the Bioceanic Road Corridor (*Corredor Rodoviário Bioceânico*).

6. Social and Environmental Impacts

Each product was evaluated separately regarding its social and environmental impacts in the source reports. The summaries below preserve this level of detail by crop, as the routes, peak months, and most sensitive ports differ between soybean and corn.

6.1 Soybean

The way soybean is transported to ports has relevant environmental implications, which warrant attention alongside the logistics analysis. The road network connecting producing regions in the Midwest to ports in the South and Southeast is predominantly highway-based—a mode that consumes more fuel and emits more greenhouse gases per metric ton transported than rail or waterway alternatives. The return of Paranaguá to a more balanced share relative to Santos in this round suggests a more even distribution of environmental and operational pressure between the two major terminals in the South and Southeast, which tends to be positive from the perspective of overall system resilience. The reconfirmation of the corridor identified toward Uruguay—now for the third time with the exact same routing and volume—reinforces the interpretation that this corridor represents a viable export alternative for producers in extreme southern Rio Grande do Sul, potentially shorter and more efficient than the journey to Brazilian terminals in the South.

The seasonal concentration of outflow between March and July also has environmental and social ramifications in port cities: the significant increase in truck traffic during this period elevates local pollutant emissions and intensifies wear and tear on urban road infrastructure, particularly at terminals operating close to their maximum capacity, such as Rio Grande and Salvador. Overall, the scenario depicted by the data suggests that environmental efficiency gains in the soybean supply chain are likely to stem less from the simple expansion of port capacity and more from modal diversification and a more balanced distribution of flows among available terminals—a distribution that, in this round, appears closer to what was observed in the initial analyses.

6.2 Corn

Just as with soybean, corn transport to ports relies heavily on highways over very long stretches between the Midwest and the coast. This translates into higher fuel consumption and greater greenhouse gas emissions per metric ton transported when compared to rail or waterway alternatives. The prominent role of the port of Belém in corn export flows reinforces the relevance of the Northern Arch (*Arco Norte*) as a route that combines shorter road segments with river transport along Amazonian rivers, reducing the total distance traveled by truck from farms in northern Mato Grosso and Pará. The reconfirmation of the Bioceanic Corridor to Antofagasta—with routing virtually identical to that of previous rounds—reinforces the interpretation that this corridor represents a real and potentially growing alternative to reduce transport distance between the Brazilian Midwest and Pacific markets, yielding environmental gains associated with lower total distance traveled.

The concentration of outflow between August and December tends to generate, during this period, a significant increase in truck traffic on access highways to ports and greater pressure on port operations in cities such as Belém and Santos, impacting local pollutant emissions and urban infrastructure wear and tear. The existence of consolidated international routes, combined with the reconfirmation of the Bioceanic Corridor, signals a trend toward logistics corridor diversification that, if expanded, can contribute to a better distribution of environmental and operational pressure across different regions and countries, rather than concentrating it exclusively in traditional Brazilian ports.

In common, both diagnostics point toward the same strategic direction: road reliance over long distances is the main driver of environmental pressure in the supply chain; the Northern Arch emerges as the currently available alternative with lower relative impact; and the seasonal concentration of outflow—occurring in distinct windows for each crop—requires tailored traffic planning and mitigation during each peak, rather than investment in port capacity alone.

7. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Consolidated Report – Guiana Islands Route

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 14 mapped ports. Corn moved 87.4 million metric tons, of which 58.3 million metric tons (67%) went through one of the 18 ports in its network.

Soybean travels an average weighted distance of 15,738.11 km based on the volume transported, compared to 12,144.06 km for corn, and costs proportionally more per metric ton (BRL 908.51 vs. BRL 756.93). This difference reflects the relative weight of each product in long-distance export routes (Table 14).

Table 14 – Guianas Route - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87.4 Mt
Volume via ports	103 Mt (73%)	58.3 Mt (67%)
No. of mapped ports	14	18
Top origin state (UF)	N/D	N/D
Weighted average distance	15,738.11 km	12,144.06 km
Weighted average cost	R$ 908.51/t	R$ 756.93/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors; for this reason, each product is presented on its own map, with line thickness indicating flow intensity along each segment.

2.1 Soybean

Figure 19 was constructed from the geospatial database and illustrates the design of the soybean transport network, with line thickness representing flow intensity along each segment. An extremely dense network can be observed in the Center-South region of the country, reflecting the proximity among producing areas, highways, and the ports of Santos, Paranaguá, and Rio Grande. Meanwhile, flows heading toward Belém and São Luís, in the so-called Northern Arch (*Arco Norte*), appear as longer and less branched corridors.

In this scenario, the corridor identified in previous rounds reemerges, originating from the extreme south of Rio Grande do Sul and continuing to the vicinity of Montevideo, in Uruguayan territory, totaling approximately 45,000 metric tons of cumulative annual flow—the exact same volume and routing observed across all previously analyzed versions of the soybean database. This marks the fourth time this corridor has been identified identically, virtually eliminating the hypothesis that it represents a point-in-time data inconsistency. It is also worth noting that the bioceanic corridor to Antofagasta and the corridor to French Guiana, both identified in the corn analyses, do not appear in any of the soybean database versions verified thus far. This cross-consistency between the two crops suggests that each alternative corridor is associated with a specific commodity: Uruguay for soybean from extreme southern Rio Grande do Sul, and the Chilean Pacific and French Guiana for corn from the Midwest and Amapá.

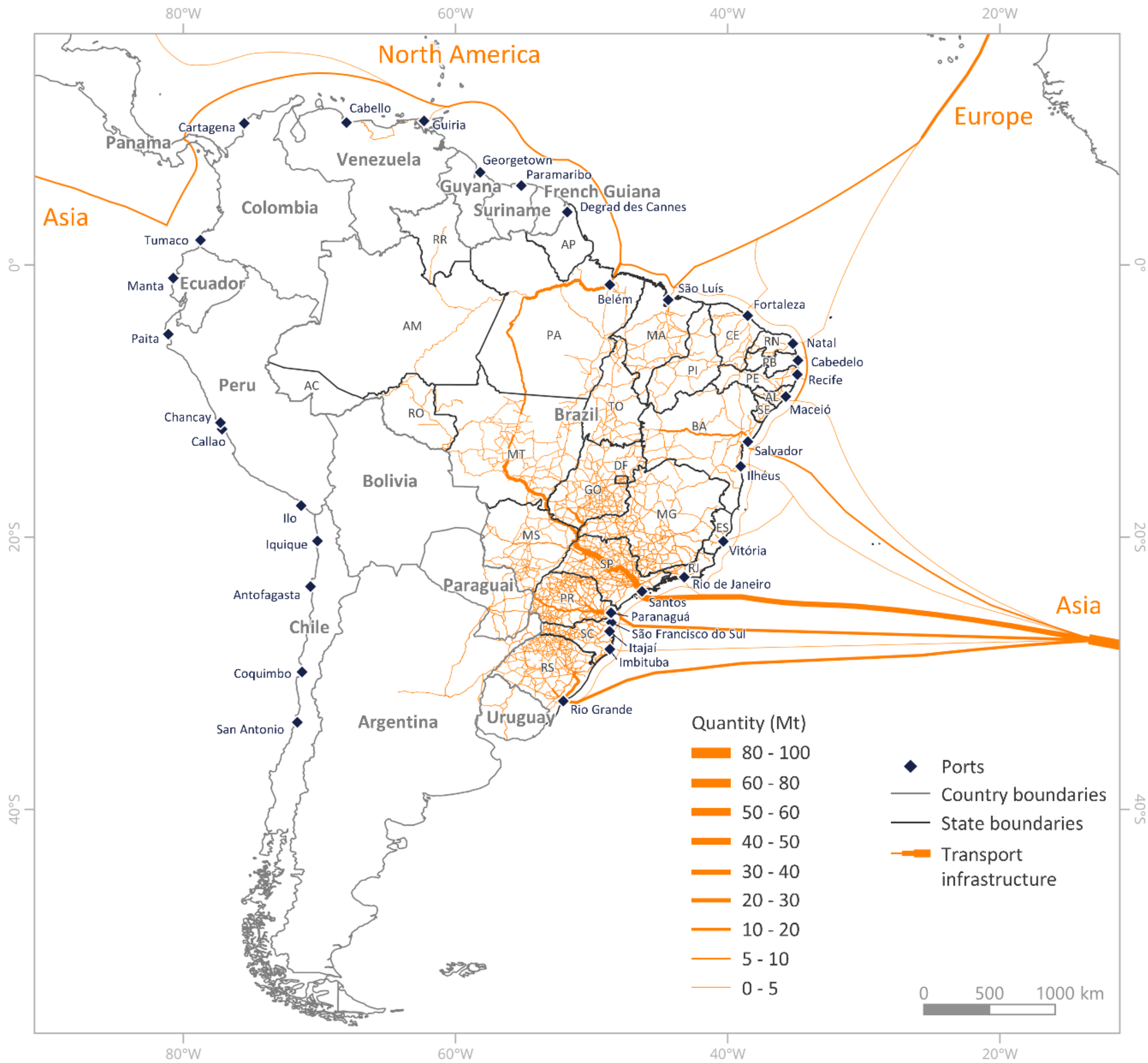

Figure 19 – Guianas Route - Soybean shipment routes to ports.

2.2 Corn

Figure 20 was constructed from the geospatial database and illustrates the design of the corn transport network. A dense network can be observed in the Center-South region, converging toward Santos and Paranaguá, alongside a longer corridor heading toward Belém in the Northern Arch (*Arco Norte*). Routes extending beyond Brazil's borders also appear, reaching ports on the Pacific (Callao in Peru and San Antonio in Chile), in the Colombian Caribbean (Cartagena), and on the Argentine coast (Bahía Blanca).

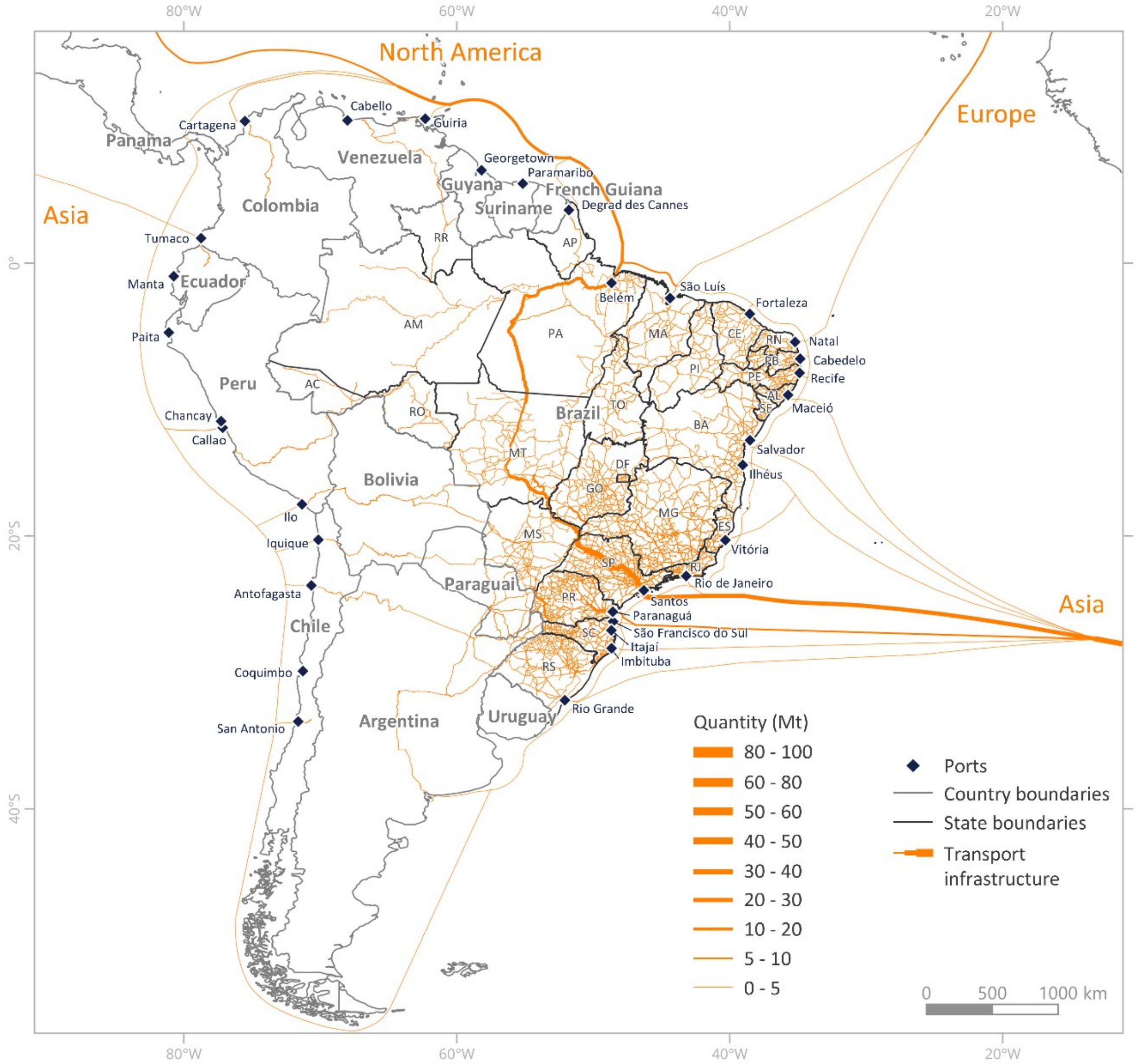

Figure 20 – Rota da Guianas - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The following table (Table 15) brings together, for the main ports of each product, the total volume moved during the year, the share of the total exported by the port network, and the average transport cost per metric ton, with soybean and corn side by side. The symbol "—" indicates that the port does not appear individually in the source table for that product, being included in the total for "Other ports".

Table 15 – Guianas Route - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	40.7	39.5%	577	30.6	52.5%	631
Belém	17.0	16.5%	861	15.0	25.7%	629
Rio Grande	16.0	15.6%	696	0.9	1.5%	916
Paranaguá	13.5	13.1%	850	7.0	12.0%	733
Salvador	6.2	6.0%	706	—	—	—
São Luís	3.9	3.8%	734	1.7	3.0%	393
Vitória	3.7	3.6%	655	1.9	3.3%	428
International ports	—	—	—	0.21	0.4%	453 to 805
Other ports	2.0	2.0%	424 to 1,172	0.7	1.2%	88 to 949

Santos leads the export of both commodities, but with different relative weight between them: it accounts for 39.5% of soybean and 52.5% of corn. Salvador appears only in the soybean network, whereas international ports appear only in the corn network.

In this round, the distribution of volumes among ports returns to the pattern observed in initial analyses: Santos holds approximately a 39.5% share and Paranaguá around 13%—a considerably more balanced relationship than recorded in the round where Santos concentrated over 50% of the flow. This reinforces the interpretation that different versions of the database represent distinct scenarios or parameterizations of the same logistics system, rather than a single trend of growing concentration at a single port.

Together, Santos and Belém account for approximately 78% of all corn exported by port, maintaining the pattern observed in previous rounds. The distribution among remaining ports also remains stable, reinforcing that the basic structure of the corn port network is consistent across the different versions of the database analyzed thus far.

3. Port Dynamics and Shipping Capacity

A port's monthly shipping capacity is generally the same regardless of the product. It is the terminal's physical infrastructure that imposes the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each crop exerts on this shared capacity (Table 16).

Table 16 – Guianas Route - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Santos	7,137	47.5%	80.8%	35.8%	78.8%
Belém	2,928	48.4%	84.9%	42.6%	93.9%
Paranaguá	2,843	39.4%	66.5%	20.5%	45.8%
Rio Grande	2,456	54.3%	92.8%	2.9%	6.7%
São Luís	2,157	14.9%	25.5%	6.7%	15.0%
Salvador	747	69.4%	100%	4.9%	11.5%
Vitória	720	43.2%	73.2%	22.3%	49.7%
Imbituba	202	48.7%	82.9%	16.1%	36.2%

Belém is the most obvious case of a port under dual pressure: it reaches 84.9% of its capacity during the soybean peak and 93.9% during the corn peak—making it the most critical terminal in the network for both crops, albeit during different windows of the year. In practice, Salvador functions as a single-product port: it reaches 100% utilization during the soybean peak and barely exceeds 12% for corn. Santos and Paranaguá, two of the largest terminals in absolute capacity, maintain a relative capacity buffer across both products and act as safety valves for the system.

For soybean, the picture confirms a return to a network with a more balanced buffer among major ports. Santos operates at an average utilization of 47.5%, very close to the values from initial analyses. Rio Grande maintains the tightest operational pattern among the major ports, exceeding 92% capacity at the peak of the harvest, while Salvador continues to reach 100% capacity in certain months, as do the smaller ports of Itajaí, Rio de Janeiro, and Recife, whose limited capacity renders them technically saturated with marginal volumes.

For corn, average capacity utilization remains considerably lower than that recorded for soybean across virtually all ports—a direct reflection of the outflow being concentrated into a shorter window of the year. At the peak of the season, Belém remains the most strained port, operating at nearly 94% of its monthly capacity, the highest level among the major terminals. Santos, despite handling a larger absolute volume, reaches a more moderate peak utilization (79%), supported by its considerably larger installed capacity.

4. Transport Seasonality

The charts below show, for each product, the total volume exported per month across all ports (on the left) and the evolution of the capacity utilization rate at the main terminals throughout the year (on the right).

4.1 Soybean

The total volume handled by the port network follows a highly distinct seasonal pattern associated with the soybean harvest calendar. The charts below (Figure 21) show, on the left, the total volume exported per month across all ports and, on the right, the evolution of the capacity utilization rate at the main terminals throughout the year.

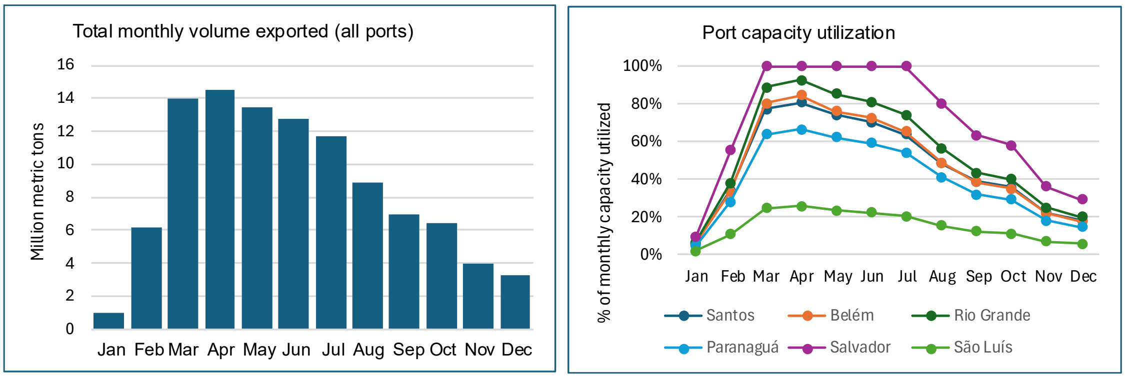

Figure 21 – Guianas Route - Total monthly volume of soybean exported and capacity utilization of main ports.

Total volume surges from around 1 million metric tons in January to a peak of approximately 14.5 million metric tons in April—a period that concentrates the harvest across major producing regions—and gradually declines through December. Port capacity utilization follows this movement, with Salvador, Rio Grande, and Belém among the most strained terminals during the peak harvest, while Santos, with its large installed capacity, returns to functioning as a system safety valve, absorbing a significant share of the seasonal pressure without approaching its operational ceiling.

4.2 Corn

The seasonal pattern for corn is markedly different from that observed for soybean. The charts below (Figure 22) show, on the left, the total volume exported per month across all ports and, on the right, the evolution of the capacity utilization rate at the main terminals throughout the year.

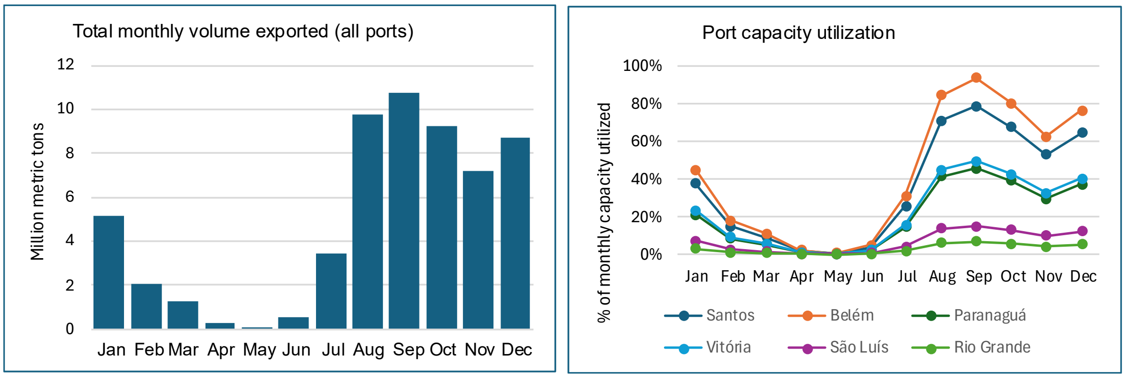

Figure 22 – Guianas Route - Total monthly volume of corn exported and capacity utilization of main ports.

While soybean exports are concentrated between March and July, corn exports experience their weakest period during precisely these months. Between April and June, the volume moved is nearly zero, before intensifying sharply between August and December, peaking in September. This behavior is a direct reflection of the second crop (*safrinha*) calendar. Planted following the soybean harvest early in the year and harvested between June and August, its availability for export materializes only in the second half of the year.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being associated with any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

The combined analysis of transport routes, network geographic design, and port operational capacity allows for an integrated view of soybean logistics in the country. This round confirms a return to a more balanced distribution between Santos and Paranaguá as observed in initial analyses, and the fourth consecutive reconfirmation of the orphan corridor toward Uruguay strongly reinforces the hypothesis that this is a real and stable route within the regional logistics network. The cross-absence of corn's exclusive corridors—Antofagasta and French Guiana—in the soybean data reinforces the interpretation that different agricultural crops tend to access distinct alternative corridors according to the location of producing regions and their relative proximity to each international border.

Highlighted in blue, the overland corridor reemerges—previously identified in a prior round—crossing the Brazilian Midwest, Paraguay, and northern Argentina to the Chilean coast near Antofagasta, with the same volume of approximately 450 metric tons, reinforcing the interpretation that it corresponds to a real infrastructure consistent with the Bioceanic Road Corridor (*Corredor Rodoviário Bioceânico*). A second uncataloged corridor also appears, observed here for the first time: a segment originating in Amapá, in extreme northern Brazil, and continuing overland to the vicinity of the border with French Guiana, with an annual cumulative flow on the order of a few hundred metric tons. This routing is consistent with outflow directed toward the port of Dégrad des Cannes in French Guiana. The combination of these two findings suggests that the geospatial network systematically contains nascent international corridors that have not yet been fully incorporated into the capacity tracking system.

Neither corridor appears in the other product's network, reinforcing that the final destination—Uruguay for soybean, Chile for corn—depends on the geographic origin of each shipment.

6. Social and Environmental Impacts

Each product was evaluated separately regarding its social and environmental impacts in the source reports. The summaries below preserve this level of detail by crop, as the routes, peak months, and most sensitive ports differ between soybean and corn.

6.1 Soybean

The way soybean is transported to ports has relevant environmental implications, which warrant attention alongside the logistics analysis. The road network connecting producing regions in the Midwest to ports in the South and Southeast is predominantly highway-based—a mode that consumes more fuel and emits more greenhouse gases per metric ton transported than rail or waterway alternatives. The fourth consecutive reconfirmation of the corridor toward Uruguay reinforces the interpretation that this route represents a viable and stable export alternative for producers in extreme southern Rio Grande do Sul, potentially shorter and more efficient than the journey to Brazilian terminals in the South, with the corresponding benefit of lower greenhouse gas emissions per metric ton transported.

The seasonal concentration of outflow between March and July also has environmental and social ramifications in port cities: the significant increase in truck traffic during this period elevates local pollutant emissions and intensifies wear and tear on urban road infrastructure, particularly in Santos, Paranaguá, and Belém—ecologically sensitive estuarine regions. Overall, the scenario depicted by the data suggests that environmental efficiency gains in the soybean supply chain are likely to stem less from the simple expansion of port capacity and more from modal diversification and a more balanced distribution of flows among available terminals, including alternative routes such as the one identified toward Uruguay.

6.2 Corn

Just as with soybean, corn transport to ports relies heavily on highways over very long stretches between the Midwest and the coast. This translates into higher fuel consumption and greater greenhouse gas emissions per metric ton transported when compared to rail or waterway alternatives. The prominent role of the port of Belém in corn export flows reinforces the relevance of the Northern Arch (*Arco Norte*) as a route that combines shorter road segments with river transport along Amazonian rivers. The reconfirmation of the bioceanic corridor to Antofagasta reinforces the potential to reduce transport distance to Pacific markets. Meanwhile, the corridor identified toward French Guiana adds a new dimension to this discussion. Because it traverses a region of preserved Amazon rainforest and Indigenous territories in extreme northern Amapá, any future expansion of this corridor will warrant heightened attention regarding impacts on forest cover and local populations, given the historical precedent of deforestation pressure associated with opening new road routes in the Amazon.

The concentration of outflow between August and December tends to generate, during this period, a significant increase in truck traffic on access highways to ports and greater pressure on port operations in cities such as Belém and Santos. The existence of multiple international corridors—some already consolidated, such as Cartagena, Callao, San Antonio, and Bahía Blanca, and others still in early stages, such as those identified to Antofagasta and French Guiana—signals a trend toward route diversification that, if managed with proper environmental care, can contribute to a better distribution of logistics pressure across different regions and countries.

In common, both diagnostics point toward the same strategic direction: road reliance over long distances is the main driver of environmental pressure in the supply chain; the Northern Arch emerges as the currently available alternative with lower relative impact; and the seasonal concentration of outflow—occurring in distinct windows for each crop—requires tailored traffic planning and mitigation during each peak, rather than investment in port capacity alone.

7. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Consolidated Report – Rondon Quadrant Route

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 14 mapped ports. Corn moved 87.4 million metric tons, of which 58.4 million metric tons (67%) went through one of the 18 ports in its network.

Soybean travels an average weighted distance of 15,739.33 km based on the volume transported, compared to 12,140.78 km for corn, and costs proportionally more per metric ton (BRL 905.04 vs. BRL 750.04). This difference reflects the relative weight of each product in long-distance export routes (Table 17).

Table 17 – Rondon Quadrant Route - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87.4 Mt

Indicator	Soybean	Corn
Volume via ports	103 Mt (73%)	58.4 Mt (67%)
No. of mapped ports	14	18
Top origin state (UF)	N/D	N/D
Weighted average distance	15,739.33 km	12,140.78 km
Weighted average cost	R$ 905.04/t	R$ 750.04/t

2. Transport Route Maps

2.1 Soybean

Figure 23 was constructed from the geospatial database and illustrates the design of the soybean transport network, with line thickness representing flow intensity along each segment. An extremely dense network can be observed in the Center-South region of the country, reflecting the proximity among producing areas, highways, and the ports of Santos, Paranaguá, and Rio Grande.

Highlighted in blue in the figure, the corridor identified in previous rounds reemerges, originating from the extreme south of Rio Grande do Sul and continuing to the vicinity of Montevideo, in Uruguayan territory, totaling approximately 45,000 metric tons of cumulative annual flow—the exact same volume and routing observed across all previous rounds of the soybean database. This marks the fifth consecutive time this corridor has been identified identically, making it practically certain that it represents a real and stable infrastructure within the regional logistics network.

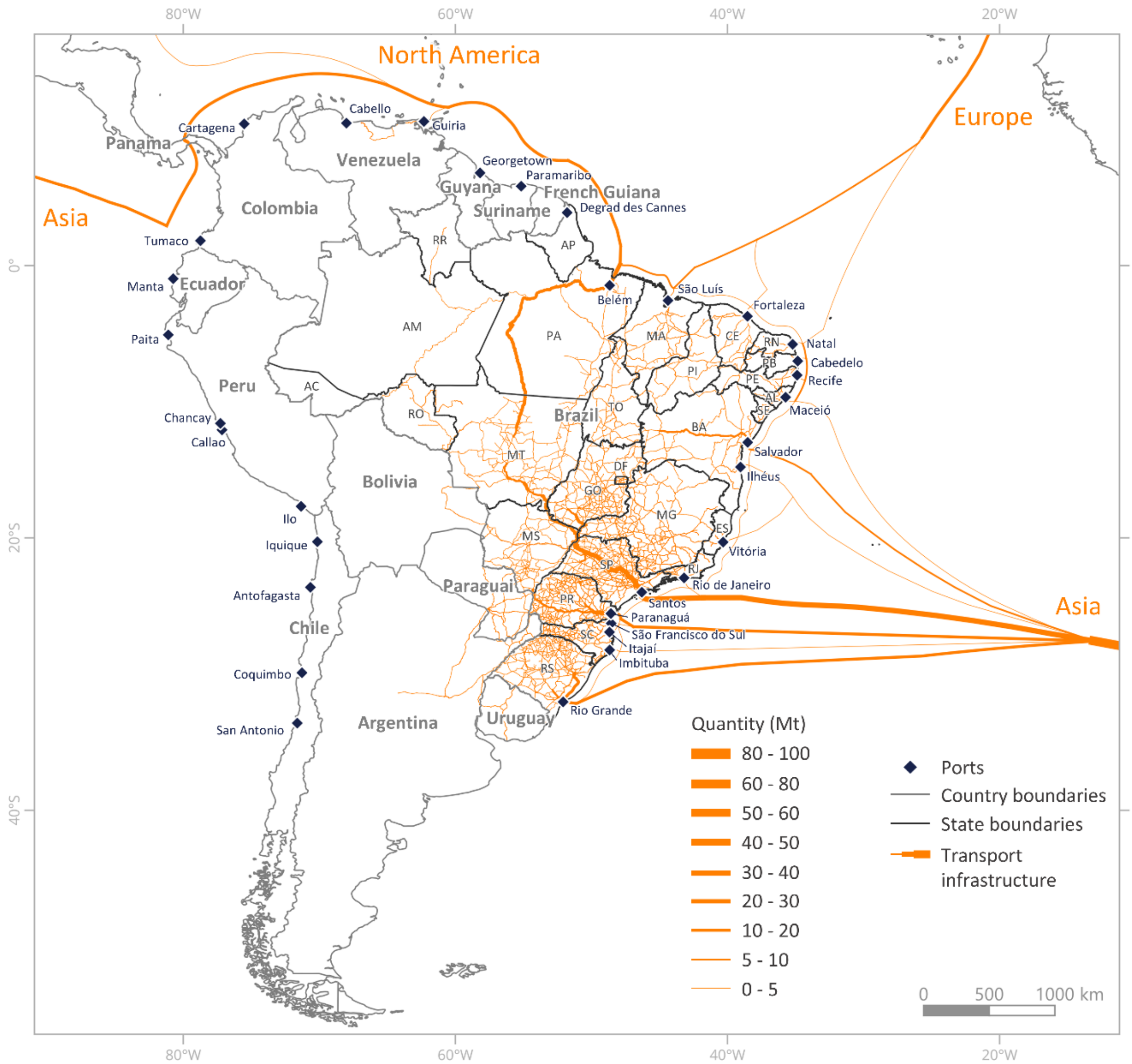

Figure 23 – Rondon Quadrant Route - Soybean shipment routes to ports.

2.2 Corn

Figure 24 was constructed from the geospatial database and illustrates the design of the corn transport network. A dense network can be observed in the Center-South region, converging toward Santos and Paranaguá, alongside a longer corridor heading toward Belém in the Northern Arch (*Arco Norte*), in addition to previously known routes reaching international ports such as Cartagena, Callao, San Antonio, and Bahía Blanca.

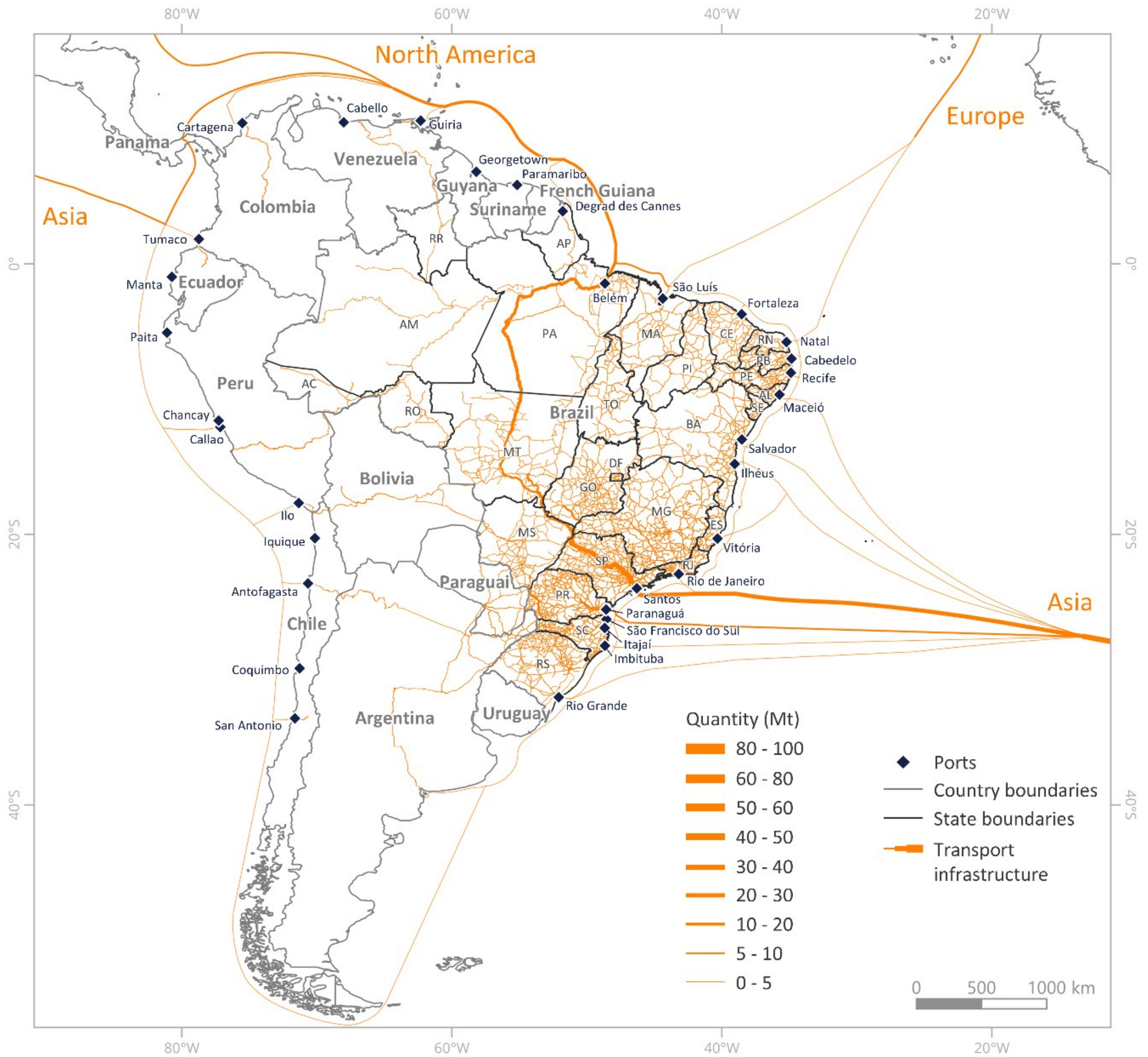

Figure 24 – Rondon Quadrant Route - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The following table (Table 18) brings together, for the main ports of each product, the total volume moved during the year, the share of the total exported by the port network, and the average transport cost per metric ton, with soybean and corn side by side. The symbol "—" indicates that the port does not appear individually in the source table for that product, being included in the total for "Other ports".

Table 18 – Rondon Quadrant Route - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	36.1	35.1%	570	27.3	46.7%	638
Belém	21.4	20.8%	869	18.2	31.2%	621

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Rio Grande	16.0	15.6%	697	0.9	1.5%	872
Paranaguá	13.4	13.1%	850	7.0	12.0%	731
Salvador	6.2	6.0%	703	—	—	—
São Luís	4.0	3.9%	738	1.7	2.8%	392
Vitória	3.7	3.6%	654	1.9	3.3%	430
Cartagena	—	—	—	0.21	0.4%	798
Other ports	2.0	2.0%	424 to 1,184	0.9	1.9%	88 to 949

Santos leads the export of both commodities, but with different relative weight between them: it accounts for 35.1% of soybean and 46.7% of corn. Salvador appears only in the soybean network, whereas Cartagena appears only in the corn network.

As observed in the equivalent corn analysis for this round, Belém surges to a 20.8% share of soybean exports (21.4 Mt)—the highest value ever recorded across all analyses conducted to date, surpassing the 16–16.5% typical of previous rounds. Santos, by contrast, retreats to 35.1%, the lowest share ever observed for this port in the soybean analysis series. This coincidence between soybean and corn patterns in this same round, both exhibiting a flow shift toward Belém, strongly suggests that the database represents a specific scenario of greater utilization of the Northern Arch (*Arco Norte*) for both crops simultaneously, rather than random variation between versions.

In this round, the distribution of volumes between Santos and Belém changes significantly. Belém surges to a 31.2% share (18.2 Mt)—the highest value observed in corn analyses conducted to date—while Santos retreats to 46.7%. Cartagena also draws attention, with a volume approximately double that observed in previous rounds (207.6 thousand metric tons, compared to values around 105 thousand metric tons). This flow shift toward the Northern Arch and Cartagena suggests a scenario in which the logistics network directs proportionally more corn to northern corridors, possibly reflecting different cost assumptions or capacity availability in this version of the data.

3. Port Dynamics and Shipping Capacity

A port's monthly shipping capacity is generally the same regardless of the product. It is the terminal's physical infrastructure that imposes the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each crop exerts on this shared capacity (Table 19).

Table 19 – Rondon Quadrant Route - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Santos	7,137	42.2%	73.1%	31.9%	76.1%
Belém	2,928	61.0%	100%	51.8%	100%
Paranaguá	2,843	39.4%	66.4%	20.5%	45.8%
Rio Grande	2,456	54.3%	92.7%	3.0%	6.7%
São Luís	2,157	15.5%	30.6%	6.4%	15.6%
Salvador	747	69.4%	100%	5.2%	12.0%
Vitória	720	43.2%	73.3%	22.3%	49.7%
Imbituba	202	48.7%	82.7%	17.7%	36.2%

Belém is the most evident case of a port under dual pressure: it reaches 100% of its capacity during the soybean peak and 100% during the corn peak—making it the most critical terminal in the network for both crops, albeit during different windows of the year. In practice, Salvador functions as a single-product port: it reaches 100% utilization during the soybean peak and barely exceeds 12% for corn. Santos and Paranaguá, two of the largest terminals in absolute capacity, maintain a relative capacity buffer across both products and act as safety valves for the system.

For soybean, the highlight of this round is Belém, which reaches 100% of its installed capacity during its peak month—the first recorded instance of full saturation for this port in the soybean analyses conducted to date, with an average utilization of 61% throughout the year, well above the 47–48% typical of previous rounds. This result is directly consistent with what was observed in the corn analysis for this same round, in which Belém also reaches 100% capacity during the peak of the second crop (*safrinha*). Santos, in turn, begins operating with a wider buffer than usual, peaking at just 73.1% of its capacity—the lowest value ever recorded for this port in the analysis series. Rio Grande maintains the tightest operational pattern among southern ports, exceeding 92% capacity at the peak of the harvest.

For corn, the highlight of this round is likewise Belém, which reaches 100% of its installed capacity during its peak month—the first instance of full saturation recorded for a major port in the corn analyses conducted to date, surpassing the 93–94% observed in previous rounds. With an average utilization of 51.8% throughout the year, Belém operates with a considerably tighter margin than Santos, whose average utilization drops to 31.9% in this version of the data. This reversal of roles, with the Northern Arch under greater pressure than the traditional Southeast corridor, represents an unprecedented configuration among the analyzed corn rounds and warrants attention as a potential signal of a scenario with greater reliance on northern port infrastructure.

4. Transport Seasonality

The charts below show, for each product, the total volume exported per month across all ports (on the left) and the evolution of the capacity utilization rate at the main terminals throughout the year (on the right).

4.1 Soybean

The total volume handled by the port network follows a highly distinct seasonal pattern associated with the soybean harvest calendar. The charts below (Figure 25) show, on the left, the total volume exported per month across all ports and, on the right, the evolution of the capacity utilization rate at the main terminals throughout the year.

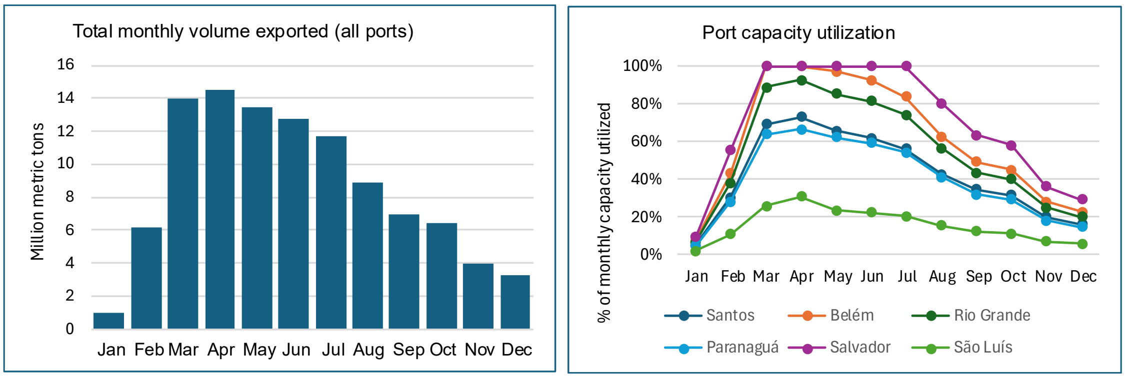

Figure 25 – Rondon Quadrant Route - Total monthly volume of soybean exported and capacity utilization of main ports.

Total volume surges from around 1 million metric tons in January to a peak of approximately 14.5 million metric tons in April, and then gradually declines through December. In this round, however, the pressure on Belém during the peak harvest is noticeably higher than observed in previous versions, with the port approaching or reaching its maximum capacity during the exact period of heaviest movement. This represents a reversal of the usual pattern, in which

Santos typically concentrates the greatest relative pressure among the major ports.

4.2 Corn

The seasonal pattern for corn is markedly different from that observed for soybean. The charts in Figure 26 show, on the left, the total volume exported per month across all ports and, on the right, the evolution of the capacity utilization rate at the main terminals throughout the year.

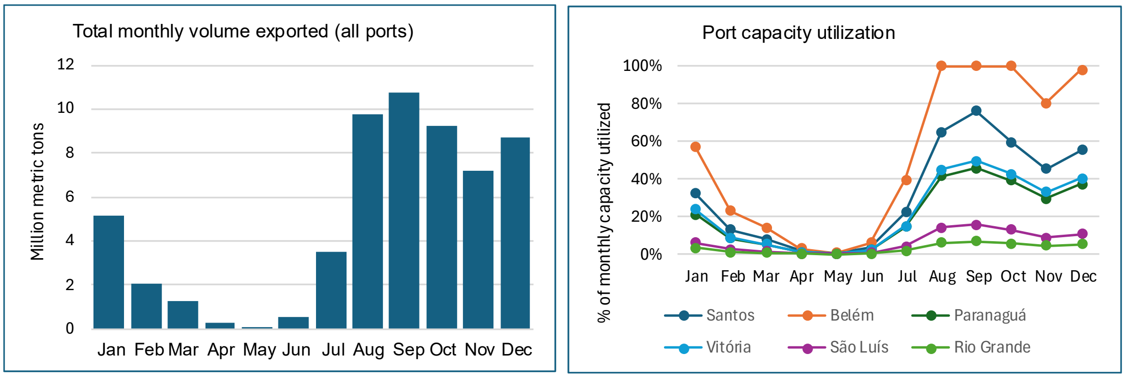

Figure 26 – Rondon Quadrant Route - Total monthly volume of corn exported and capacity utilization of main ports.

Corn export flows remain concentrated between August and December, peaking in September, reflecting the second crop (*safrinha*) calendar—cultivated in succession to soybean and harvested between June and August. In this round, however, the pressure on Belém during the peak harvest is noticeably higher than observed in previous versions, with the port reaching its maximum capacity during the exact period of heaviest movement. This indicates that, should this scenario of greater concentration in the Northern Arch (*Arco Norte*) be confirmed, Belém's infrastructure would operate without a safety margin during critical months.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

The higher concentration of flow through Belém in this round, for both soybean and corn, reinforces an environmental red flag already highlighted in the equivalent corn analysis. Operating an Amazonian port near its maximum capacity limit tends to intensify truck and vessel traffic in the region, creating potential pressure on Belém's urban infrastructure and surrounding estuarine ecosystems. The reconfirmation, for the fifth consecutive time, of the orphan corridor toward Uruguay maintains the interpretation previously recorded in earlier rounds. For producers in extreme southern Rio Grande do Sul, this route can represent a shorter travel distance than the journey to southern Brazilian terminals, yielding potential gains in both logistics and environmental efficiency.

The bioceanic corridor to Antofagasta, Chile—crossing the Brazilian Midwest, Paraguay, and northern Argentina—is reconfirmed with the same volume of approximately 450 metric tons observed in the previous round. The corridor to French Guiana, originating in Amapá, is also reconfirmed with the exact same routing. A third corridor, identified for the first time in this round, features a segment traversing interior Bolivia, passing near Cochabamba, and extending to the vicinity of the port of Ilo on Peru's southern coast, accounting for nearly 12,000 metric tons of cumulative annual flow. This routing is consistent with the Southern Interoceanic Highway (*Corredor Rodoviário Interoceânico Sul*), an integration project connecting western Brazil (including Rondônia, as suggested by the file name) to the Peruvian Pacific coast through Bolivian territory. It is the highest-volume orphan corridor identified to date across all analyses performed, easily surpassing both Antofagasta and French Guiana.

6. Social and Environmental Impacts

Each product was evaluated separately regarding its social and environmental impacts in the source reports. The summaries below preserve this level of detail by crop, as the routes, peak months, and most sensitive ports differ between soybean and corn.

6.1 Soybean

The higher concentration of flow through Belém in this round, for both soybean and corn, reinforces an environmental red flag already highlighted in the equivalent corn analysis. Operating an Amazonian port near its maximum capacity limit tends to intensify truck and vessel traffic in the region, creating potential pressure on Belém's urban infrastructure and surrounding estuarine ecosystems. The reconfirmation, for the fifth consecutive time, of the uncataloged corridor toward Uruguay maintains the interpretation previously recorded in earlier rounds: for producers in extreme southern Rio Grande do Sul, this route can represent a shorter travel distance than the journey to southern Brazilian terminals, yielding potential gains in both logistics and environmental efficiency.

The seasonal concentration of outflow between March and July continues to generate, during this period, a significant increase in truck traffic on access highways to ports. In this round, this effect combines with an additional pressure on Belém, which becomes the most operationally critical port in the network for both soybean and corn—a pattern that, if persistent, would warrant heightened attention to infrastructure planning and environmental mitigation in the Northern Arch (*Arco Norte*) region.

6.2 Corn

The higher concentration of flow through Belém in this round reinforces the relevance of the Northern Arch (*Arco Norte*) as a logistics corridor, but also raises an environmental red flag. Operating an Amazonian port near its maximum capacity limit tends to intensify truck and vessel traffic in the region, creating potential pressure on Belém's urban infrastructure and surrounding estuarine ecosystems. The corridor identified through Bolivia to the port of Ilo adds a new potential export route to Pacific markets; however, its path traverses Bolivian territory and transition zones between the Cerrado and the Amazon—regions that warrant heightened attention regarding the impacts of any potential road infrastructure expansion on vegetation cover and local communities on both the Brazilian and Bolivian sides.

The reconfirmation of the corridors to Antofagasta and French Guiana, coupled with the identification of the new corridor via Bolivia, reinforces a recurring pattern across the analyses conducted. The geospatial network consistently documents multiple international routes at varying stages of maturity, distinct from the four international ports already consolidated in the tabular database. From an environmental perspective, route diversification can be positive if managed in a planned manner by distributing logistics pressure across different regions. However, it can also expand the impact frontier if the growth of these routes is not accompanied by adequate environmental safeguards, particularly in the Amazonian and Andean portions of the identified corridors.

In common, both diagnostics point toward the same strategic direction: road reliance over long distances is the main driver of environmental pressure in the supply chain; the Northern Arch emerges as the currently available alternative with lower relative impact; and the seasonal concentration of outflow—occurring in distinct windows for each crop—requires tailored traffic planning and mitigation during each peak, rather than investment in port capacity alone.

7. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Consolidated Report – Transoceanic (Bioceanic) Railway

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 16 mapped ports. Corn moved 87.4 million metric tons, of which 58.3 million metric tons (67%) went through one of the 19 ports in its network.

Soybean travels an average weighted distance of 12,093.63 km based on the volume transported, compared to 12,140.78 km for corn, and costs proportionally more per metric ton (BRL 756.91 vs. BRL 750.04). This difference reflects the relative weight of each product in long-distance export routes (Table 20).

Table 20 – Transoceanic (Bioceanic) Railway - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87.4 Mt
Volume via ports	103 Mt (73%)	58.3 Mt (67%)
No. of mapped ports	16	19
Top origin state (UF)	N/D	N/D

Indicator	Soybean	Corn
Weighted average distance	12,093.63 km	12,140.78 km
Weighted average cost	R$ 756.91/t	R$ 750.04/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors. For this reason, each product is presented on its own map, with line thickness indicating the flow intensity along each segment.

2.1 Soybean

Figure 27 shows the soybean export network, with line thickness proportional to the flow intensity along each segment.

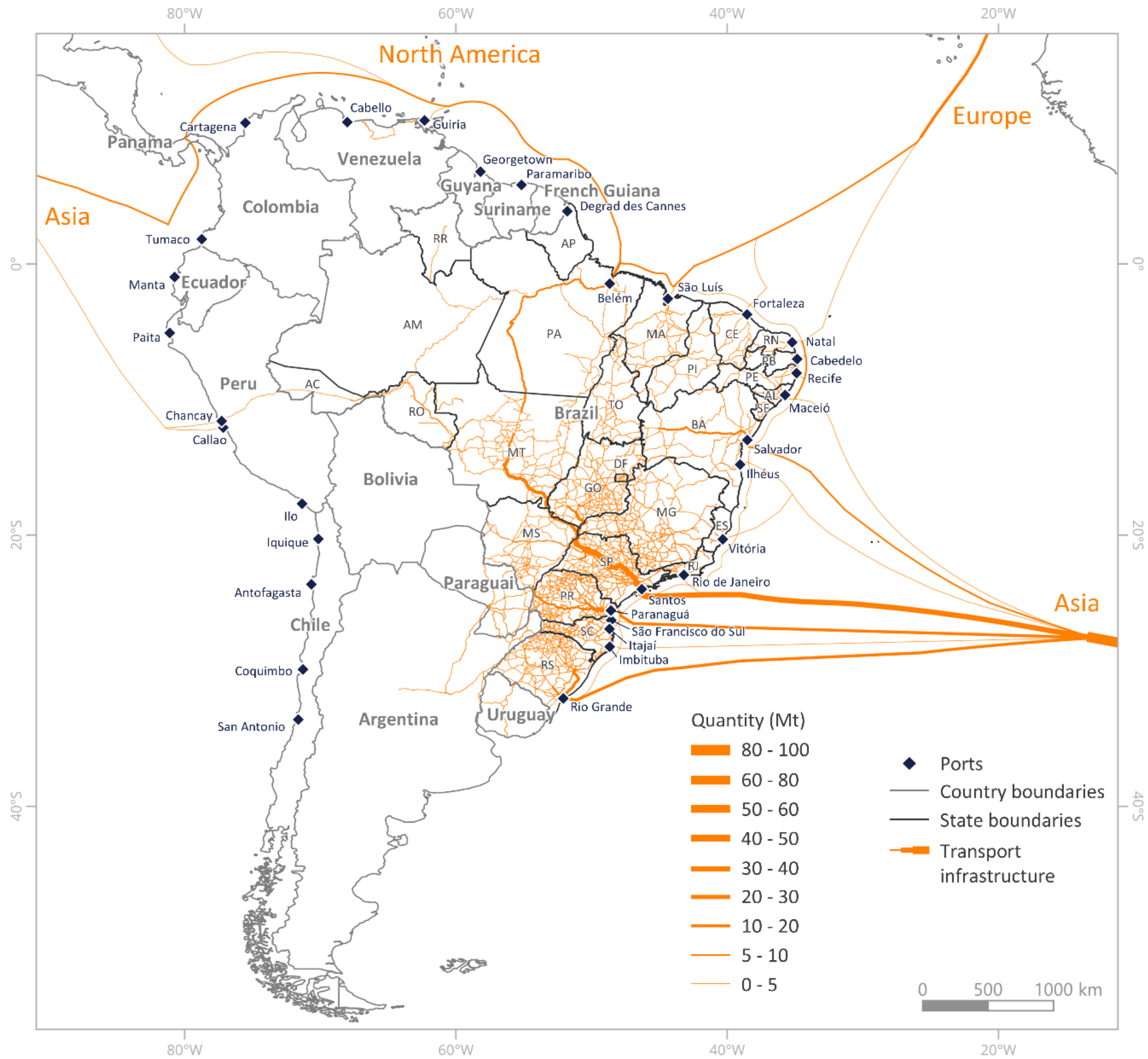

Figure 27 – Transoceanic (Bioceanic) Railway - Soybean shipment routes to ports.

2.2 Corn

Figure 28 shows the corn export network, with line thickness proportional to the flow intensity along each segment.

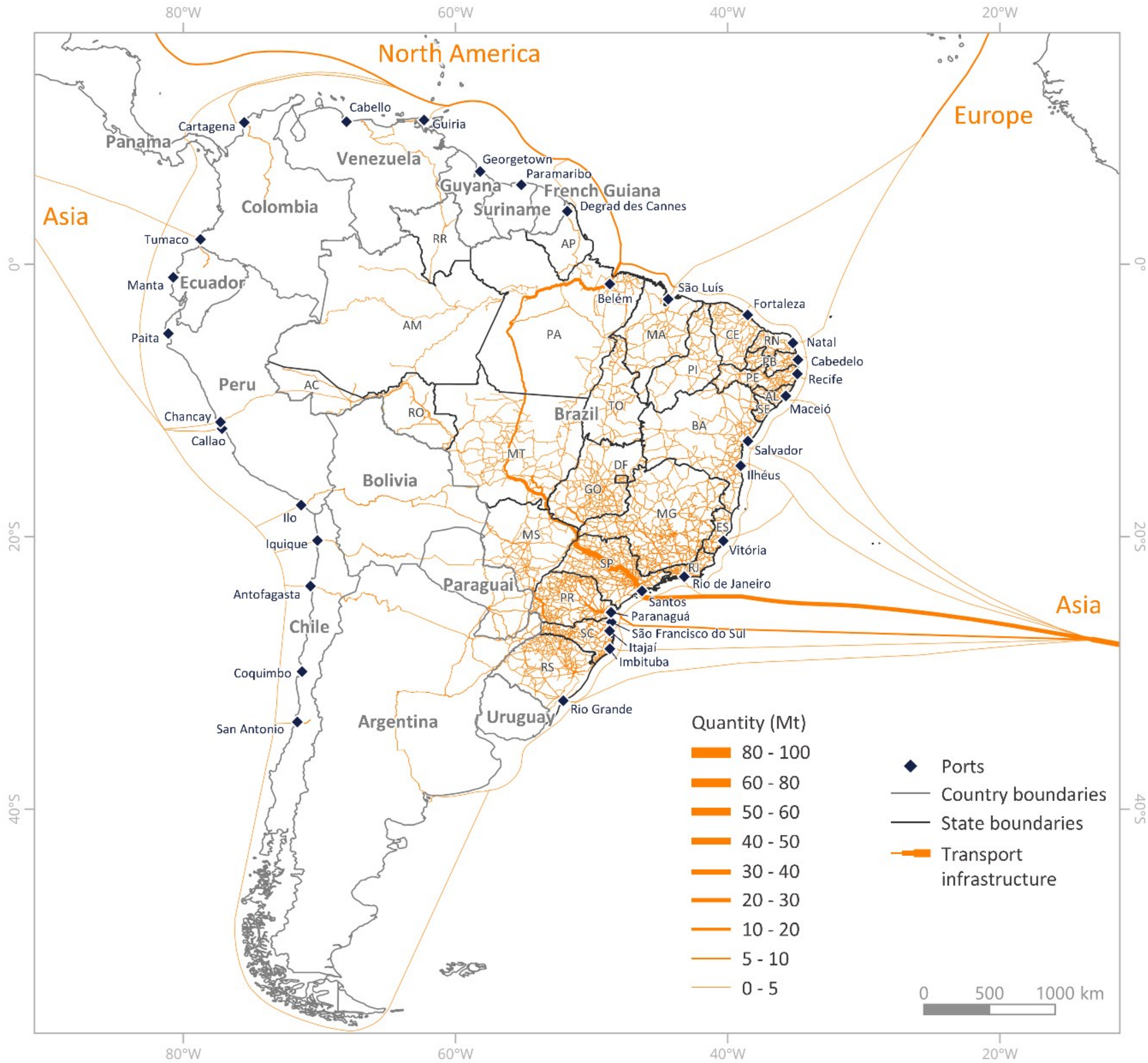

Figure 28 – Transoceanic (Bioceanic) Railway - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The following table (Table 21) brings together, for the main ports of each product, the total volume moved during the year, the share of the total exported by the port network, and the average transport cost per metric ton, with soybean and corn side by side. The symbol "—" indicates that the port does not appear individually in the source table for that product, being included in the total for "Other ports".

Table 21 – Transoceanic (Bioceanic) Railway - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	39.9	38.7%	670	30.4	52.2%	649
Rio Grande	16.1	15.6%	602	0.9	1.5%	849
Belém	16.1	15.6%	827	13.7	23.5%	603
Paranaguá	13.5	13.1%	818	7.0	12.0%	729
Salvador	6.2	6.0%	698	—	—	—
São Luís	3.9	3.8%	728	1.7	3.0%	394
Vitória	3.7	3.6%	652	1.9	3.3%	430
Callao (PE)	1.2	1.2%	1.382	0.97	1.7%	1,279
Chancay (PE)	0.28	0.3%	1.366	0.26	0.4%	1,388
Other ports	2.1	2.0%	424 to 1,172	1.3	2.3%	88 to 804

Santos leads the export of both commodities, but with different relative weight between them: it accounts for 38.7% of soybean and 52.2% of corn. Salvador appears only in the soybean network.

As observed in the equivalent corn analysis for this round, Peruvian ports emerge with volumes that remain small compared to major Brazilian terminals, but they already represent a measurable share of export flows. Together, Callao and Chancay account for nearly 1.5 million metric tons of soybean, with an average transport cost well above average—exceeding BRL 1,300 per metric ton, reflecting the distance traveled to the Pacific coast. Among traditional ports, the distribution remains close to that observed in the earliest soybean rounds, with Santos concentrating roughly 39% of the total, while Rio Grande and Belém share second position.

The most striking data point in this table is the sharp increase in Callao's volume, which jumps from marginal values around 12 thousand metric tons in previous rounds to nearly 1 million metric tons—an almost 80-fold growth. Chancay, even while operating with a still-modest volume (260 thousand metric tons), emerges as a relevant port upon its debut in the database. Both Peruvian ports exhibit average transport costs well above average, exceeding BRL 1,200 per metric ton—an expected outcome given that they serve origins located at great distances, traversing virtually the entire South American continent to reach the Pacific coast.

3. Port Dynamics and Shipping Capacity

A port's monthly shipping capacity is generally the same, regardless of the product. It is the terminal's physical infrastructure that imposes the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each crop exerts on this shared capacity (Table 22).

Table 22 – Transoceanic (Bioceanic) Railway - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Santos	7,137	46.6%	80.5%	35.5%	78.8%
Belém	2,928	45.7%	80.9%	39.0%	88.8%
Paranaguá	2,843	39.6%	66.1%	20.5%	45.8%
Rio Grande	2,456	54.6%	92.8%	—	—
Chancay (PE)	23	100%	100%	93.9%	100%
Callao (PE)	124	83.9%	100%	65.3%	100%
Salvador	747	69.4%	100%	—	—
Vitória	720	43.2%	73.2%	22.3%	49.7%
Cartagena (CO)	34	—	—	58.7%	100%
São Luís	2,157	—	—	6.7%	15.0%

Chancay (PE) is the most evident case of a port under dual pressure: it reaches 100% capacity during the soybean peak and 100% during the corn peak—making it the most critical terminal in the network for both crops, albeit during different windows of the year. Santos and Belém, two of the largest terminals in absolute capacity, maintain a relative capacity buffer across both products and act as safety valves for the system.

For soybean, the most striking result in this table is Chancay, operating at 100% of its capacity in all twelve months of the year—a full, continuous saturation without any seasonal buffer, unlike the pattern observed across all other ports analyzed to date. Callao accompanies this pressure with an average utilization of 83.9%, also hitting its capacity ceiling in several months. This operational behavior is even more extreme than that observed in the corn analysis for the same round, in which Chancay operated at an average of 93.9%. Here, soybean appears to occupy the port's capacity fully, suggesting that in this version of the data, the Peruvian Pacific corridor is already at its absolute operational limit for both crops.

For corn, the picture reveals an uncommon situation. The small Peruvian ports operate under extreme pressure, well above that observed at any Brazilian terminal. Chancay reaches an average utilization of 93.9% throughout the entire year, almost perpetually at the limit of its monthly capacity of just 23,000 metric tons. Callao, with a slightly larger capacity, operates at an average of 65.3% capacity, but reaches 100% in several months of the year. This pattern suggests that, in this version of the data, the Peruvian Pacific corridor is already operating at the limit of its current infrastructure—even with absolute volumes that remain small compared to major Brazilian ports—an indication that any future expansion of flow along this route would depend on additional investment in port capacity.

4. Transport Seasonality

The charts below show, for each product, the total volume exported per month across all ports (on the left) and the evolution of the capacity utilization rate at the main terminals throughout the year (on the right).

4.1 Soybean

The total volume handled by the port network follows the already familiar seasonal pattern associated with the soybean harvest calendar. The charts below (Figure 29) show, on the left, the total volume exported per month across all ports and, on the right, the evolution of the capacity utilization rate in Santos, Rio Grande, Belém, and the two Peruvian ports.

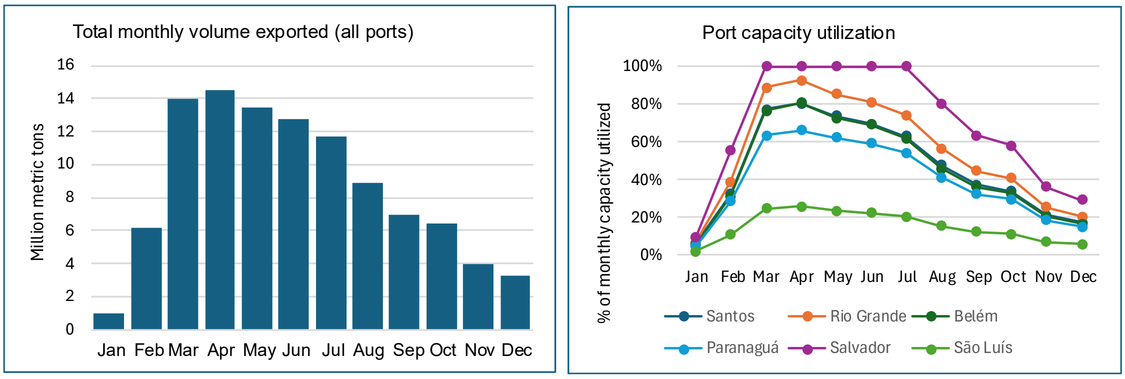

Figure 29 – Transoceanic (Bioceanic) Railway - Total monthly volume of soybean exported and capacity utilization of main ports.

The chart on the right shows Chancay as a constant line at the top of the graph, pinned at 100% throughout the entire year—a behavior that does not follow harvest seasonality, suggesting that the port already operates at its capacity limit regardless of the volume available for export in any given month. Callao follows a similar pattern, albeit with slight slack in certain months. This contrasts sharply with major Brazilian ports, whose utilization closely matches the seasonal cycle of the harvest, peaking between March and July with pronounced troughs during the rest of the year.

4.2 Corn

The seasonal pattern for corn is markedly different from that observed for soybean. The charts below (Figure 30) show, on the left, the total volume exported per month across all ports and, on the right, the evolution of the capacity utilization rate in Santos, Belém, Paranaguá, and the two Peruvian ports.

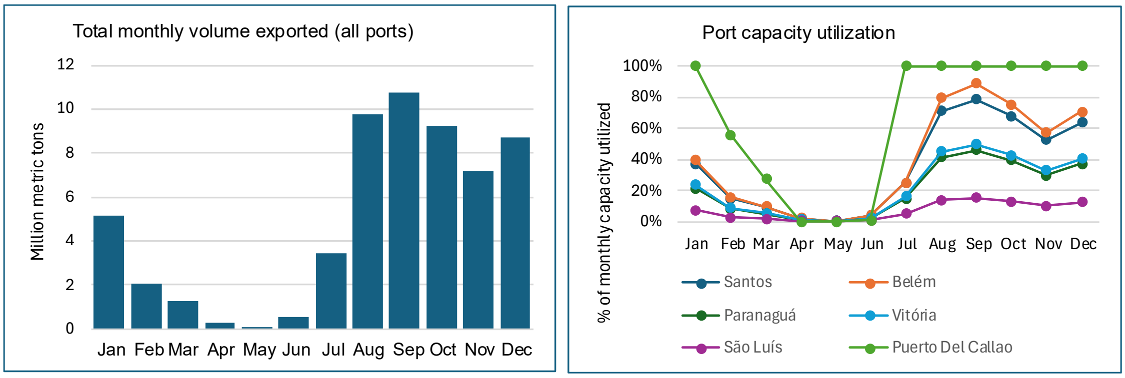

Figure 30 – Transoceanic (Bioceanic) Railway - Total monthly volume of corn exported and capacity utilization of main ports.

The chart on the right highlights the atypical behavior of the Peruvian ports. Chancay operates at, or very close to, 100% capacity during virtually every month of the year—with a single significant dip in May, matching the low-volume pattern observed across other ports during corn's seasonal trough. Callao follows a similar dynamic, albeit with a slightly smoother curve, reaching 100% capacity in January, February, and during the peak period between July and December. This contrasts with Santos and Belém, which, despite handling much larger volumes in absolute terms, operate with a relative capacity buffer throughout the year.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being linked to any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

For soybean, this round confirms the same structural shift observed in the equivalent corn analysis: the integration of Chancay and Callao into the monitored logistics network, with both Peruvian ports operating under capacity pressure far higher than that observed at Brazilian terminals. Chancay, in particular, remains saturated throughout all twelve months of the year. The fifth consecutive reconfirmation of the uncataloged corridor toward Uruguay reinforces the stability of this route as a specific feature of the soybean logistics network, distinct from the corn-exclusive corridors identified in previous rounds. Taken together, these findings suggest an international logistics network that is more diversified and dynamic than what is captured by traditionally monitored ports, with the Peruvian Pacific corridor emerging as a priority focus for future capacity investments.

This round brings the most structural shift observed to date in the corn analyses: the integration of Chancay—the new Peruvian megaport built with Chinese investment—into the monitored logistics network, accompanied by a sharp surge in volume at the neighboring port of Callao. Both ports operate under capacity pressure far exceeding that seen at Brazilian terminals, signaling that the Peruvian Pacific corridor, while still accounting for a small fraction of total exports, is already operating at the limit of its current infrastructure. The reconfirmation, with varying intensities, of the orphan corridors to Antofagasta, French Guiana, and via Bolivia to Ilo reinforces the existence of an international logistics network richer and more dynamic than that captured by traditionally monitored ports, carrying growing implications for infrastructure planning and the environmental impact analysis associated with these emerging routes.

Neither corridor appears in the other product's network, underscoring that the final destination—Uruguay for soybean, Peru for corn—depends on the geographical origin of each cargo.

6. Social and Environmental Impacts

Each product was evaluated separately regarding its social and environmental impacts in the source reports. The summaries below preserve this level of detail by crop, as the routes, peak months, and most sensitive ports differ between soybean and corn.

6.1 Soybean

The full, continuous saturation of Chancay throughout the entire year, for both soybean and corn, is a critical signal for logistics planning. Even with absolute volumes that remain small compared to major Brazilian ports, the port no longer possesses operational margin to absorb demand increases without additional investment in capacity. From an environmental perspective, access to Chancay and Callao from Midwest producing regions depends on ultra-long-distance overland routes, which significantly elevates the carbon footprint per metric ton transported compared to traditional ports in the South and Southeast—unless these cargoes move through partially waterway or railway corridors not yet fully mapped in this database.

Overall, route diversification—encompassing both established corridors and emerging ones, such as the Peruvian Pacific—can contribute to distributing logistics and environmental pressure across different regions, provided it is accompanied by adequate infrastructure investment at bottlenecks already operating at their limit, such as Chancay.

6.2 Corn

Chancay's entry into the logistics network of Brazilian agribusiness warrants special attention from an environmental and geopolitical standpoint. As a direct hub for trade with Asia, the port reduces the need for intermediate calls and, in theory, can shorten the total distance traveled by cargoes bound for Asian markets, with potential gains in energy efficiency per metric ton transported. On the other hand, the fact that the port is already operating near saturation—even with volumes from Brazil that remain small—suggests that any future expansion of this flow would depend on new port infrastructure investments in Peru, with corresponding impacts along the Peruvian coast. On the Brazilian side, access to Chancay and Callao from the Midwest relies on ultra-long-distance overland routes traversing Bolivian territory, reinforcing the environmental significance of the highway corridor identified through Bolivia in this and previous rounds.

The reconfirmation of the corridors to Antofagasta and French Guiana, with varying intensity across rounds, reinforces the findings already recorded in previous analyses. The geospatial network consistently documents multiple international routes at different stages of maturity. The arrival of Chancay as a fully cataloged port illustrates how South American logistics infrastructure is undergoing a transformation, with the potential to redistribute flows and, consequently, shifting patterns of environmental pressure throughout the export supply chain of Brazilian corn.

In common, both diagnostics point toward the same strategic direction: road reliance over long distances is the main driver of environmental pressure in the supply chain; the Northern Arch (*Arco Norte*) emerges as the currently available alternative with lower relative impact; and the seasonal concentration of outflow—occurring in distinct windows for each crop—requires tailored traffic planning and mitigation during each peak, rather than investment in port capacity alone.

7. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

2035 Scenario – Ports

This scenario assumes investments that raise the shipping capacity of all ports to 15 million metric tons per month for each product compared to the Current Baseline Scenario.

Consolidated Report – 2035 Baseline Scenario

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 19 mapped ports. Corn moved 87 million metric tons, of which 58 million metric tons (67%) went through one of the 27 ports in its network.

Soybean travels an average weighted distance of 15,723.87 km based on the volume transported, compared to 12,109.43 km for corn, and costs proportionally more per metric ton (BRL 908.60 vs. BRL 757.32). This difference reflects the relative weight of each product in long-distance export routes (Table 23).

Table 23 – 2035 Baseline Scenario - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87 Mt
Volume via ports	103 Mt (73%)	58 Mt (67%)
No. of mapped ports	19	27
Top origin state (UF)	N/D	N/D
Weighted average distance	15,723.87 km	12,109.43 km
Weighted average cost	R$ 908.60/t	R$ 757.32/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors. For this reason, each product is presented on its own map, with line thickness indicating the flow intensity along each segment.

2.1 Soybean

Figure 31 shows the soybean outflow network, with line thickness proportional to the flow intensity along each segment.

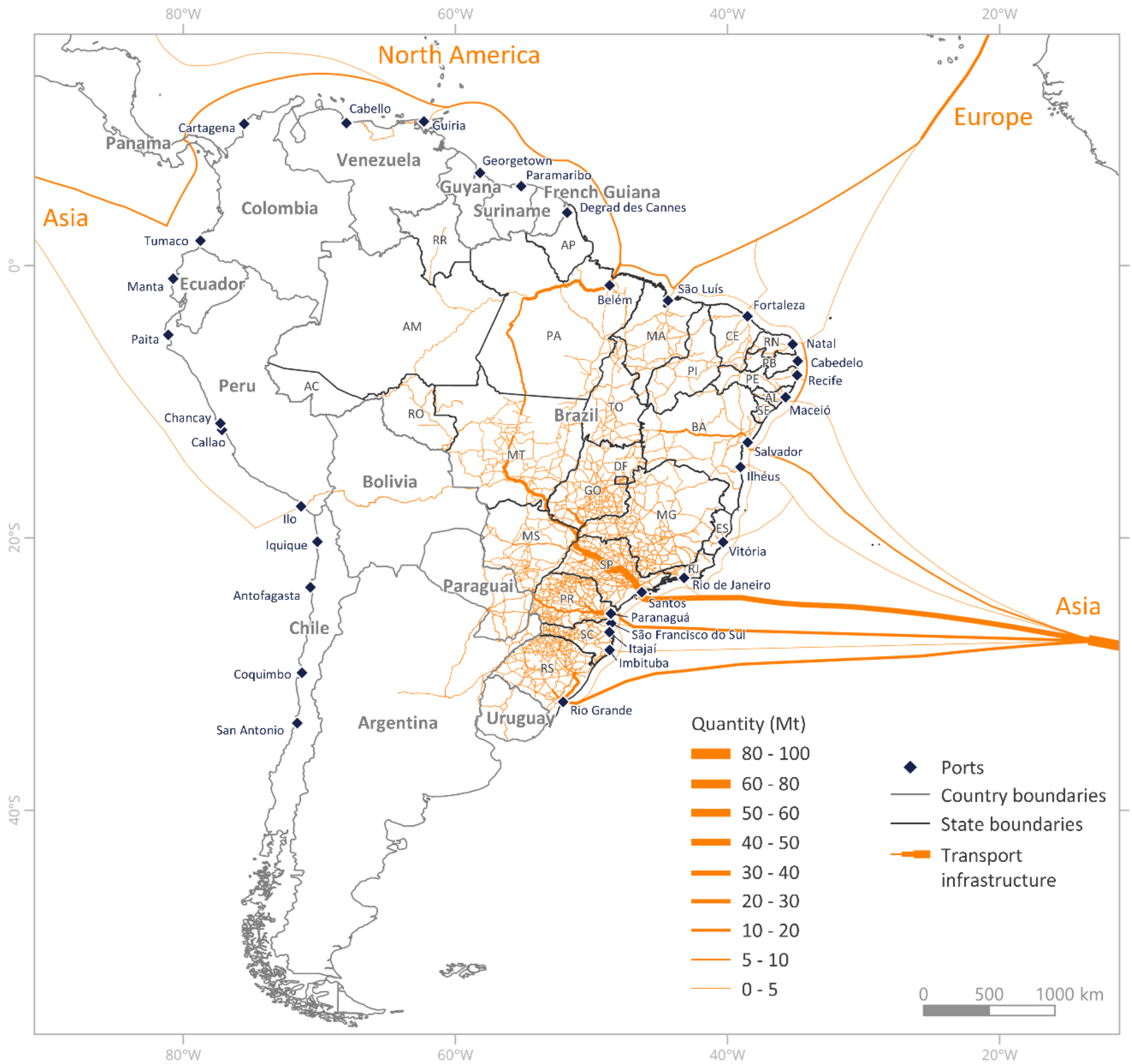

Figure 31 – 2035 Baseline Scenario - Soybean shipment routes to ports.

2.2 Corn

Figure 32 shows the corn outflow network, with line thickness proportional to the flow intensity along each segment.

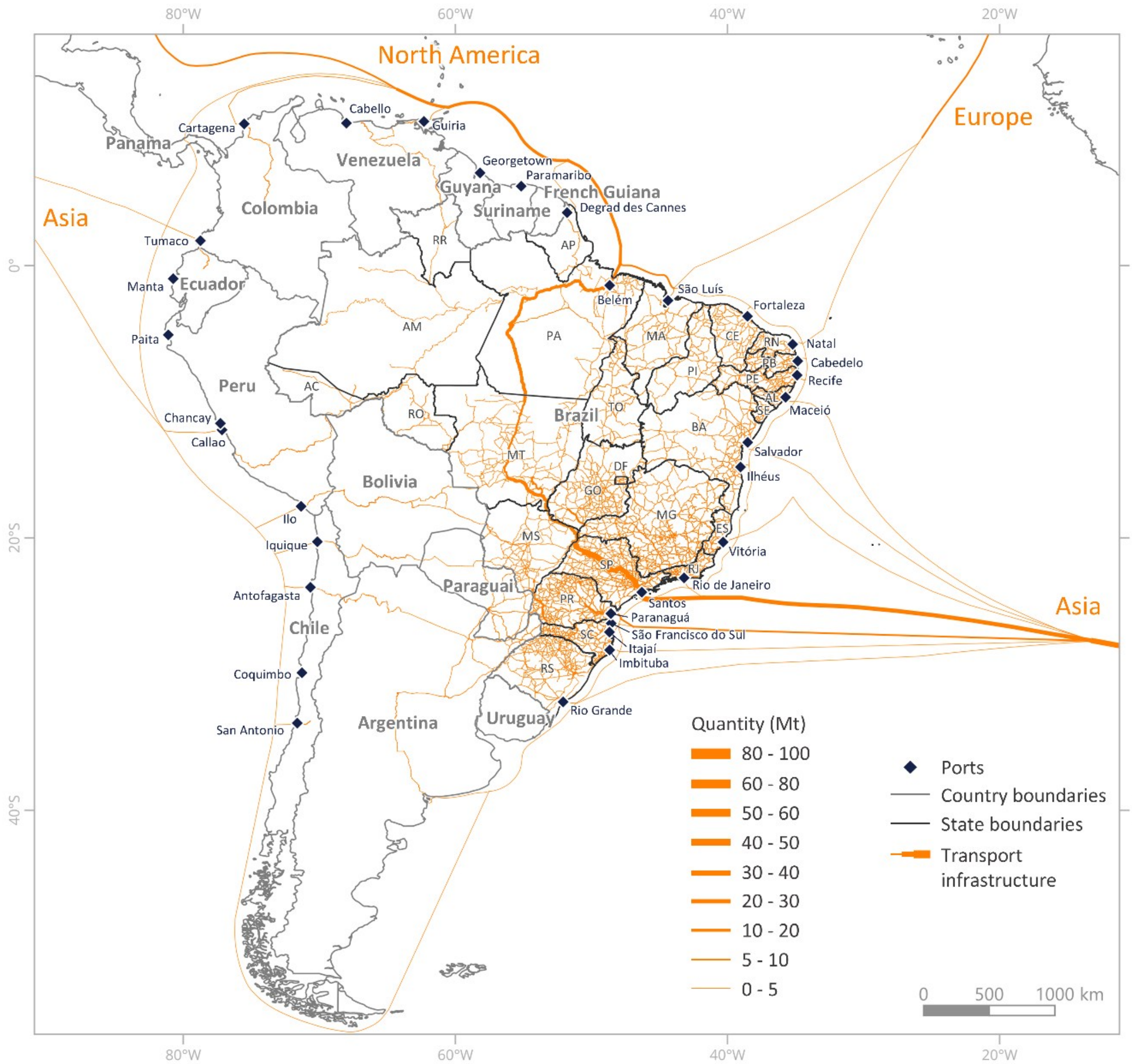

Figure 32 – 2035 Baseline Scenario - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The table below (Table 24) brings together, for the main ports of each product, the total volume moved during the year, the share of total volume exported by the port network, and the average transport cost per metric ton, with soybean and corn shown side by side. The symbol "—" indicates that the port does not appear individually in that product's original source table, being included within the total for "Other ports".

Table 24 – 2035 Baseline Scenario - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	40.3	39.1%	683	29.9	51.3%	730
Belém	16.1	15.7%	860	13.6	23.3%	706

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Rio Grande	16.0	15.6%	605	0.9	1.5%	851
Paranaguá	12.7	12.4%	890	6.5	11.2%	818
Salvador	7.0	6.8%	656	—	—	—
São Luís	3.8	3.7%	779	1.4	2.4%	523
Vitória	3.7	3.6%	694	1.7	3.0%	464
Cartagena (CO)	—	—	—	1.0	1.8%	806
Other ports	3.3	3.2%	—	3.2	5.5%	—

Santos leads the outflow of both products, but with a different weight between them: it concentrates 39.1% of soybean and 51.3% of corn. Salvador appears only in the soybean network, while Cartagena (CO) appears only in the corn network.

3. Port Dynamics and Shipping Capacity

The monthly shipping capacity of each port is generally the same regardless of the product. It is the terminal's physical infrastructure that sets the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each harvest exerts on this shared capacity (Table 25).

Table 25 – 2035 Baseline Scenario - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Belém	15,000	9.0%	15.2%	7.5%	16.6%
Cabedelo	15,000	0.0%	0.0%	0.1%	0.2%
Fortaleza	15,000	0.0%	0.1%	0.1%	0.2%
Güiria (VE)	15,000	0.0%	0.0%	0.0%	0.1%
Ilhéus	15,000	0.3%	0.5%	—	—
Imbituba	15,000	0.6%	1.0%	—	—
Itajaí	15,000	0.6%	1.0%	—	—
Maceió	15,000	0.0%	0.0%	—	—
Antofagasta (CH)	15,000	—	—	0.0%	0.0%
Bahía Blanca (AR)	15,000	—	—	0.0%	0.1%
Cartagena (CO)	15,000	—	—	0.6%	1.4%
Degrad des Cannes (GF)	15,000	—	—	0.0%	0.0%

Belém and Cabedelo, two of the largest terminals in absolute capacity, maintain relative capacity buffers for both products and serve as safety valves for the system.

4. Transport Seasonality

The charts below (Figure 33 and Figure 34) show, for each product, the total volume exported per month across all ports (left) and the evolution of the capacity utilization rate at major terminals throughout the year (right).

4.1 Soybean

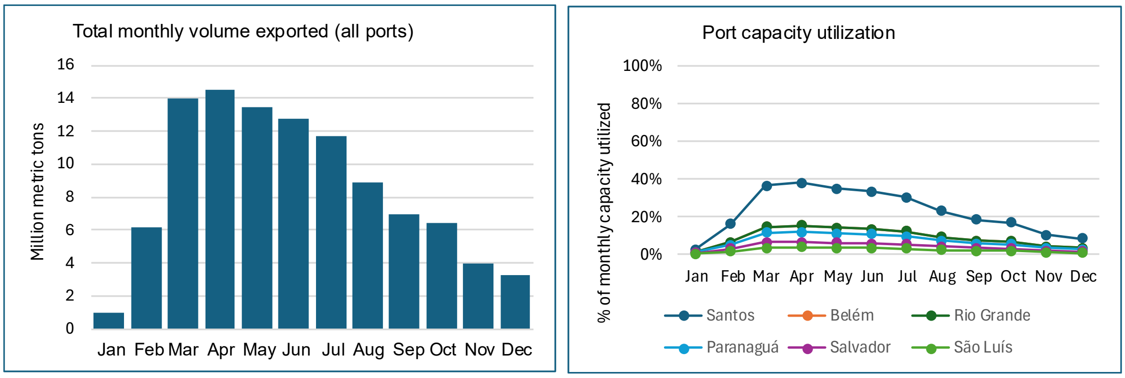

Figure 33 – 2035 Baseline Scenario - Total monthly volume of soybean exported and capacity utilization of main ports.

4.2 Corn

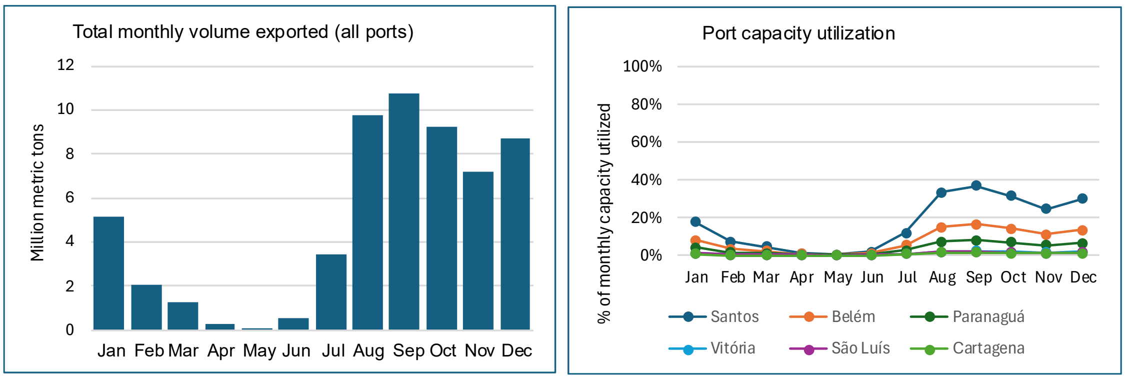

Figure 34 – 2035 Baseline Scenario - Total monthly volume of corn exported and capacity utilization of main ports.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being linked to any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

The joint analysis of transport routes, network spatial layout, and operational port capacity allows for an integrated interpretation of soybean logistics in the country. The data show a supply chain concentrated around a few major ports, with Santos playing a central role, along with pronounced seasonality that translates into port capacity utilization peaks throughout the year. The presence of orphan corridors identified in the geospatial database underscores the importance of continuous monitoring of alternative routes—both for their logistics potential and for the social and environmental impacts associated with their eventual expansion. This set of observations can serve as a foundation for future discussions on multimodal infrastructure investment and seasonal port operation planning.

6. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Consolidated Report – 2035 – Ports – Amazon Route

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 19 mapped ports. Corn moved 87 million metric tons, of which 58 million metric tons (67%) went through one of the 27 ports in its network.

Soybean travels an average weighted distance of 15,723.87 km based on the volume transported, compared to 12,109.44 km for corn, and costs proportionally more per metric ton (BRL 908.60 vs. BRL 757.32), a difference that reflects the relative weight of each product in long-distance export routes (Table 26).

Table 26 – 2035 Ports – Amazon Route - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87 Mt
Volume via ports	103 Mt (73%)	58 Mt (67%)
No. of mapped ports	19	27
Top origin state (UF)	N/D	N/D
Weighted average distance	15,723.87 km	12,109.44 km
Weighted average cost	R$ 908.60/t	R$ 757.32/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors. For this reason, each product is presented on its own map, with line thickness indicating the flow intensity along each segment.

2.1 Soybean

The map below (Figure 35) shows the soybean outflow network, with line thickness proportional to the flow intensity along each segment.

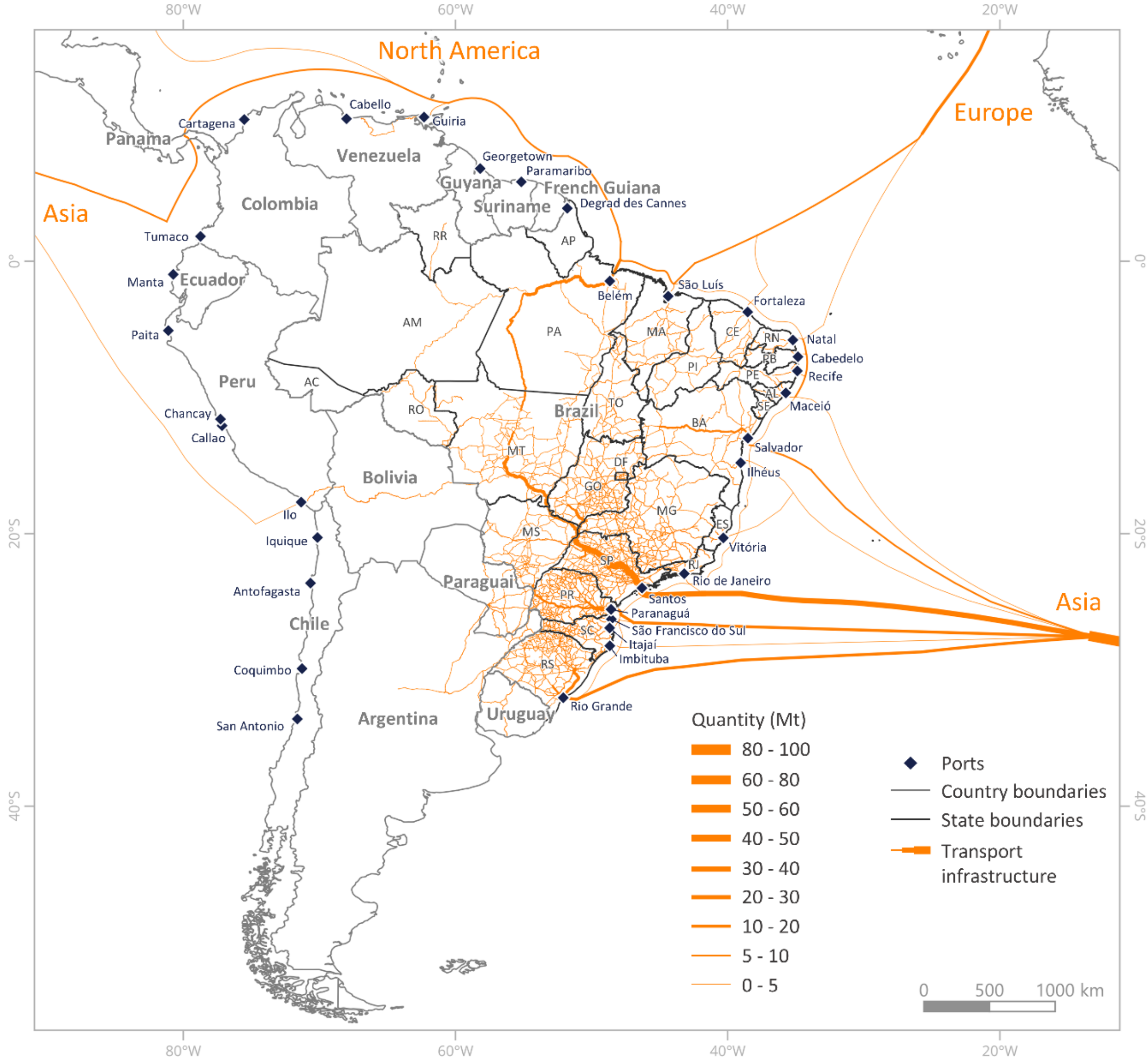

Figure 35 – 2035 Ports – Amazon Route - Soybean shipment routes to ports.

2.2 Corn

The map below (Figure 36) shows the corn outflow network, with line thickness proportional to the flow intensity along each segment.

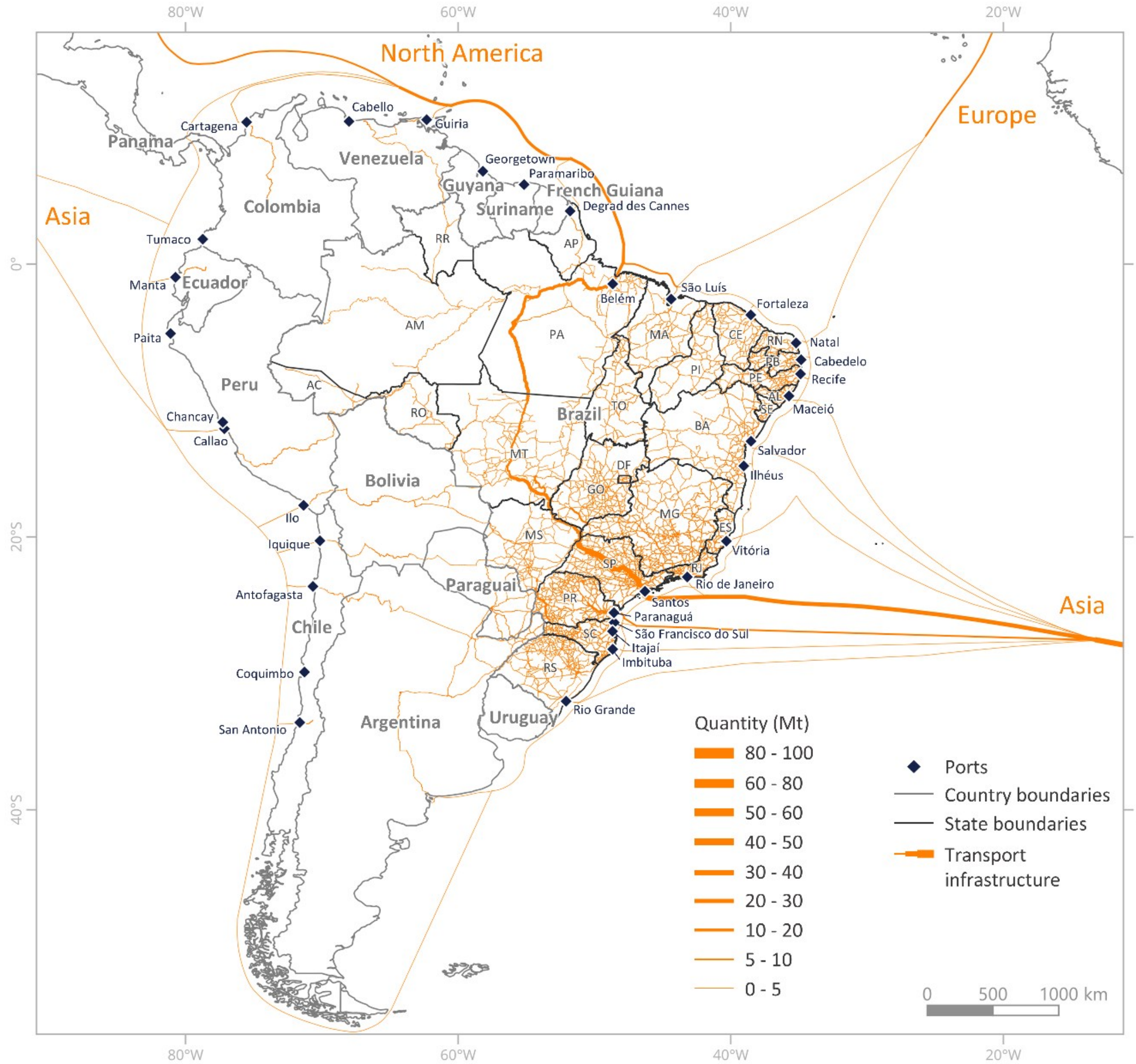

Figure 36 – 2035 Ports – Amazon Route - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The table below (Table 27) brings together, for the main ports of each product, the total volume moved during the year, the share of total volume exported by the port network, and the average transport cost per metric ton, with soybean and corn shown side by side. The symbol "—" indicates that the port does not appear individually in that product's original source table, being included within the total for "Other ports".

Table 27 – 2035 Ports – Amazon Route - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	40.3	39.1%	683	29.9	51.3%	730
Belém	16.1	15.7%	860	13.6	23.3%	706

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Rio Grande	16.0	15.6%	605	0.9	1.5%	851
Paranaguá	12.7	12.4%	890	6.5	11.2%	818
Salvador	7.0	6.8%	656	—	—	—
São Luís	3.8	3.7%	779	1.4	2.4%	523
Vitória	3.7	3.6%	694	1.7	3.0%	465
Cartagena (CO)	—	—	—	1.0	1.8%	806
Other ports	3.3	3.2%	—	3.2	5.5%	—

Santos leads the outflow of both products, but with a different weight between them: it concentrates 39.1% of soybean and 51.3% of corn. Salvador appears only in the soybean network, while Cartagena (CO) appears only in the corn network.

3. Port Dynamics and Shipping Capacity

The monthly shipping capacity of each port is generally the same regardless of the product. It is the terminal's physical infrastructure that sets the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each harvest exerts on this shared capacity (Table 28).

Table 28 – 2035 Ports – Amazon Route - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/mês)	Soybean		Corn	
		Util. média	Util. máxima	Util. média	Util. máxima
Belém	15,000	9.0%	15.2%	7.5%	16.6%
Cabedelo	15,000	0.0%	0.0%	0.1%	0.2%
Fortaleza	15,000	0.0%	0.1%	0.1%	0.2%
Güiria (VE)	15,000	0.0%	0.0%	0.0%	0.1%
Ilhéus	15,000	0.3%	0.5%	—	—
Imbituba	15,000	0.6%	1.0%	—	—
Itajaí	15,000	0.6%	1.0%	—	—
Maceió	15,000	0.0%	0.0%	—	—
Antofagasta (CH)	15,000	—	—	0.0%	0.0%
Bahía Blanca (AR)	15,000	—	—	0.0%	0.1%
Cartagena (CO)	15,000	—	—	0.6%	1.4%
Degrad des Cannes (GF)	15,000	—	—	0.0%	0.0%

Belém and Cabedelo, two of the largest terminals in absolute capacity, maintain relative capacity buffers for both products and serve as safety valves for the system.

4. Transport Seasonality

The charts below (Figure 37 and Figure 38) show, for each product, the total volume exported per month across all ports (left) and the evolution of the capacity utilization rate at major terminals throughout the year (right).

4.1 Soybean

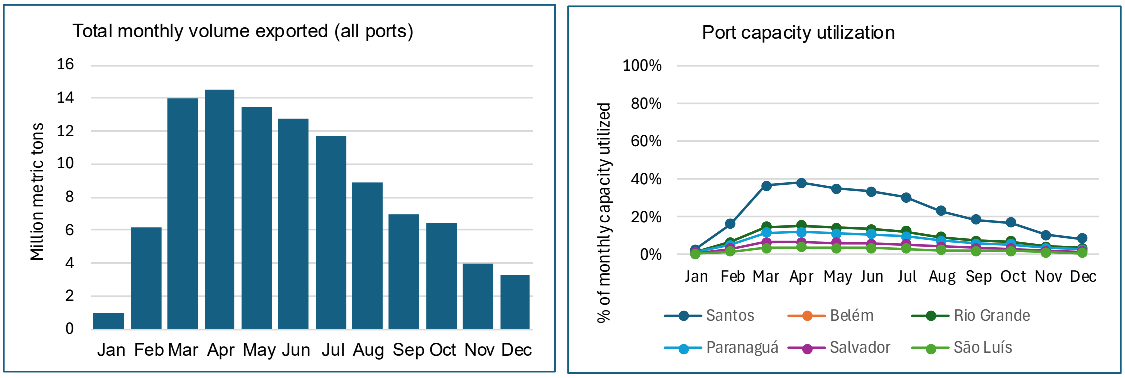

Figure 37 – 2035 Ports – Amazon Route - Total monthly volume of soybean exported and capacity utilization of main ports.

4.2 Corn

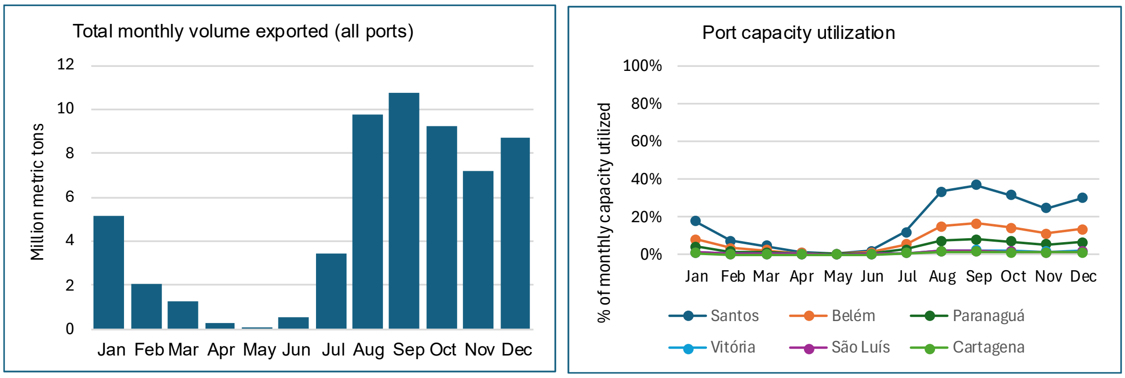

Figure 38 – 2035 Ports – Amazon Route - Total monthly volume of corn exported and capacity utilization of main ports.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being linked to any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

The joint analysis of transport routes, network spatial layout, and operational port capacity allows for an integrated interpretation of soybean logistics in the country. The data show a supply chain concentrated around a few major ports, with Santos playing a central role, along with pronounced seasonality that translates into port capacity utilization peaks throughout the year. The presence of orphan corridors identified in the geospatial database underscores the importance of continuous monitoring of alternative routes—both for their logistics potential and for the social and environmental impacts associated with their eventual expansion. This set of observations can serve as a foundation for future discussions on multimodal infrastructure investment and seasonal port operation planning.

6. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Consolidated Report – 2035 – Ports – Capricorn Route

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 20 mapped ports. Corn moved 87 million metric tons, of which 58 million metric tons (67%) went through one of the 27 ports in its network.

Soybean travels an average weighted distance of 15,713.91 km based on the volume transported, compared to 12,100.14 km for corn, and costs proportionally more per metric ton (BRL 905.85 vs. BRL 754.97), a difference that reflects the relative weight of each product in long-distance export routes (Table 29).

Table 29 - 2035 – Ports – Capricorn Route - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87 Mt
Volume via ports	103 Mt (73%)	58 Mt (67%)
No. of mapped ports	20	27
Top origin state (UF)	N/D	N/D
Weighted average distance	15,713.91 km	12,100.14 km
Weighted average cost	R$ 905.85/t	R$ 754.97/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors. For this reason, each product is presented on its own map, with line thickness indicating the flow intensity along each segment.

2.1 Soybean

The map below (Figure 39) shows the soybean outflow network, with line thickness proportional to the flow intensity along each segment.

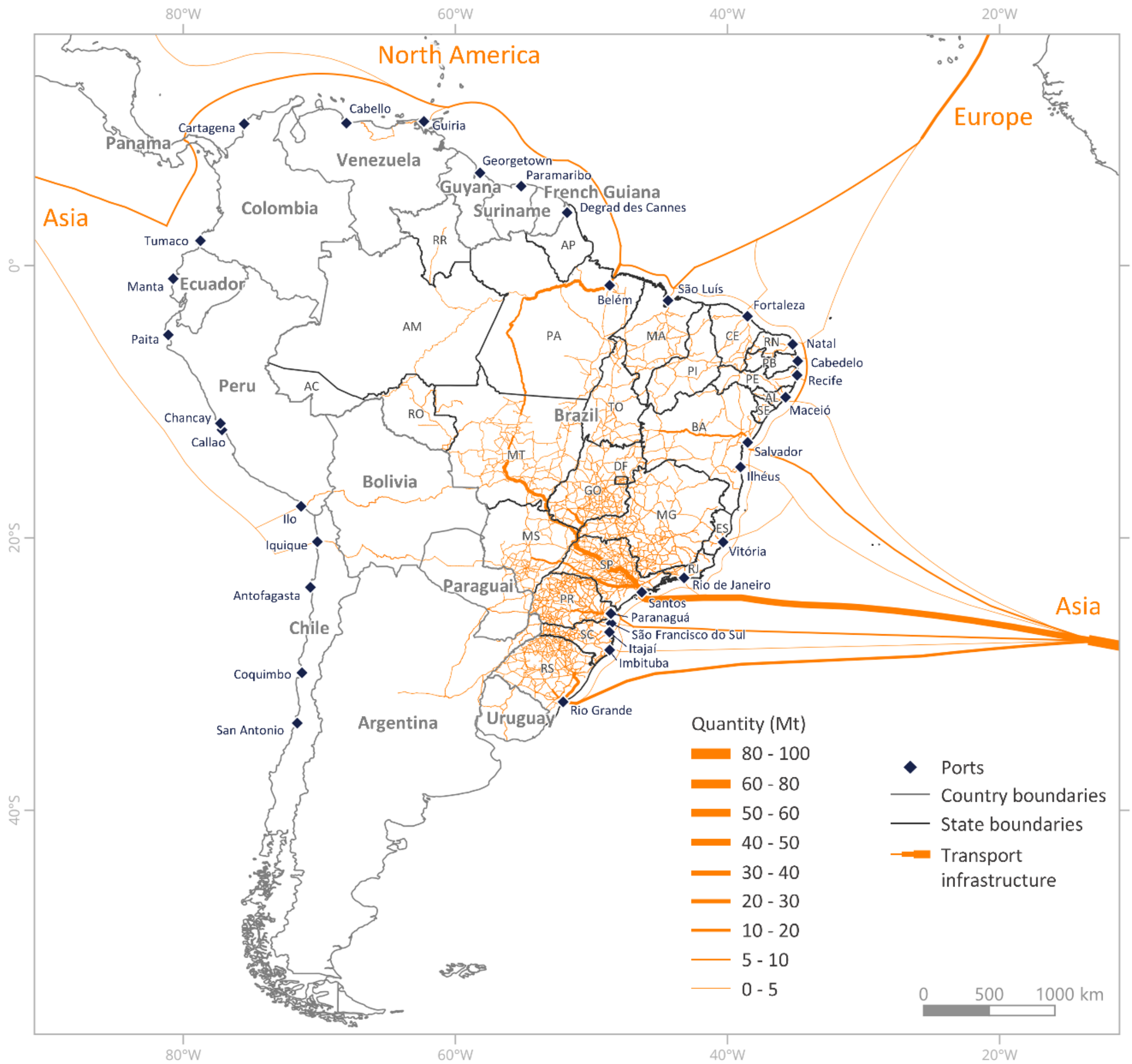

Figure 39 – 2035 – Ports – Capricorn Route - Soybean shipment routes to ports.

2.2 Corn

The map below (Figure 40) shows the corn outflow network, with line thickness proportional to the flow intensity along each segment.

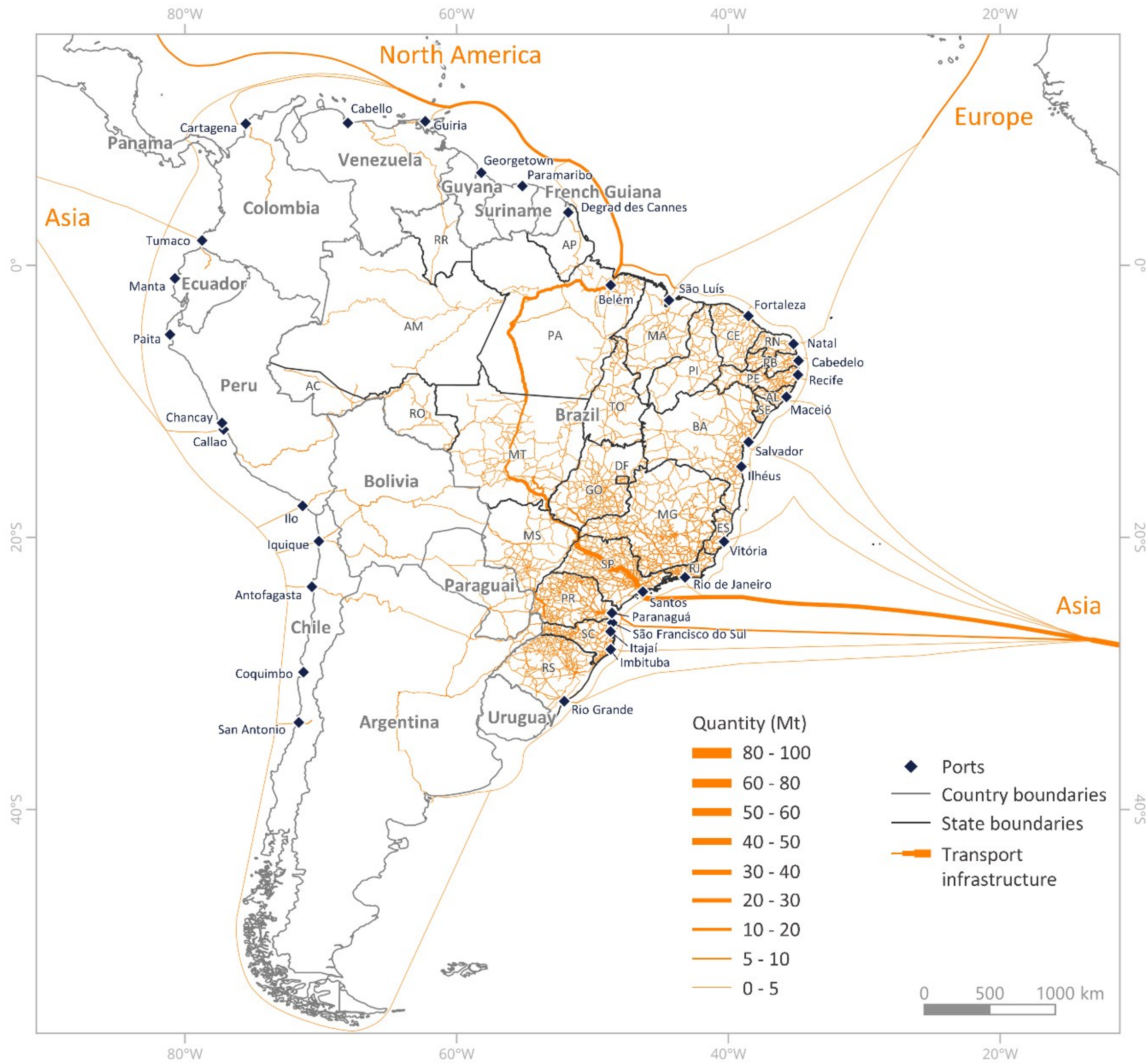

Figure 40 – 2035 – Ports – Capricorn Route - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The table below (Table 30) brings together, for the main ports of each product, the total volume moved during the year, the share of total volume exported by the port network, and the average transport cost per metric ton, with soybean and corn shown side by side. The symbol "—" indicates that the port does not appear individually in that product's original source table, being included within the total for "Other ports".

Table 30 - 2035 – Ports – Capricorn Route - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	44.2	43.0%	554	30.5	52,1%	723
Belém	16.1	15.7%	853	13.6	23,2%	705

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Rio Grande	15.8	15.3%	822	0.9	1,5%	841
Paranaguá	8.8	8.5%	875	6.0	10,3%	788
Salvador	7.0	6.8%	636	—	—	—
São Luís	3.8	3.7%	770	1.4	2.4%	522
Vitória	3.7	3.6%	701	1.7	3.0%	464
Cartagena (CO)	—	—	—	1.0	1.8%	801
Other ports	3.5	3.4%	—	3.4	5.7%	—

Santos leads the outflow of both products, but with a different weight between them: it concentrates 43.0% of soybean and 52.1% of corn. Salvador appears only in the soybean network, while Cartagena (CO) appears only in the corn network.

3. Port Dynamics and Shipping Capacity

The monthly shipping capacity of each port is generally the same regardless of the product. It is the terminal's physical infrastructure that sets the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each harvest exerts on this shared capacity (Table 31).

Table 31- 2035 – Ports – Capricorn Route - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Belém	15,000	9.0%	15.2%	7.5%	16.6%
Cabedelo	15,000	0.0%	0.0%	0.1%	0.2%
Fortaleza	15,000	0.0%	0.1%	0.1%	0.2%
Güiria (VE)	15,000	0.0%	0.0%	0.0%	0.1%
Ilhéus	15,000	0.3%	0.5%	—	—
Imbituba	15,000	0.5%	0.9%	—	—
Iquique (CH)	15,000	0.0%	0.0%	—	—
Itajaí	15,000	0.5%	0.8%	—	—
Antofagasta (CH)	15,000	—	—	0.0%	0.0%
Bahía Blanca (AR)	15,000	—	—	0.0%	0.1%
Cartagena (CO)	15,000	—	—	0.6%	1.4%
Degrad des Cannes (GF)	15,000	—	—	0.0%	0.0%

Belém and Cabedelo, two of the largest terminals in absolute capacity, maintain relative capacity buffers for both products and serve as safety valves for the system.

4. Transport Seasonality

The charts below (Figure 41 and Figure 42) show, for each product, the total volume exported per month across all ports (left) and the evolution of the capacity utilization rate at major terminals throughout the year (right).

4.1 Soybean

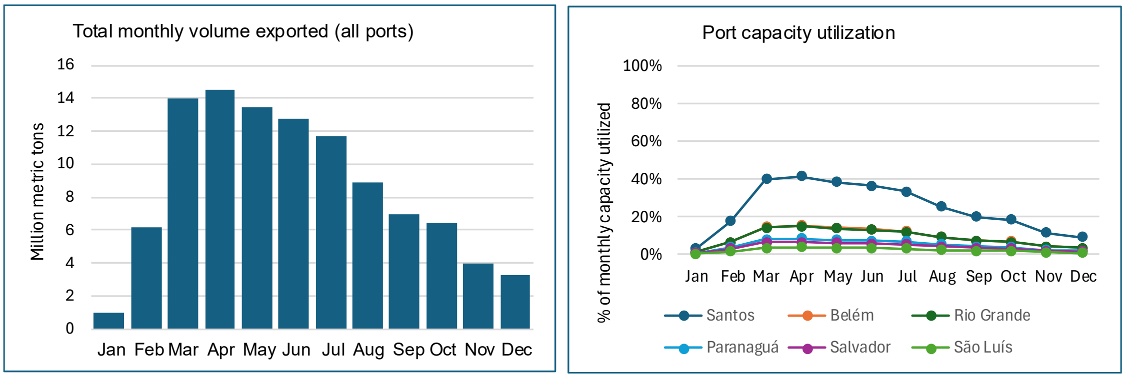

Figure 41 – 2035 – Ports – Capricorn Route - Total monthly volume of soybean exported and capacity utilization of main ports.

4.2 Corn

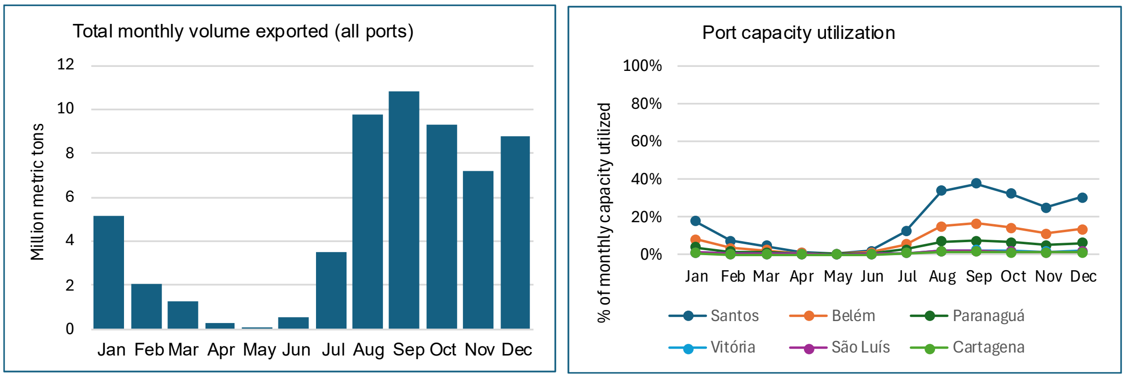

Figure 42 – 2035 – Ports – Capricorn Route - Total monthly volume of corn exported and capacity utilization of main ports.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being linked to any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

The joint analysis of transport routes, network spatial layout, and operational port capacity allows for an integrated interpretation of soybean logistics in the country. The data show a supply chain concentrated around a few major ports, with Santos playing a central role, along with pronounced seasonality that translates into port capacity utilization peaks throughout the year. The presence of orphan corridors identified in the geospatial database underscores the importance of continuous monitoring of alternative routes—both for their logistics potential and for the social and environmental impacts associated with their eventual expansion. This set of observations can serve as a foundation for future discussions on multimodal infrastructure investment and seasonal port operation planning.

6. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Consolidated Report – 2035 – Ports – Porto Alegre–Coquimbo Route

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 19 mapped ports. Corn moved 87 million metric tons, of which 58 million metric tons (67%) went through one of the 27 ports in its network.

Soybean travels an average weighted distance of 15,712.54 km based on the volume transported, compared to 12,107.41 km for corn, and costs proportionally more per metric ton (BRL 908.34 vs. BRL 757.25), a difference that reflects the relative weight of each product in long-distance export routes (Table 32).

Table 32 – 2035 – Ports – Porto Alegre–Coquimbo Route – General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87 Mt
Volume via ports	103 Mt (73%)	58 Mt (67%)
No. of mapped ports	19	27
Top origin state (UF)	N/D	N/D
Weighted average distance	15,712.54 km	12,107.41 km
Weighted average cost	R$ 908.34/t	R$ 757.25/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors. For this reason, each product is presented on its own map, with line thickness indicating the flow intensity along each segment.

2.1 Soybean

The map below (Figure 43) shows the soybean outflow network, with line thickness proportional to the flow intensity along each segment.

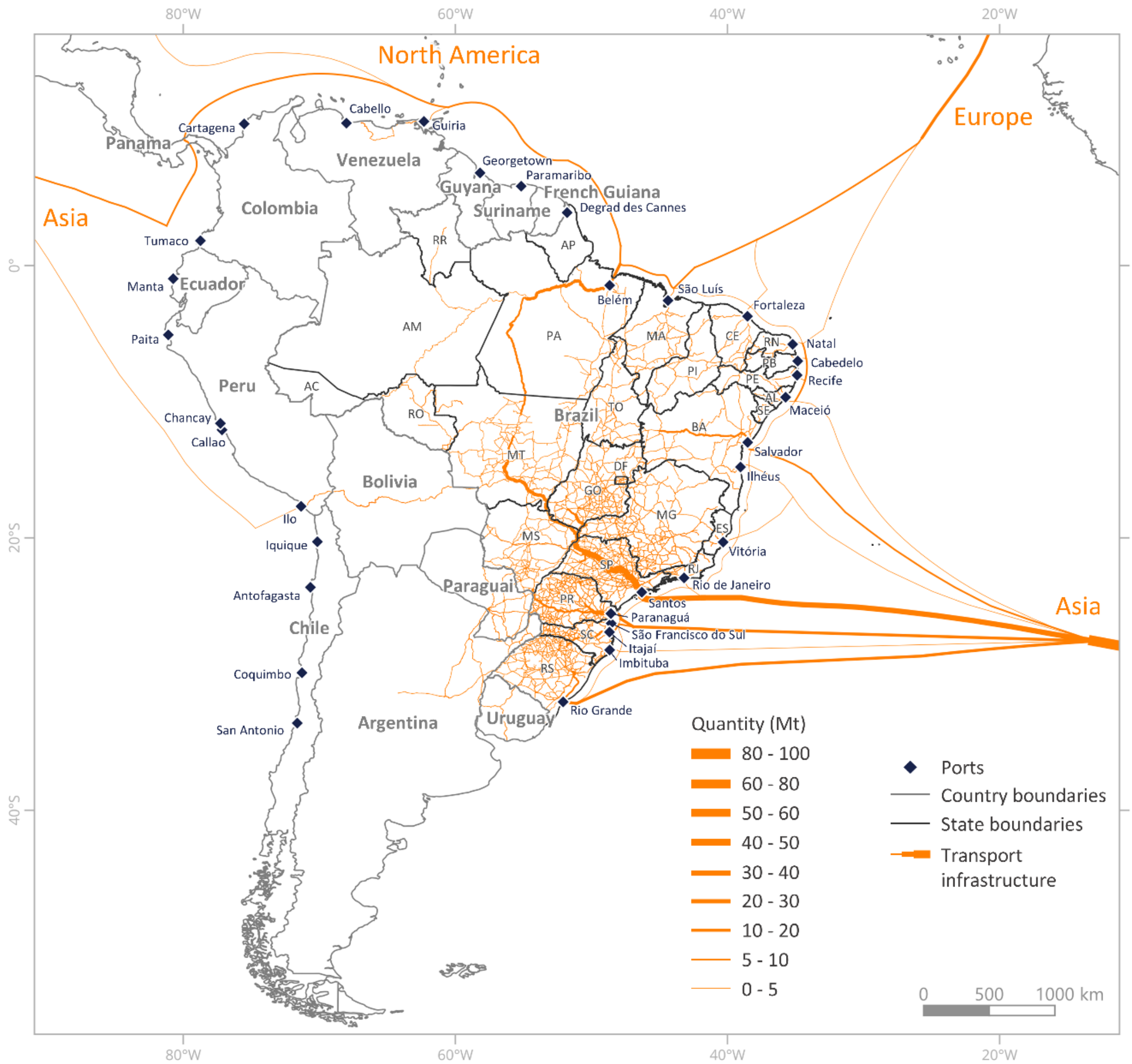

Figure 43 – 2035 – Ports – Porto Alegre–Coquimbo Route - Soybean shipment routes to ports.

2.2 Corn

The map below (Figure 44) shows the corn outflow network, with line thickness proportional to the flow intensity along each segment.

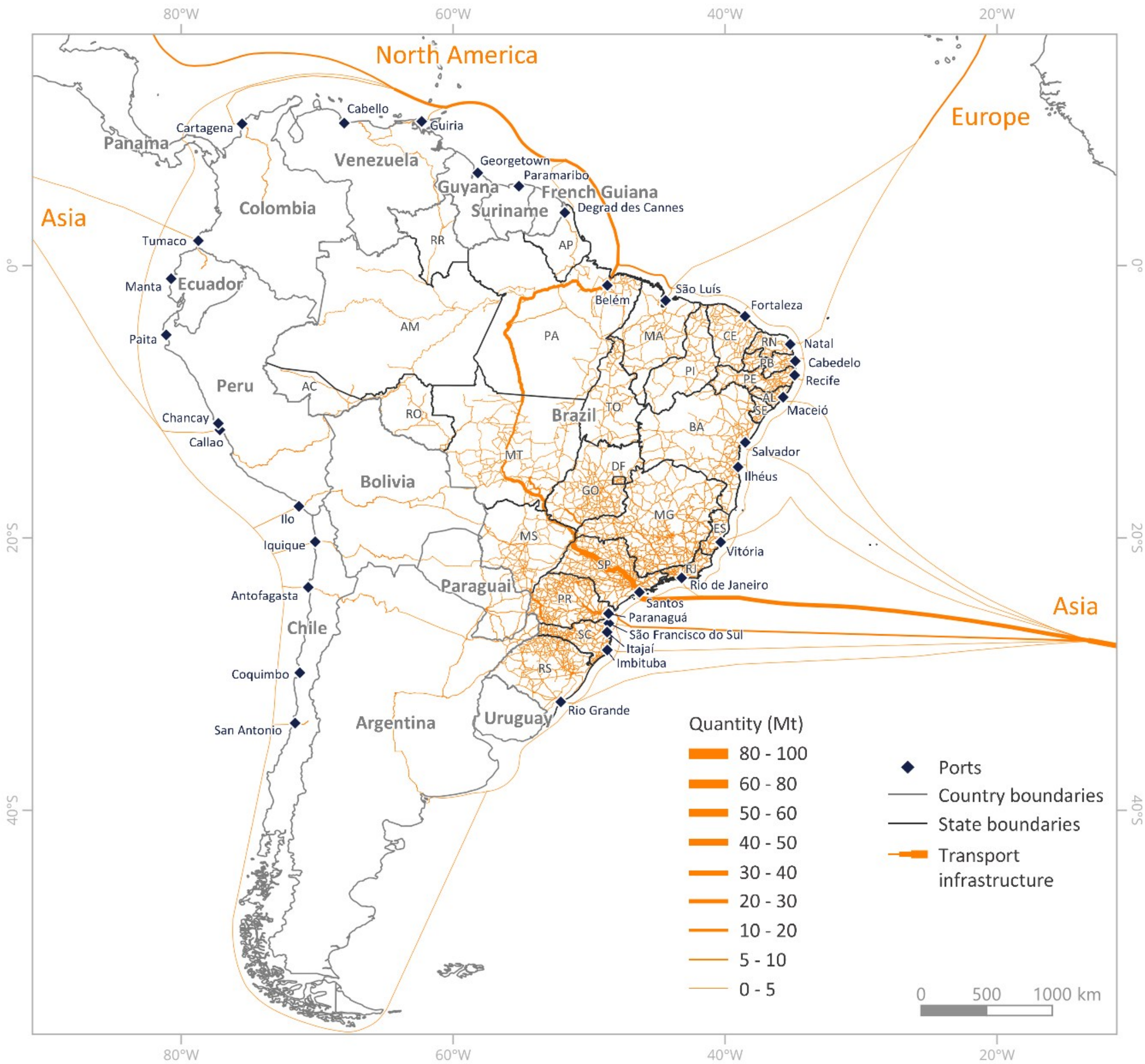

Figure 44 – 2035 – Ports – Porto Alegre–Coquimbo Route - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The table below (Table 33) brings together, for the main ports of each product, the total volume moved during the year, the share of total volume exported by the port network, and the average transport cost per metric ton, with soybean and corn shown side by side. The symbol "—" indicates that the port does not appear individually in that product's original source table, being included within the total for "Other ports".

Table 33 – 2035 – Ports – Porto Alegre–Coquimbo Route - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	40.5	39.3%	547	29.9	51.3%	705
Belém	16.1	15.7%	861	13.6	23.3%	707

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Paranaguá	12.6	12.2%	894	6.5	11.2%	786
Rio Grande	11.1	10.8%	915	—	—	—
Salvador	7.0	6.8%	586	—	—	—
Itajaí	6.5	6.3%	548	0.9	1.5%	572
São Luís	3.8	3.7%	775	1.4	2.5%	525
Vitória	—	—	—	1.7	3.0%	464
Cartagena (CO)	—	—	—	1.0	1.8%	806
Other ports	5.5	5.3%	—	3.1	5.4%	—

Santos leads the outflow of both products, but with a different weight between them: it concentrates 39.3% of soybean and 51.3% of corn. Rio Grande and Salvador appear only in the soybean network, while Vitória and Cartagena (CO) appear only in the corn network.

3. Port Dynamics and Shipping Capacity

The monthly shipping capacity of each port is generally the same regardless of the product. It is the terminal's physical infrastructure that sets the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each harvest exerts on this shared capacity (Table 34).

Table 34 – 2035 – Ports – Porto Alegre–Coquimbo Route - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Belém	15,000	9.0%	15.2%	7.6%	16.6%
Cabedelo	15,000	0.0%	0.0%	0.1%	0.2%
Fortaleza	15,000	0.0%	0.1%	0.1%	0.2%
Güiria (VE)	15,000	0.0%	0.0%	0.0%	0.1%
Ilhéus	15,000	0.3%	0.5%	—	—
Imbituba	15,000	0.3%	0.5%	—	—
Itajaí	15,000	3.6%	6.1%	—	—
Maceió	15,000	0.0%	0.0%	—	—
Antofagasta (CH)	15,000	—	—	0.0%	0.0%
Bahía Blanca (AR)	15,000	—	—	0.0%	0.0%
Cartagena (CO)	15,000	—	—	0.6%	1.4%
Degrad des Cannes (GF)	15,000	—	—	0.0%	0.0%

Belém and Cabedelo, two of the largest terminals in absolute capacity, maintain relative capacity buffers for both products and serve as safety valves for the system.

4. Transport Seasonality

The charts below (Figure 45 and Figure 46) show, for each product, the total volume exported per month across all ports (left) and the evolution of the capacity utilization rate at major terminals throughout the year (right).

4.1 Soybean

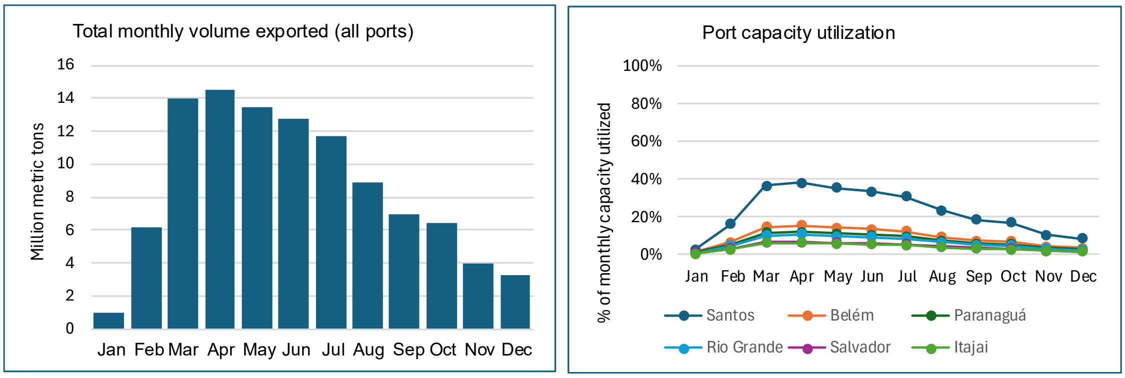

Figure 45 – 2035 – Ports – Porto Alegre–Coquimbo Route - Total monthly volume of soybean exported and capacity utilization of main ports.

4.2 Corn

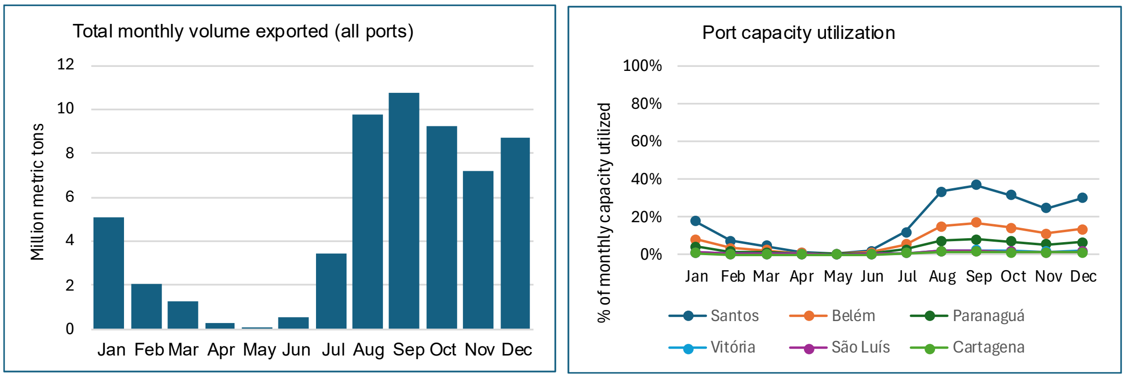

Figure 46 – 2035 – Ports – Porto Alegre–Coquimbo Route - Total monthly volume of corn exported and capacity utilization of main ports.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being linked to any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

The joint analysis of transport routes, network spatial layout, and operational port capacity allows for an integrated interpretation of corn logistics in the country. The data show a supply chain concentrated around a few major ports, with Santos playing a central role, along with pronounced seasonality that translates into port capacity utilization peaks throughout the year. The presence of orphan corridors identified in the geospatial database underscores the importance of continuous monitoring of alternative routes—both for their logistics potential and for the social and environmental impacts associated with their eventual expansion. This set of observations can serve as a foundation for future discussions on multimodal infrastructure investment and seasonal port operation planning.

6. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Consolidated Report – 2035 – Ports – Guiana Islands Route

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 19 mapped ports. Corn moved 87 million metric tons, of which 58 million metric tons (67%) went through one of the 27 ports in its network.

Soybean travels an average weighted distance of 15,727.12 km based on the volume transported, compared to 12,110.14 km for corn, and costs proportionally more per metric ton (BRL 908.19 vs. BRL 756.49), a difference that reflects the relative weight of each product in long-distance export routes (Table 35).

Table 35 – 2035 – Ports – Guianas Route - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87 Mt
Volume via ports	103 Mt (73%)	58 Mt (67%)
No. of mapped ports	19	27
Top origin state (UF)	N/D	N/D
Weighted average distance	15,727.12 km	12,110.4 km
Weighted average cost	R$ 908.19/t	R$ 756.49/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors. For this reason, each product is presented on its own map, with line thickness indicating the flow intensity along each segment.

2.1 Soybean

The map below (Figure 47) shows the soybean outflow network, with line thickness proportional to the flow intensity along each segment.

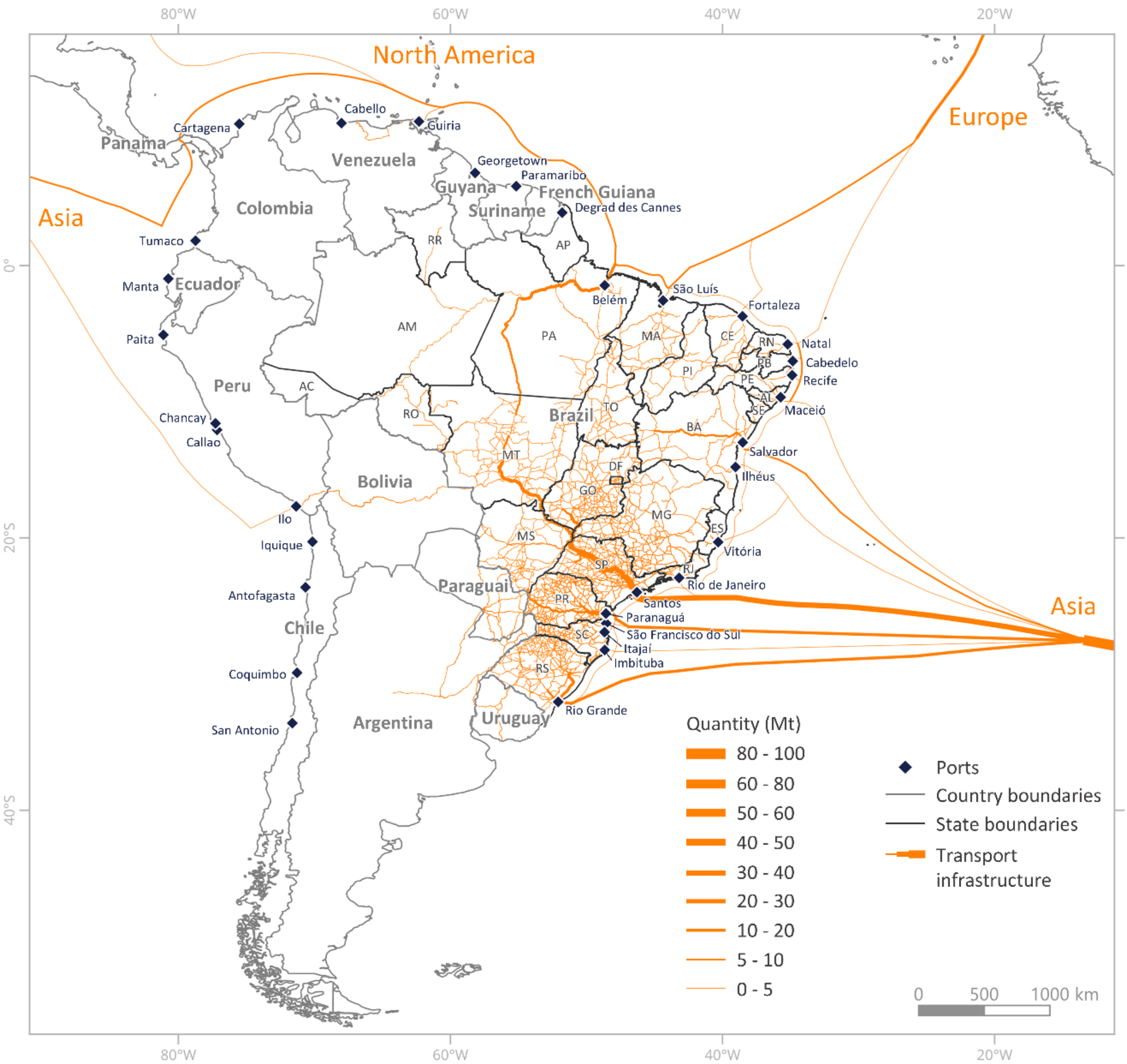

Figure 47 – 2035 – Ports – Guianas Route - Soybean shipment routes to ports.

2.2 Corn

The map below (Figure 48) shows the corn outflow network, with line thickness proportional to the flow intensity along each segment.

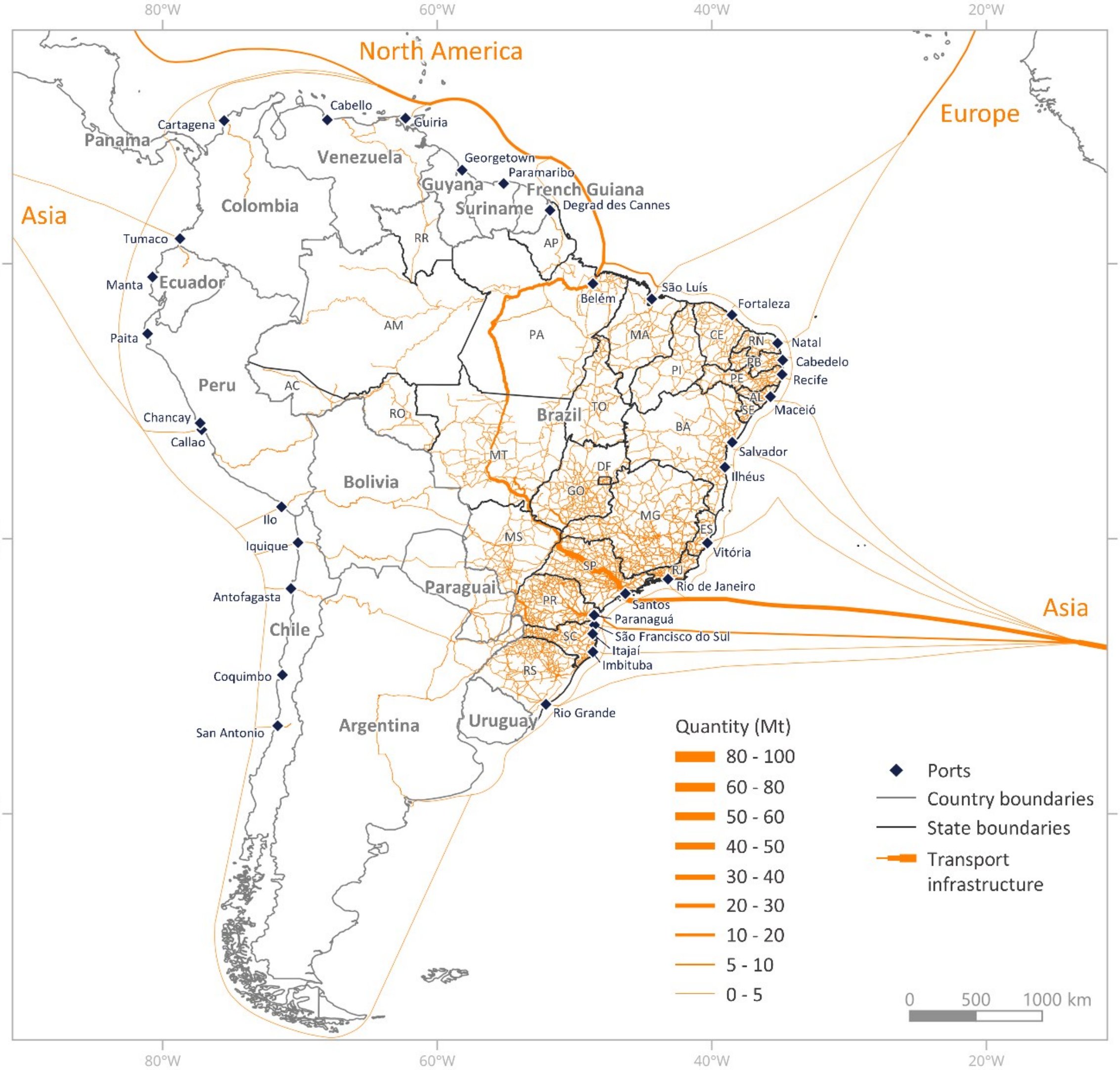

Figure 48 – 2035 – Ports – Guianas Route - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The table below (Table 36) brings together, for the main ports of each product, the total volume moved during the year, the share of total volume exported by the port network, and the average transport cost per metric ton, with soybean and corn shown side by side. The symbol "—" indicates that the port does not appear individually in that product's original source table, being included within the total for "Other ports".

Table 36 – 2035 – Ports – Guianas Route - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	**Share**	**Cost (R$/t)**	**Vol. (Mt)**	**Share**	**Cost (R$/t)**
Santos	40.2	39.0%	685	29.9	51.3%	727
Belém	16.3	15.9%	855	13.6	23.3%	713

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Rio Grande	16.0	15.6%	603	0.9	1.5%	851
Paranaguá	12.7	12.4%	888	6.5	11.2%	817
Salvador	7.0	6.8%	651	—	—	—
São Luís	3.8	3.7%	779	1.4	2.4%	521
Vitória	3.7	3.6%	697	1.7	3.0%	464
Cartagena (CO)	—	—	—	1.0	1.8%	805
Other ports	3.2	3.1%	—	3.2	5.5%	—

Santos leads the outflow of both products, but with a different weight between them: it concentrates 39.0% of soybean and 51.3% of corn. Salvador appears only in the soybean network, while Cartagena (CO) appears only in the corn network.

3. Port Dynamics and Shipping Capacity

The monthly shipping capacity of each port is generally the same regardless of the product. It is the terminal's physical infrastructure that sets the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each harvest exerts on this shared capacity (Table 37).

Table 37 – 2035 – Ports – Guianas Route - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Belém	15,000	9.1%	15.4%	7.6%	16.6%
Cabedelo	15,000	0.0%	0.0%	0.1%	0.2%
Fortaleza	15,000	0.0%	0.1%	0.1%	0.2%
Güiria (VE)	15,000	0.0%	0.0%	0.0%	0.1%
Ilhéus	15,000	0.3%	0.5%	—	—
Imbituba	15,000	0.6%	1.0%	—	—
Itajaí	15,000	0.6%	1.0%	—	—
Maceió	15,000	0.0%	0.0%	—	—
Antofagasta (CH)	15,000	—	—	0.0%	0.0%
Bahía Blanca (AR)	15,000	—	—	0.0%	0.1%
Cartagena (CO)	15,000	—	—	0.6%	1.4%
Degrad des Cannes (GF)	15,000	—	—	0.0%	0.0%

Belém and Cabedelo, two of the largest terminals in absolute capacity, maintain relative capacity buffers for both products and serve as safety valves for the system.

4. Transport Seasonality

The charts below (Figure 49 and Figure 50) show, for each product, the total volume exported per month across all ports (left) and the evolution of the capacity utilization rate at major terminals throughout the year (right).

4.1 Soybean

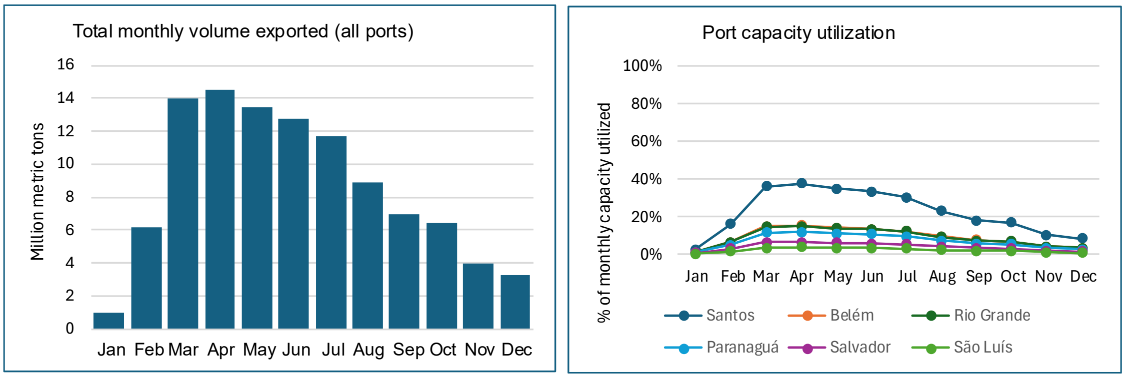

Figure 49 – 2035 – Ports – Guianas Route - Total monthly volume of soybean exported and capacity utilization of main ports.

4.2 Corn

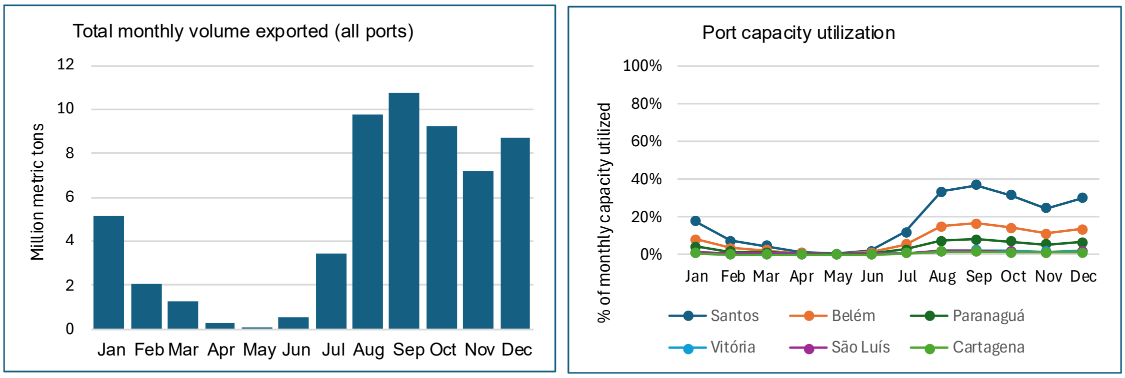

Figure 50 – 2035 – Ports – Guianas Route - Total monthly volume of corn exported and capacity utilization of main ports.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being linked to any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

The joint analysis of transport routes, network spatial layout, and operational port capacity allows for an integrated interpretation of soybean logistics in the country. The data show a supply chain concentrated around a few major ports, with Santos playing a central role, along with pronounced seasonality that translates into port capacity utilization peaks throughout the year. The presence of orphan corridors identified in the geospatial database underscores the importance of continuous monitoring of alternative routes—both for their logistics potential and for the social and environmental impacts associated with their eventual expansion. This set of observations can serve as a foundation for future discussions on multimodal infrastructure investment and seasonal port operation planning.

6. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Consolidated Report – 2035 – Ports – Rondon Quadrant Route

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 19 mapped ports. Corn moved 87 million metric tons, of which 58 million metric tons (67%) went through one of the 27 ports in its network.

Soybean travels an average weighted distance of 15,636.25 km based on the volume transported, compared to 11,969.00 km for corn, and costs proportionally more per metric ton (BRL 903.61 vs. BRL 747.58), a difference that reflects the relative weight of each product in long-distance export routes (Table 38).

Table 38 – 2035 – Ports – Rondon Quadrant Route - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87 Mt
Volume via ports	103 Mt (73%)	58 Mt (67%)
No. of mapped ports	19	27
Top origin state (UF)	N/D	N/D
Weighted average distance	15,636.25 km	11,969.00 km
Weighted average cost	R$ 903.61/t	R$ 747.58/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors. For this reason, each product is presented on its own map, with line thickness indicating the flow intensity along each segment.

2.1 Soybean

The map below (Figure 51) shows the soybean outflow network, with line thickness proportional to the flow intensity along each segment.

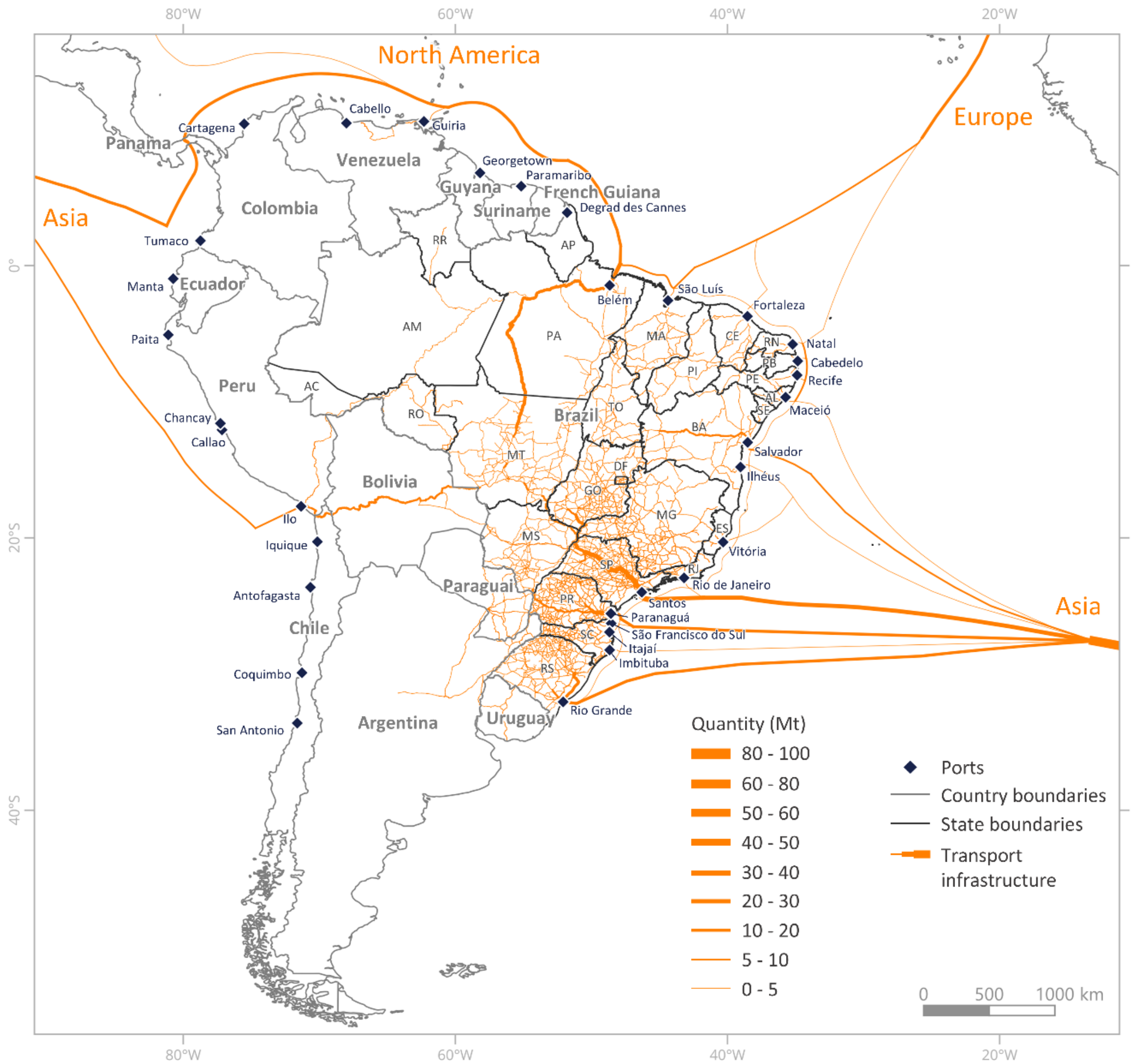

Figure 51 – 2035 – Ports – Rondon Quadrant Route - Soybean shipment routes to ports.

2.2 Corn

The map below (Figure 52) shows the corn outflow network, with line thickness proportional to the flow intensity along each segment.

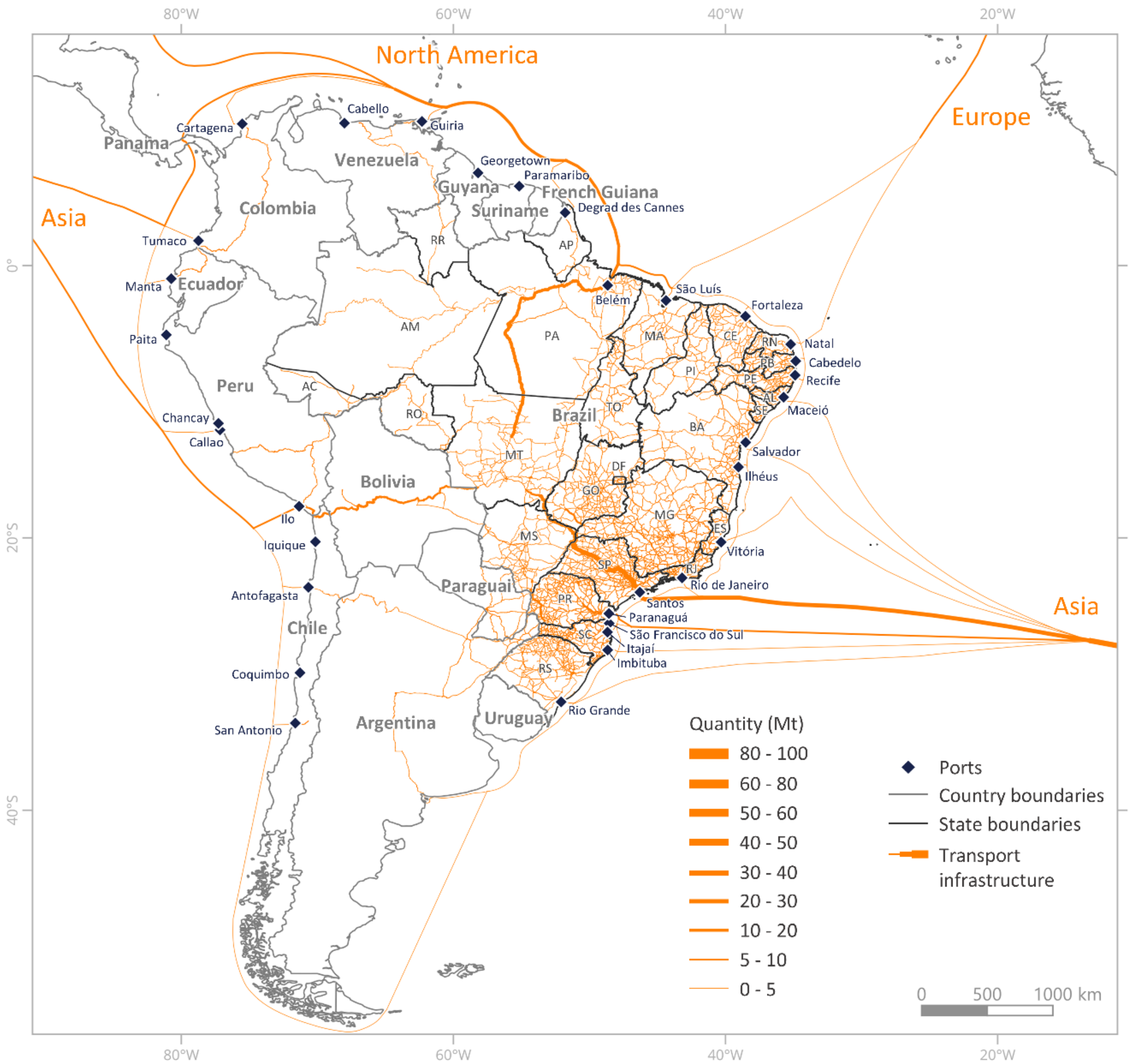

Figure 52 – 2035 – Ports – Rondon Quadrant Route - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The table below (Table 39) brings together, for the main ports of each product, the total volume moved during the year, the share of total volume exported by the port network, and the average transport cost per metric ton, with soybean and corn shown side by side. The symbol "—" indicates that the port does not appear individually in that product's original source table, being included within the total for "Other ports".

Table 39 – 2035 – Ports – Rondon Quadrant Route - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	30.3	29.4%	652	22.3	38.3%	698
Belém	20.6	20.0%	823	16.7	28.6%	685

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Rio Grande	16.0	15.6%	612	—	—	—
Paranaguá	12.6	12.3%	889	6.4	11.0%	816
Salvador	7.0	6.8%	672	—	—	—
Ilo (PE)	5.8	5.6%	1,387	5.3	9.1%	1,331
São Luís	3.8	3.7%	785	1.4	2.5%	512
Vitória	—	—	—	1.7	2.8%	495
Cartagena (CO)	—	—	—	1.0	1.8%	795
Other ports	6.8	6.7%	—	3.5	6.0%	—

Santos leads the outflow of both products, but with a different weight between them: it concentrates 29.4% of soybean and 38.3% of corn. Rio Grande and Salvador appear only in the soybean network, while Vitória and Cartagena (CO) appear only in the corn network.

3. Port Dynamics and Shipping Capacity

The monthly shipping capacity of each port is generally the same regardless of the product. It is the terminal's physical infrastructure that sets the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each harvest exerts on this shared capacity (Table 40).

Table 40 – 2035 – Ports – Rondon Quadrant Route - Installed (shared) capacity and monthly utilization by port and by product.

Porto	Capacidade (mil t/mês)	Soybean		Corn	
		Util. média	Util. máxima	Util. média	Util. máxima
Belém	15,000	11.4%	19.4%	9.3%	20.5%
Cabedelo	15,000	0.0%	0.0%	0.1%	0.2%
Fortaleza	15,000	0.0%	0.1%	0.1%	0.2%
Güiria (VE)	15,000	0.0%	0.0%	0.0%	0.1%
Ilhéus	15,000	0.3%	0.5%	—	—
Imbituba	15,000	0.6%	1.0%	—	—
Itajaí	15,000	0.6%	1.1%	—	—
Maceió	15,000	0.0%	0.0%	—	—
Antofagasta (CH)	15,000	—	—	0.0%	0.0%
Bahía Blanca (AR)	15,000	—	—	0.0%	0.1%
Cartagena (CO)	15,000	—	—	0.6%	1.4%
Degrad des Cannes (GF)	15,000	—	—	0.0%	0.0%

Belém and Cabedelo, two of the largest terminals in absolute capacity, maintain relative capacity buffers for both products and serve as safety valves for the system.

4. Transport Seasonality

The charts below (Figure 53 and Figure 54) show, for each product, the total volume exported per month across all ports (left) and the evolution of the capacity utilization rate at major terminals throughout the year (right).

4.1 Soybean

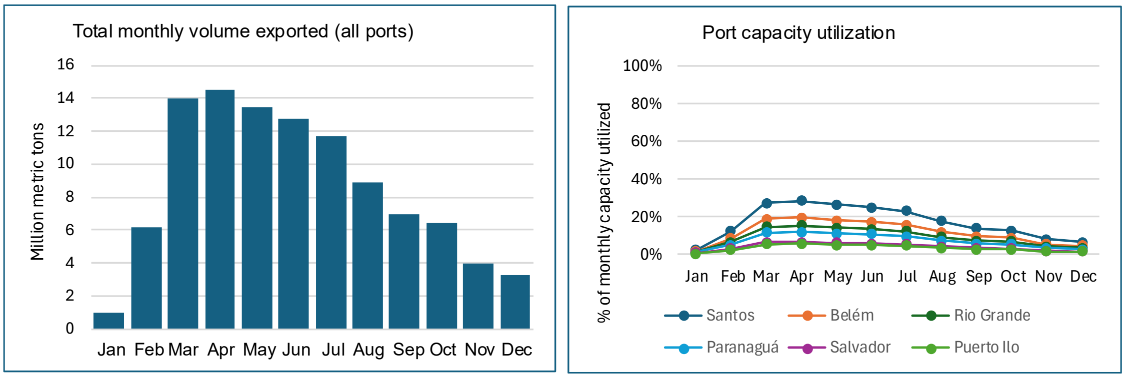

Figure 53 – 2035 – Ports – Rondon Quadrant Route - Total monthly volume of soybean exported and capacity utilization of main ports.

4.2 Corn

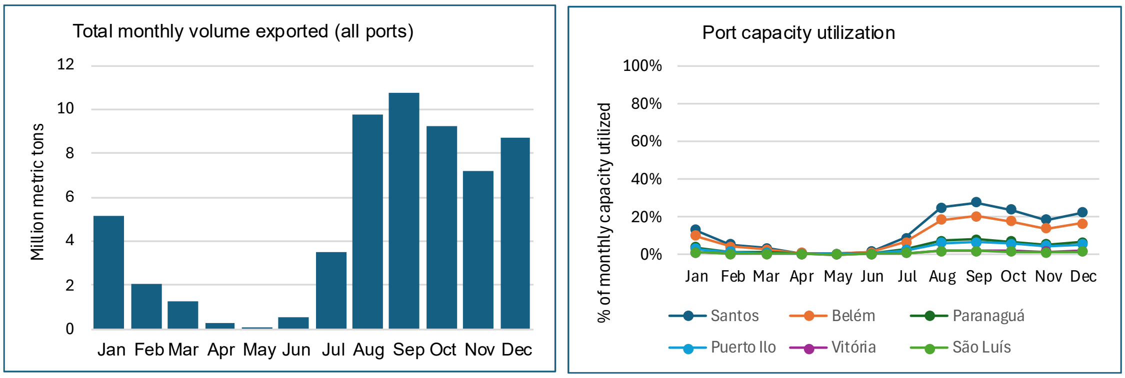

Figure 54 – 2035 – Ports – Rondon Quadrant Route - Total monthly volume of corn exported and capacity utilization of main ports.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being linked to any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

The joint analysis of transport routes, network spatial layout, and operational port capacity allows for an integrated interpretation of soybean logistics in the country. The data show a supply chain concentrated around a few major ports, with Santos playing a central role, along with pronounced seasonality that translates into port capacity utilization peaks throughout the year. The presence of orphan corridors identified in the geospatial database underscores the importance of continuous monitoring of alternative routes—both for their logistics potential and for the social and environmental impacts associated with their eventual expansion. This set of observations can serve as a foundation for future discussions on multimodal infrastructure investment and seasonal port operation planning.

6. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Consolidated Report – 2035 – Ports – Transoceanic (Bioceanic) Railway

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 20 mapped ports. Corn moved 87 million metric tons, of which 58 million metric tons (67%) went through one of the 28 ports in its network.

Soybean travels an average weighted distance of 15,560.41 km based on the volume transported, compared to 11,916.68 km for corn, and costs proportionally more per metric ton (BRL 906.33 vs. BRL 755.03), a difference that reflects the relative weight of each product in long-distance export routes (Table 41).

Table 41 – 2035 – Ports – Transoceanic (Bioceanic) Railway - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87 Mt
Volume via ports	103 Mt (73%)	58 Mt (67%)
No. of mapped ports	20	28
Top origin state (UF)	N/D	N/D
Weighted average distance	15,560.41 km	11,916.68 km
Weighted average cost	R$ 906.33/t	R$ 755.03/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors. For this reason, each product is presented on its own map, with line thickness indicating the flow intensity along each segment.

2.1 Soybean

The map below (Figure 55) shows the soybean outflow network, with line thickness proportional to the flow intensity along each segment.

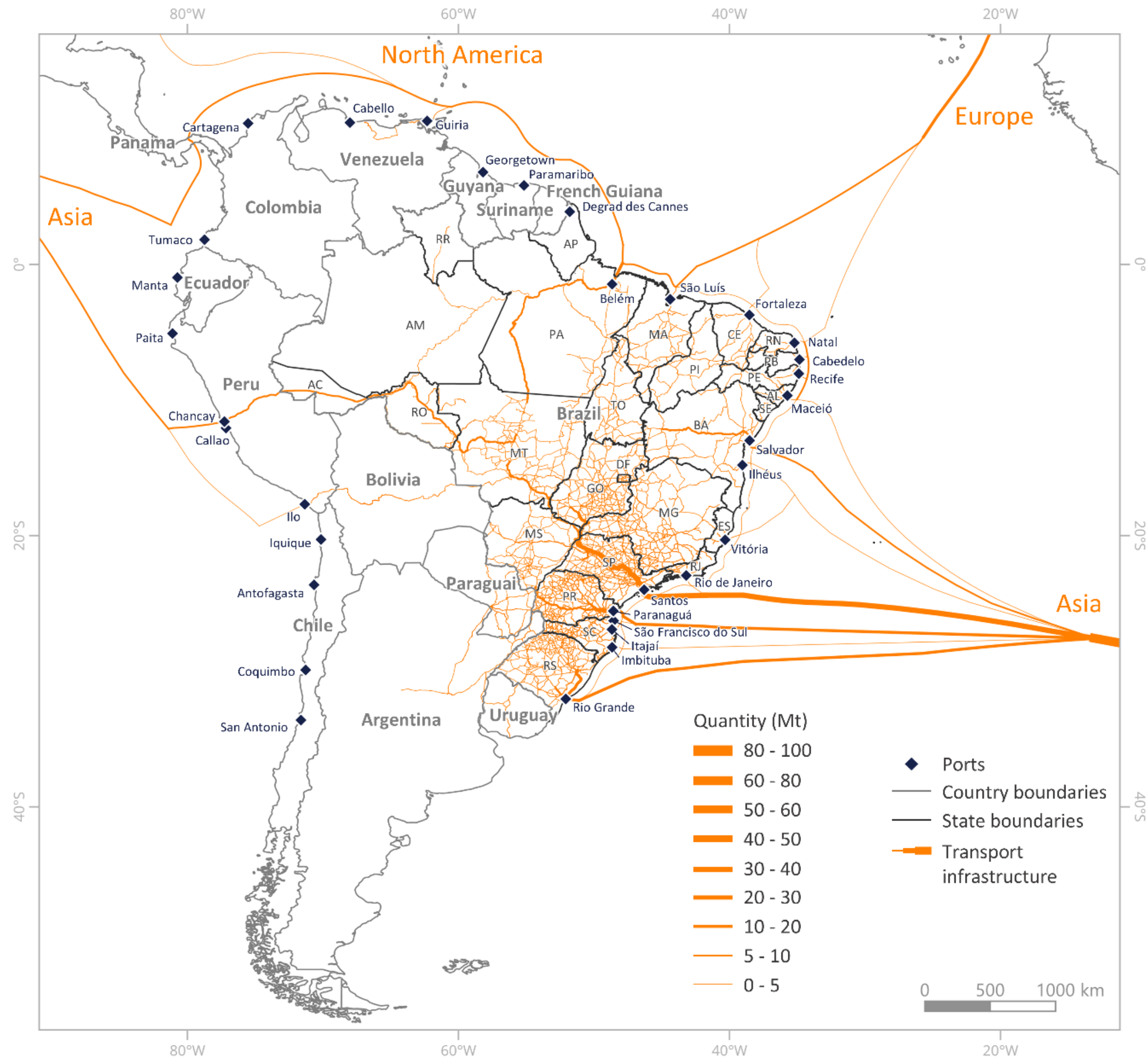

Figure 55 – 2035 – Ports – Transoceanic (Bioceanic) Railway - Soybean shipment routes to ports.

2.2 Corn

The map below (Figure 56) shows the corn outflow network, with line thickness proportional to the flow intensity along each segment.

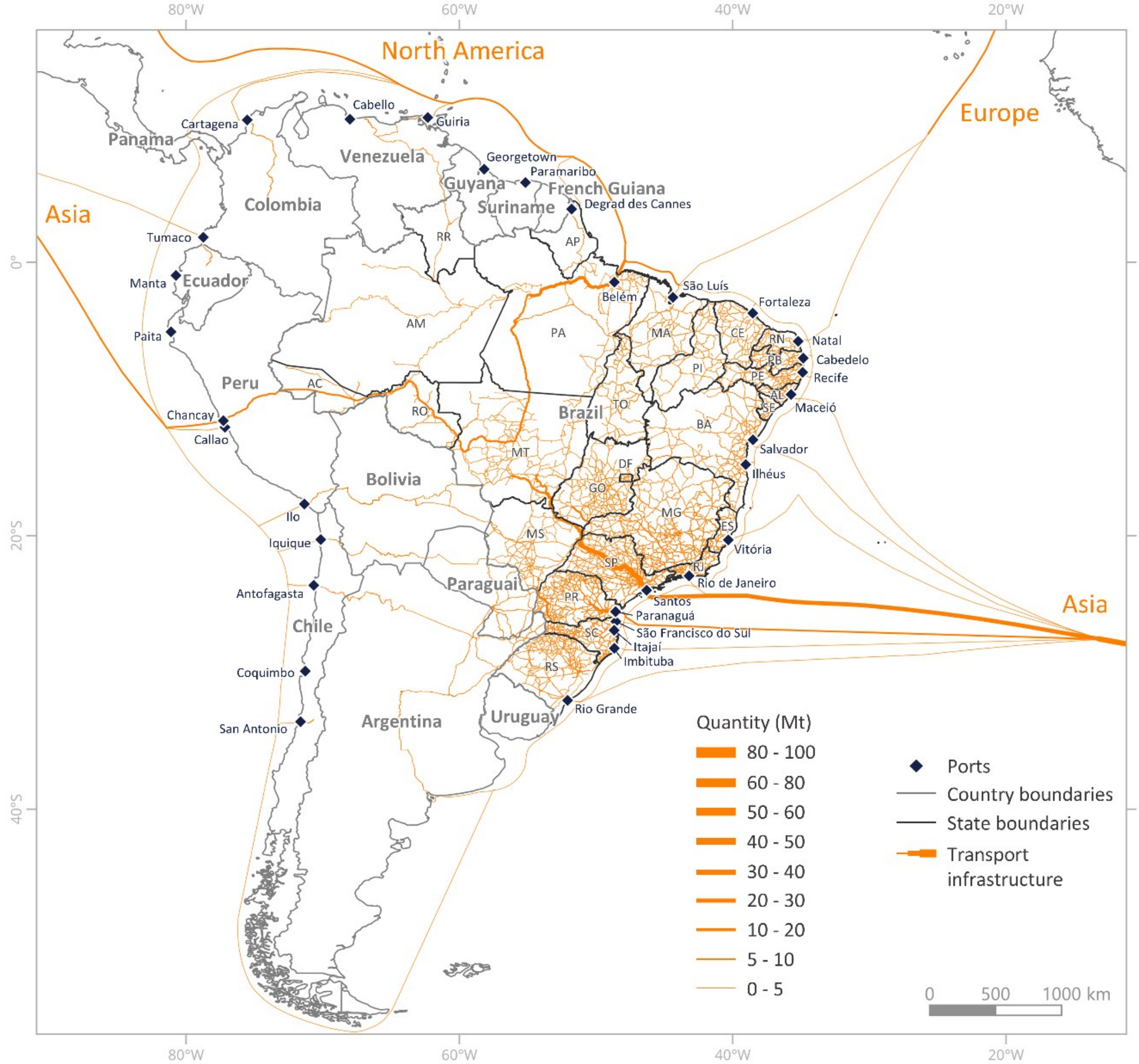

Figure 56 – 2035 – Ports – Transoceanic (Bioceanic) Railway - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The table below (Table 42) brings together, for the main ports of each product, the total volume moved during the year, the share of total volume exported by the port network, and the average transport cost per metric ton, with soybean and corn shown side by side. The symbol "—" indicates that the port does not appear individually in that product's original source table, being included within the total for "Other ports".

Table 42 – 2035 – Ports – Transoceanic (Bioceanic) Railway - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	32.8	31.9%	663	25.9	44.4%	717
Rio Grande	16.0	15.6%	606	—	—	—

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Belém	15.2	14.8%	820	11.6	19.9%	675
Paranaguá	12.7	12.3%	895	6.5	11.2%	814
Chancay (PE)	8.5	8.2%	1,393	6.4	10.9%	1,398
Salvador	7.0	6.8%	677	—	—	—
São Luís	3.8	3.7%	781	1.4	2.4%	523
Vitória	—	—	—	1.7	3.0%	465
Cartagena (CO)	—	—	—	1.0	1.8%	806
Other ports	6.9	6.7%	—	3.7	6.4%	—

Santos leads the outflow of both products, but with a different weight between them: it concentrates 31.9% of soybean and 44.4% of corn. Rio Grande and Salvador appear only in the soybean network, while Vitória and Cartagena (CO) appear only in the corn network.

3. Port Dynamics and Shipping Capacity

The monthly shipping capacity of each port is generally the same regardless of the product. It is the terminal's physical infrastructure that sets the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each harvest exerts on this shared capacity (Table 43).

Table 43 – 2035 – Ports – Transoceanic (Bioceanic) Railway - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Belém	15,000	8.4%	14.3%	6.5%	14.2%
Cabedelo	15,000	0.0%	0.0%	0.1%	0.2%
Chancay (PE)	15,000	4.7%	8.0%	3.5%	7.8%
Fortaleza	15,000	0.0%	0.1%	0.1%	0.2%
Güiria (VE)	15,000	0.0%	0.0%	—	—
Ilhéus	15,000	0.3%	0.5%	—	—
Imbituba	15,000	0.6%	1.0%	—	—
Itajaí	15,000	0.7%	1.2%	—	—
Antofagasta (CH)	15,000	—	—	0.0%	0.0%
Bahía Blanca (AR)	15,000	—	—	0.0%	0.1%
Cartagena (CO)	15,000	—	—	0.6%	1.4%
Degrad des Cannes (GF)	15,000	—	—	0.0%	0.0%

Belém and Cabedelo, two of the largest terminals in absolute capacity, maintain relative capacity buffers for both products and serve as safety valves for the system.

4. Transport Seasonality

The charts below (Figure 57 and Figure 58) show, for each product, the total volume exported per month across all ports (left) and the evolution of the capacity utilization rate at major terminals throughout the year (right).

4.1 Soybean

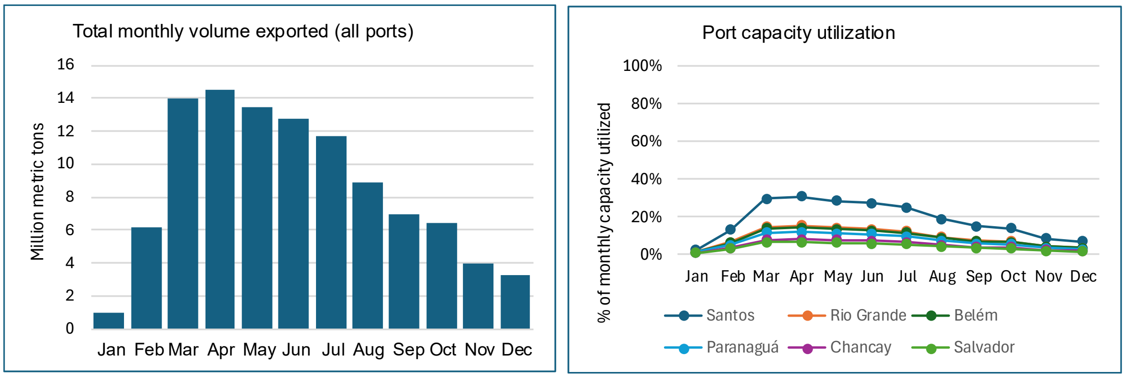

Figure 57 – 2035 – Ports – Transoceanic (Bioceanic) Railway - Total monthly volume of soybean exported and capacity utilization of main ports.

4.2 Corn

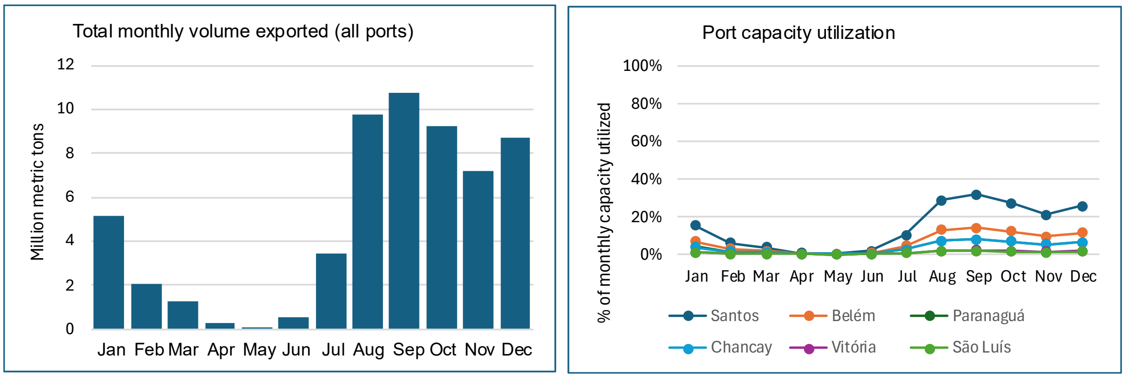

Figure 58 – 2035 – Ports – Transoceanic (Bioceanic) Railway - Total monthly volume of corn exported and capacity utilization of main ports.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being linked to any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

The joint analysis of transport routes, network spatial layout, and operational port capacity allows for an integrated interpretation of corn logistics in the country. The data show a supply chain concentrated around a few major ports, with Santos playing a central role, along with pronounced seasonality that translates into port capacity utilization peaks throughout the year. The presence of orphan corridors identified in the geospatial database underscores the importance of continuous monitoring of alternative routes—both for their logistics potential and for the social and environmental impacts associated with their eventual expansion. This set of observations can serve as a foundation for future discussions on multimodal infrastructure investment and seasonal port operation planning.

6. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

2035 Scenario – All Investments

This scenario assumes investments that raise the monthly shipping capacity of all ports to 15 million metric tons for each product, in addition to the implementation of all projects relative to the Current Scenario - Baseline.

Consolidated Report – All Investments implemented

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 19 mapped ports. Corn moved 87 million metric tons, of which 58 million metric tons (67%) went through one of the 27 ports in its network.

Soybean travels an average weighted distance of 15,716.52 km based on the volume transported, compared to 12,103.52 km for corn, and costs proportionally more per metric ton (BRL 907.05 vs. BRL 753.32), a difference that reflects the relative weight of each product in long-distance export routes (Table 44).

Table 44 - All Investments implemented - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87 Mt
Volume via ports	103 Mt (73%)	58 Mt (67%)
No. of mapped ports	19	27
Top origin state (UF)	N/D	N/D
Weighted average distance	15,716.52 km	12,103.52 km
Weighted average cost	R$ 907.05/t	R$ 753.32/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors. For this reason, each product is presented on its own map, with line thickness indicating the flow intensity along each segment.

2.1 Soybean

The map below (Figure 59) shows the soybean outflow network, with line thickness proportional to the flow intensity along each segment.

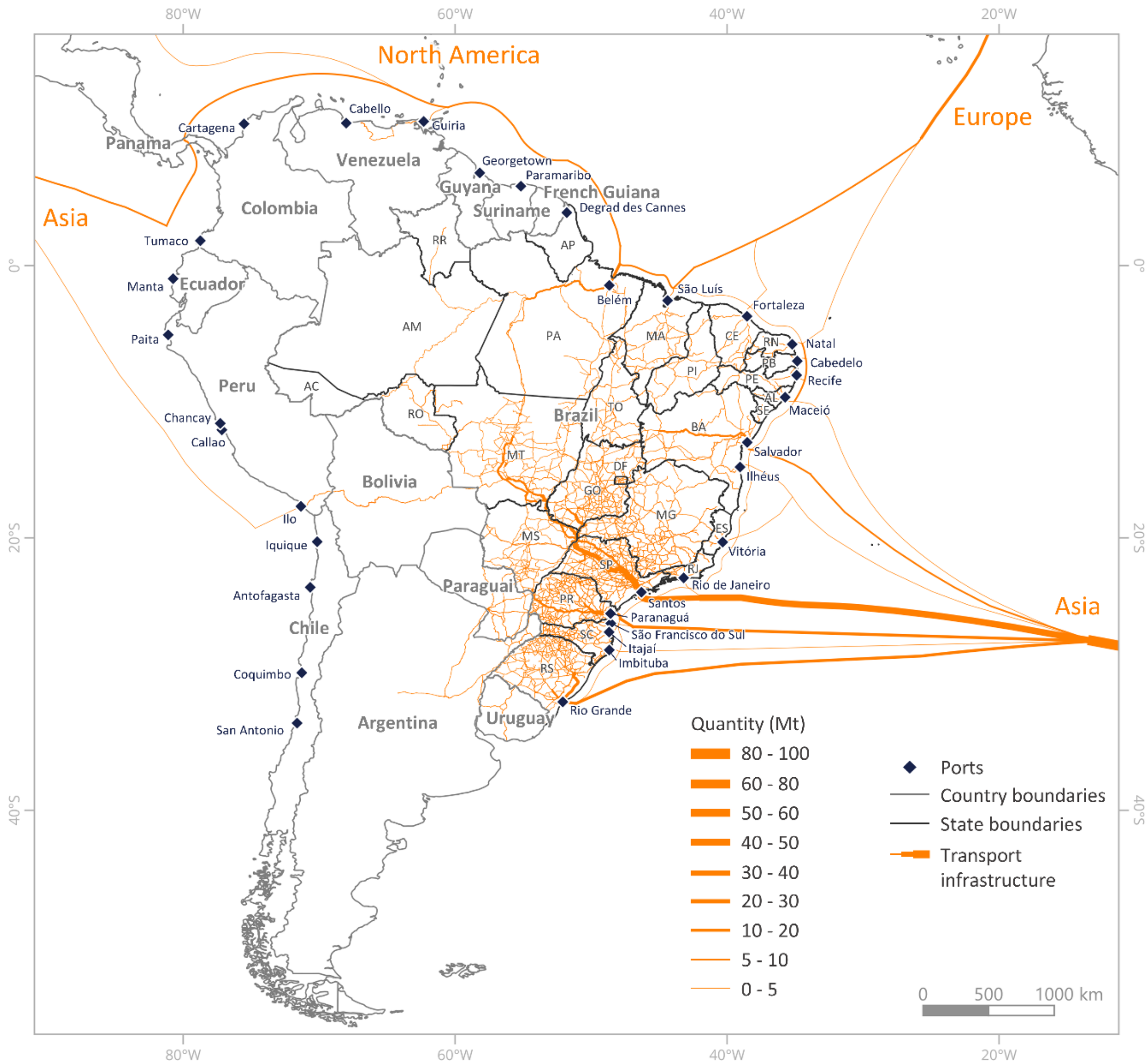

Figure 59 - All Investments implemented - Soybean shipment routes to ports.

2.2 Corn

The map below (Figure 60) shows the corn outflow network, with line thickness proportional to the flow intensity along each segment.

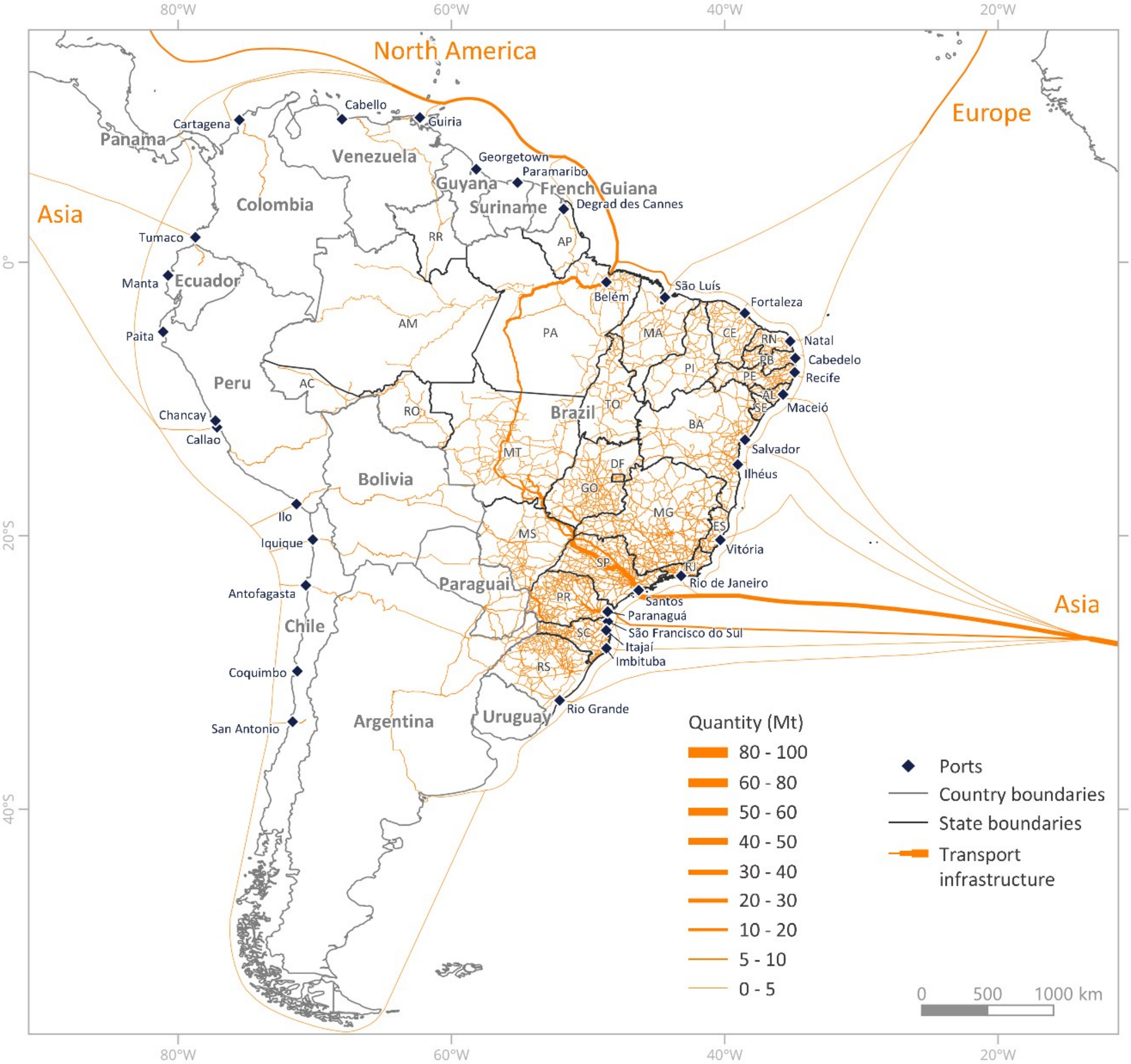

Figure 60 - All Investments implemented - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The table below (Table 45) brings together, for the main ports of each product, the total volume moved during the year, the share of total volume exported by the port network, and the average transport cost per metric ton, with soybean and corn shown side by side. The symbol "—" indicates that the port does not appear individually in that product's original source table, being included within the total for "Other ports".

Table 45 - All Investments implemented - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	41.3	40.1%	681	30.6	52.4%	725
Rio Grande	16.0	15.6%	606	0.9	1.5%	843

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Belém	15.1	14.7%	847	13.1	22.5%	685
Paranaguá	12.8	12.4%	886	6.5	11.2%	815
Salvador	7.0	6.8%	649	—	—	—
São Luís	3.8	3.7%	769	1.4	2.5%	509
Vitória	3.7	3.6%	797	1.6	2.8%	521
Cartagena (CO)	—	—	—	1.0	1.8%	801
Demais ports	3.3	3.2%	—	3.2	5.4%	—

Santos leads the outflow of both products, but with a different weight between them: it concentrates 40.1% of soybean and 52.4% of corn. Salvador appears only in the soybean network, while Cartagena (CO) appears only in the corn network.

3. Port Dynamics and Shipping Capacity

The monthly shipping capacity of each port is generally the same regardless of the product. It is the terminal's physical infrastructure that sets the ceiling, not the crop being transported. What changes—and changes significantly—is the pressure that each harvest exerts on this shared capacity (Table 46).

Table 46 - All Investments implemented - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Belém	15,000	8.4%	14.2%	7.3%	16.0%
Cabedelo	15,000	0.0%	0.0%	0.1%	0.2%
Fortaleza	15,000	0.0%	0.1%	0.1%	0.2%
Güiria (VE)	15,000	0.0%	0.0%	0.0%	0.1%
Ilhéus	15,000	0.3%	0.5%	—	—
Imbituba	15,000	0.6%	1.0%	—	—
Itajaí	15,000	0.7%	1.2%	—	—
Maceió	15,000	0.0%	0.0%	—	—
Antofagasta (CH)	15,000	—	—	0.0%	0.0%
Bahía Blanca (AR)	15,000	—	—	0.0%	0.1%
Cartagena (CO)	15,000	—	—	0.6%	1.4%
Degrad des Cannes (GF)	15,000	—	—	0.0%	0.0%

Belém and Cabedelo, two of the largest terminals in absolute capacity, maintain relative capacity buffers for both products and serve as safety valves for the system.

4. Transport Seasonality

The charts below (Figure 61 and Figure 62) show, for each product, the total volume exported per month across all ports (left) and the evolution of the capacity utilization rate at major terminals throughout the year (right).

4.1 Soybean

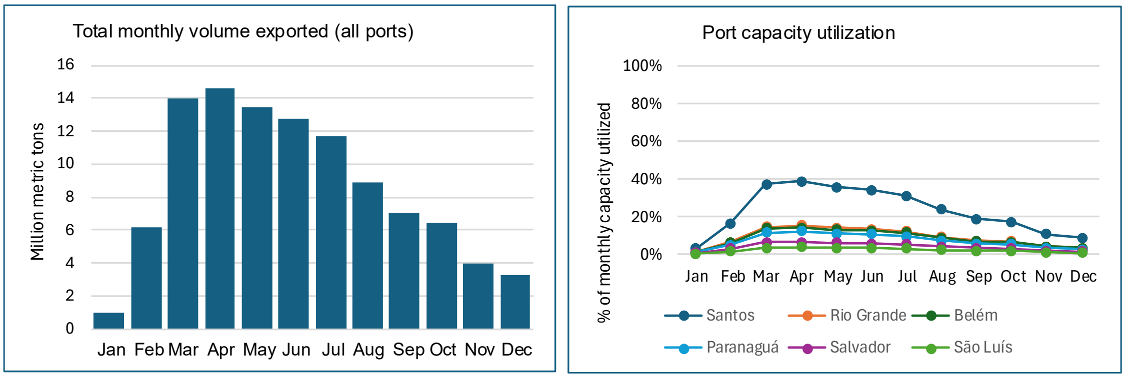

Figure 61 - All Investments implemented - Total monthly volume of soybean exported and capacity utilization of main ports.

4.2 Corn

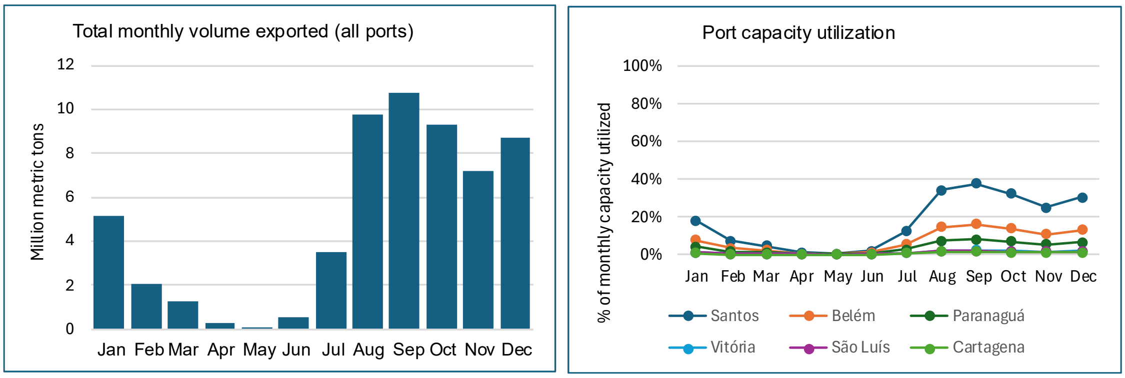

Figure 62 - All Investments implemented - Total monthly volume of corn exported and capacity utilization of main ports.

Because peaks rarely coincide between the two commodities, the same ports typically serve both crops over the course of the year without pressure accumulating into a single period—one of the key hidden strengths of the current infrastructure from a network planning perspective.

5. Orphan Corridors

Each product can reveal within its network a logistics corridor that crosses international borders without being linked to any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than a single export pattern.

The joint analysis of transport routes, network spatial layout, and operational port capacity allows for an integrated interpretation of soybean logistics in the country. The data show a supply chain concentrated around a few major ports, with Santos playing a central role, along with pronounced seasonality that translates into port capacity utilization peaks throughout the year. The presence of orphan corridors identified in the geospatial database underscores the importance of continuous monitoring of alternative routes—both for their logistics potential and for the social and environmental impacts associated with their eventual expansion. This set of observations can serve as a foundation for future discussions on multimodal infrastructure investment and seasonal port operation planning.

6. Final Considerations

An integrated reading of the tables and maps for soybean and corn makes it possible to identify the extent to which both products share the same port infrastructure and where each exerts distinct pressure on the network. Ports showing high utilization for both commodities warrant investment priority, as they concentrate operational risk throughout virtually the entire year. Conversely, ports with high utilization in only one of the two products indicate terminals that are more dedicated to a single crop, offering a relative capacity buffer outside their respective peak window. Orphan corridors, where present, require continuous monitoring as regional infrastructure advances—both for their potential to relieve traditional terminals and for the social and environmental impacts that their eventual consolidation may entail.

Cenário 2035 – All Investments and Transoceanic (Bioceanic) Railway

This scenario assumes investments that raise the monthly shipping capacity of all ports to 15 million metric tons for each product, in addition to the implementation of all projects, including the full Transoceanic (Bioceanic) Railway, relative to the Current Scenario - Baseline.

Consolidated Report - All Investments and Transoceanic (Bioceanic) Railway

1. Overall Transport Overview

Soybean moved 142 million metric tons in the analyzed cycle, of which 103 million metric tons (73%) passed through one of the 20 mapped ports. Corn moved 87 million metric tons, of which 58 million metric tons (67%) went through one of the 28 ports in its network.

Soybean travels an average weighted distance of 15,656.31 km based on the volume transported, compared to 12,010.24 km for corn, and costs proportionally more per metric ton (BRL 905.65 vs. BRL 752.49), a difference that reflects the relative weight of each product in long-distance export routes (Table 47).

Table 47 - All Investments and Transoceanic (Bioceanic) Railway - General comparative dashboard between soybean and corn.

Indicator	Soybean	Corn
Total volume transported	142 Mt	87 Mt
Volume via ports	103 Mt (73%)	58 Mt (67%)
No. of mapped ports	20	28
Top origin state (UF)	N/D	N/D
Weighted average distance	15,656.31 km	12,010.24 km
Weighted average cost	R$ 905.65/t	R$ 752.49/t

2. Transport Route Maps

The soybean and corn networks have distinct layouts, geographic reaches, and orphan corridors. For this reason, each product is presented on its own map, with line thickness indicating the flow intensity along each segment.

2.1 Soybean

The map below (Figure 63) shows the soybean outflow network, with line thickness proportional to the flow intensity along each segment.

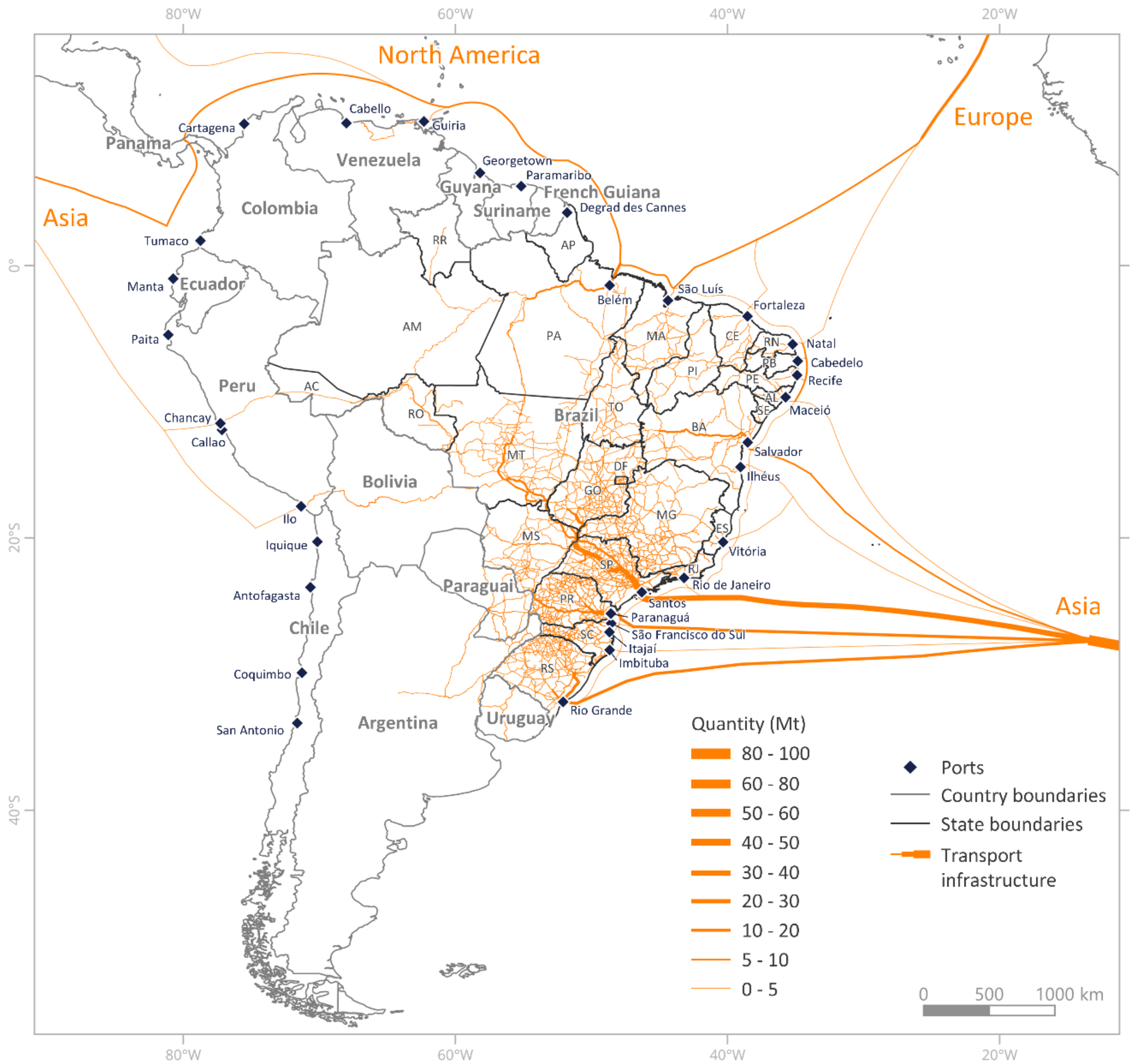

Figure 63 - All Investments and Transoceanic (Bioceanic) Railway - Soybean shipment routes to ports.

2.2 Corn

The map below (Figure 64) shows the corn outflow network, with line thickness proportional to the flow intensity along each segment.

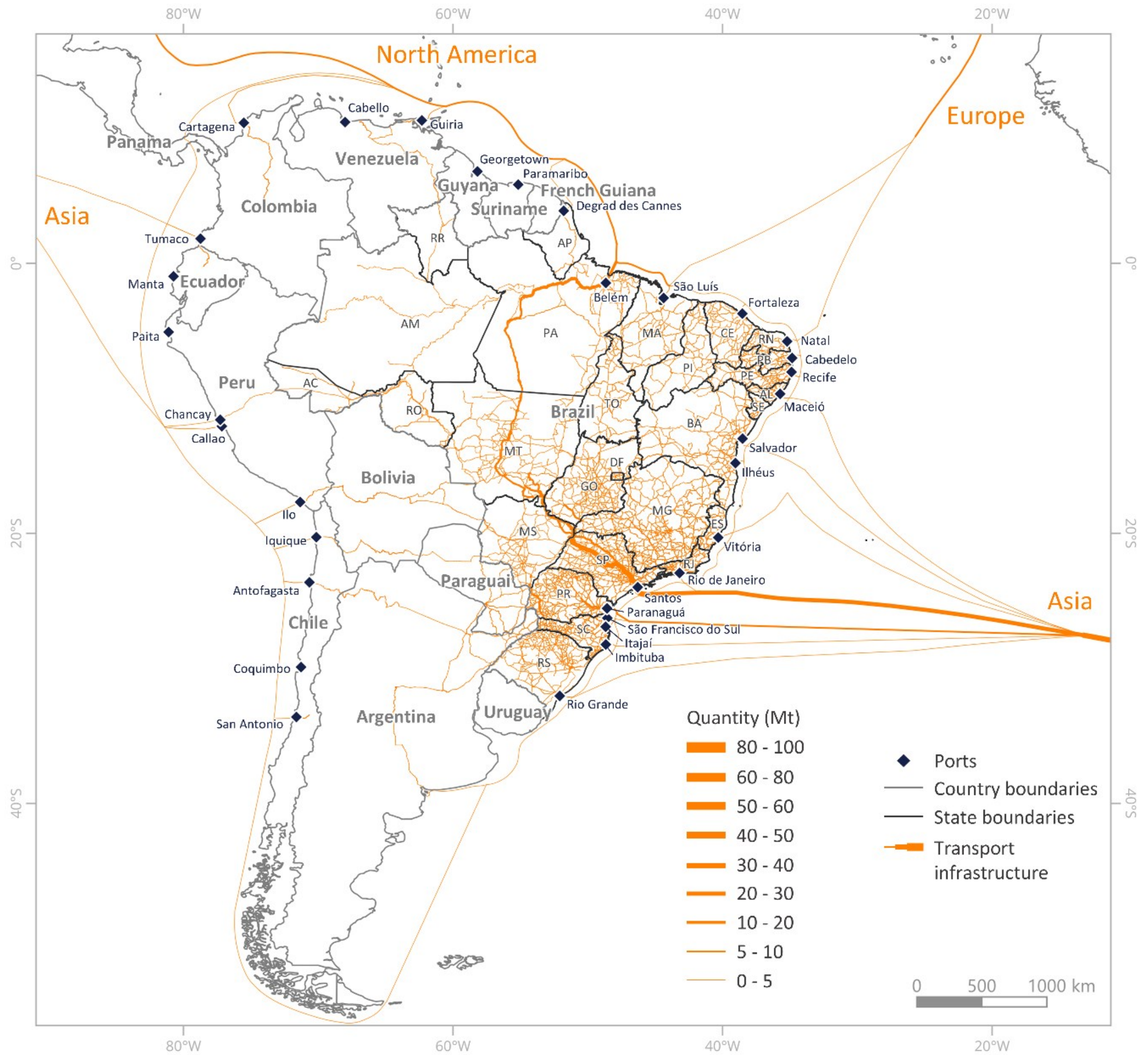

Figure 64 - All Investments and Transoceanic (Bioceanic) Railway - Corn shipment routes to ports.

2.3 Volume and Cost by Port

The table below (Table 48) brings together, for the main ports of each product, the total volume moved during the year, the share of total volume exported by the port network, and the average transport cost per metric ton, with soybean and corn shown side by side. The symbol "—" indicates that the port does not appear individually in that product's original source table, being included within the total for "Other ports".

Table 48 - All Investments and Transoceanic (Bioceanic) Railway - Volume, share, and average transport cost by port, soybean and corn.

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Santos	39.9	38.7%	677	30.2	51.6%	716
Rio Grande	16.0	15.6%	602	—	—	—

Port	Soybean			Corn		
	Vol. (Mt)	Share	Cost (R$/t)	Vol. (Mt)	Share	Cost (R$/t)
Belém	14.2	13.7%	804	11.0	18.9%	660
Paranaguá	12.8	12.4%	887	6.6	11.2%	811
Salvador	7.0	6.7%	650	—	—	—
São Luís	3.8	3.7%	779	1.4	2.5%	509
Vitória	3.7	3.6%	792	1.6	2.8%	521
Chancay (PE)	—	—	—	2.7	4.6%	1,385
Cartagena (CO)	—	—	—	1.0	1.8%	801
Other ports	5.7	5.6%	—	3.8	6.6%	—

Santos leads the outbound transport of both products, but with a different share for each: it accounts for 38.7% of the soybean and 51.6% of the corn. Rio Grande and Salvador appear only in the soybean network, while Chancay (PE) and Cartagena (CO) appear only in the corn network.

3. Port Dynamics and Shipping Capacity

The monthly loading capacity of each port is, in general, the same regardless of the product. It is the terminal's physical infrastructure that sets the ceiling, not the crop being transported. What changes—and changes considerably—is the pressure each harvest places on that shared capacity (Table 49).

Table 49 - All Investments and Transoceanic (Bioceanic) Railway - Installed (shared) capacity and monthly utilization by port and by product.

Port	Capacity (Mt/month)	Soybean		Corn	
		Average Util.	Max Util.	Average Util.	Max Util.
Belém	15,000	7.9%	13.3%	6.1%	13.5%
Cabedelo	15,000	0.0%	0.0%	0.1%	0.2%
Chancay (PE)	15,000	1.4%	2.5%	1.5%	3.3%
Fortaleza	15,000	0.0%	0.1%	0.1%	0.2%
Güiria (VE)	15,000	0.0%	0.0%	—	—
Ilhéus	15,000	0.3%	0.5%	—	—
Imbituba	15,000	0.6%	1.0%	—	—
Itajaí	15,000	0.6%	1.0%	—	—
Antofagasta (CH)	15,000	—	—	0.0%	0.0%
Bahía Blanca (AR)	15,000	—	—	0.0%	0.1%
Cartagena (CO)	15,000	—	—	0.6%	1.4%
Degrad des Cannes (GF)	15,000	—	—	0.0%	0.0%

Belém and Cabedelo, two of the largest terminals in terms of absolute capacity, maintain relative spare capacity for both products and function as safety valves for the system.

4. Transport Seasonality

The charts below (Figure 65 and Figure 66) show, for each product, the total volume shipped per month across all ports (left) and the evolution of capacity utilization rates at the main terminals throughout the year (right).

4.1 Soybean

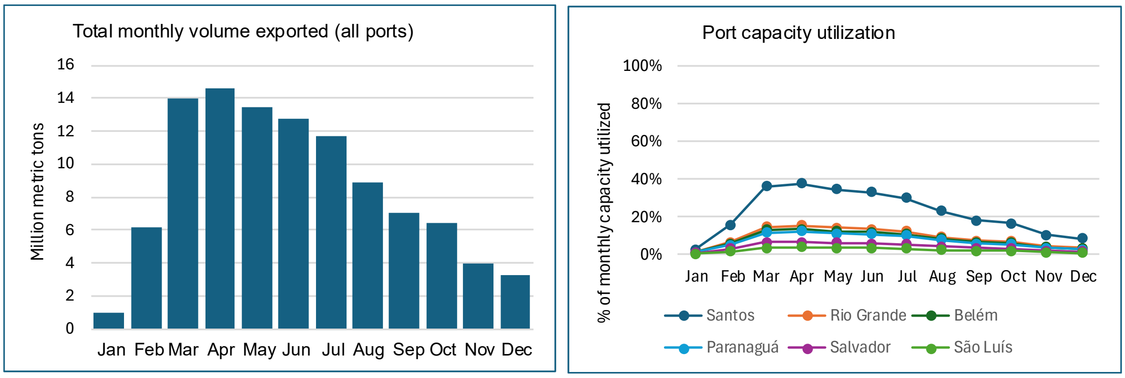

Figure 65 - All Investments and Transoceanic (Bioceanic) Railway - Total monthly volume of soybean exported and capacity utilization of main ports.

4.2 Corn

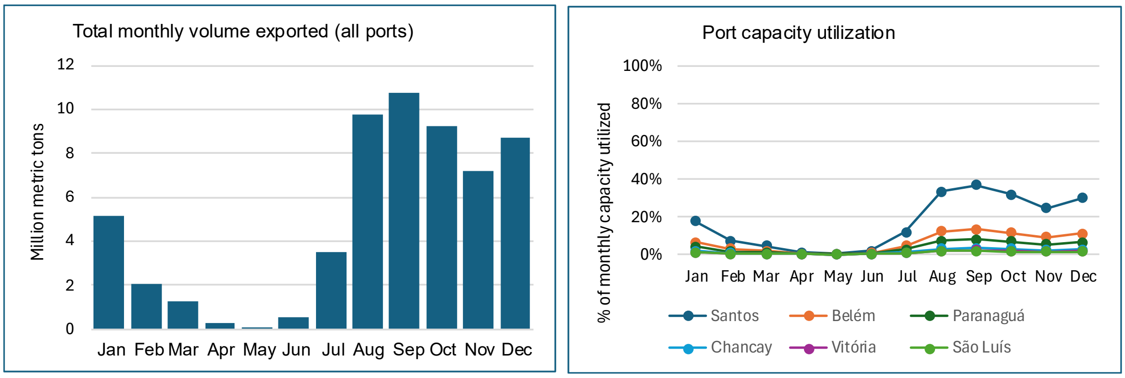

Figure 66 - All Investments and Transoceanic (Bioceanic) Railway - Total monthly volume of corn exported and capacity utilization of main ports.

Because the peaks rarely coincide between the two products, the same ports can typically handle both crops throughout the year without pressure accumulating in a single period—one of the biggest hidden advantages of the current infrastructure from a network planner’s perspective.

5. Orphan Corridors

Each product may reveal, within its network, a logistics corridor that crosses international borders without being associated with any formally monitored port. These corridors differ from one another, indicating that the choice of alternative routes responds to the specific geography of each crop rather than to a single, uniform flow pattern.

The joint analysis of transportation routes, the geographic layout of the network, and the operational capacity of the ports provides an integrated view of corn logistics in the country. The data show a chain concentrated in a few major ports, with Santos playing a central role, and pronounced seasonality that translates into peaks in port utilization throughout the year. The presence of orphan corridors identified in the geospatial database further underscores the importance of continuous monitoring of alternative routes, both because of their logistical potential and the social and environmental impacts associated with their potential expansion. Taken together, these observations can provide a basis for future discussions on investment in multimodal infrastructure and on the seasonal planning of port operations.

6. Final Considerations

A joint analysis of the tables and maps for soybean and corn makes it possible to identify the extent to which the two products share the same port infrastructure and the points at which each places different pressures on the network. Ports that show high utilization for both products should be prioritized for investment, as they concentrate operational risk during virtually the entire year. In contrast, ports with high utilization for only one of the two products indicate terminals that are more dedicated to a single crop, with relatively available capacity outside its peak season. Orphan corridors, when present, warrant continuous monitoring as regional infrastructure develops, both because of their potential to relieve traditional terminals and because of the Social and Environmental Impacts that their eventual consolidation may bring.

8 Comparative Summary of the Scenarios

Three consolidated reports were prepared to compare the scenarios. This is a preliminary study, still ongoing, that tracks changes in the continental logistics system.

8.1 Comparison of the Eight Scenarios Against the Current Baseline

Consolidated analysis of eight logistics infrastructure scenarios. The seven alternative scenarios are evaluated against the Current scenario, taken as the baseline, with emphasis on reducing distance and the weighted average cost per ton transported.

Executive Summary

This report evaluates eight logistics infrastructure scenarios for the transportation of soybean and corn from Brazil: Current, Amazonian, Antofagasta, Capricorn, Coquimbo, Guianas, Rondon, and Transoceanic. The Current scenario represents a snapshot of the infrastructure currently in place and serves as the reference against which all other scenarios are measured. The other seven represent proposed alternatives aimed at expanding the transportation network, easing the burden on the most congested ports, and, ideally, reducing the distance and average transportation cost per ton.

The central evaluation metric is the weighted average cost per ton, which incorporates both the overland journey to the port and the maritime distance to the destination market. The weighted average distance follows the same logic: the longer the total route, the higher the freight cost and the greater the greenhouse gas emissions per ton shipped. Reducing these two indicators is the ultimate test of any proposed logistics improvement.

The central conclusion of the analysis is straightforward: six of the seven alternative scenarios produce no measurable improvement in distance or cost relative to the Current scenario. The observed variations are below 0.5%, within the range of natural fluctuations in routing data, and do not represent genuine gains in logistics efficiency.

The Rondon scenario shows a modest improvement in corn transportation costs (-1.0%), but at the cost of completely saturating the port of Belém due to the inclusion of the Ferrogrão railway in the project. The only scenario that produces a significant and structural gain is the Transoceanic scenario, which reduces the average distance for soybean by 23% and the cost by 17%, but depends on railway infrastructure that has not yet been implemented.

The intermediate scenarios have a distinct analytical value. The progressive mapping of alternative logistics corridors that are not yet formally monitored—such as the Uruguayan soybean corridor, the bi-oceanic corridor to Antofagasta, access to French Guiana, and the Southern Interoceanic corridor, via Bolivia, to the Peruvian port of Ilo—reveals that the continental logistics network is denser and more diversified than official data capture. These corridors do not yet alter the average indicators, but they point to the directions in which traffic growth may occur as regional infrastructure advances.

The Current Scenario as the Baseline

Under the Current scenario, soybean travel an average of 15,734 km from origin to the destination port, at a weighted average cost of R$908.93 per ton. Corn travels 12,143 km at R$757.79/t—a shorter distance and lower cost because the crop, harvested as a second-season crop in the second half of the year, uses a shipping window in which shorter routes are more accessible and the ports of the Northern Arc operate with greater relative spare capacity.

Santos is the dominant terminal, handling 39.7% of soybean and 52.5% of corn volumes shipped by port. Belém, the second-largest terminal, accounts for 16.3% of soybean and 25.6% of corn, and already operates at 83.9% of capacity during the soybean peak and 93.7% during the corn peak—levels that place the port permanently in the operational risk zone. Rio Grande completes the picture of pressured ports, reaching 92.8% utilization during the soybean peak. Salvador reaches 100% in certain months, but its absolute volume is small and its role in the network is marginal. No international logistics corridors beyond the formally cataloged terminals are identified.

This scenario (Table 50) defines the core problem that the alternative scenarios attempt to solve. Belém and Rio Grande operate near capacity, the reliance on Santos creates systemic vulnerability, and no alternative routes capable of redistributing flow and reducing average transport costs have been identified. The following seven scenarios are evaluated in light of this baseline.

Table 50 Consolidated comparative panel: 8 scenarios - key indicators.

INDICATOR GENERAL OVERVIEW — WEIGHTED AVERAGE DISTANCE AND COST	Current	Amazonian	Antofagasta	Capricorn	Coquimbo	Guianas	Rondon	Transoceanic
Scenario	Current infra. (baseline)	Current + internat. corn ports	Current + Antofagasta Link	Current — greater conc. Santos	Current — balanced distrib.	Current + French Guiana corridor	Expanded Northern Arc	Transoceanic Railway
Avg. distance — Soybean (km)	15,734	15,734	15,734	15,726	15,735	15,738	15,739	**12,094**
Avg. distance — Corn (km)	12,143	12,143	12,143	**12,137**	12,143	12,144	12,141	12,141
Average cost — Soybean (R$/t)	908.93	908.93	908.93	906.15	908.76	908.51	905.04	**756.91**
Average cost — Corn (R$/t)	757.79	757.79	757.79	755.43	757.73	756.93	**750.04**	**750.04**
No. of ports — Soybean	14	14	14	14	14	14	14	**16**
No. of ports — Corn	N/D	18	18	18	18	18	18	**19**
PORT OF SANTOS								
Share — Soybean	39.7%	39.7%	39.7%	43.4%	39.9%	39.5%	35.1%	38.7%
Average cost — Soybean (R$/t)	577	577	577	530	**496**	577	570	670
Max. util. — Soybean	81.3%	81.2%	81.4%	88.7%	81.6%	80.8%	73.1%	80.5%
Share — Corn	52.5%	52.5%	52.5%	53.3%	52.7%	52.5%	46.7%	52.2%
Average cost — Corn (R$/t)	631	631	631	627	**613**	631	638	649
Max. util. — Corn	78.9%	78.9%	78.9%	80.3%	78.9%	78.8%	76.1%	78.8%
PORT OF BELÉM (NORTHERN ARC)								
Share — Soybean	16.3%	16.3%	16.3%	16.3%	16.3%	16.5%	**20.8%**	15.6%
Average cost — Soybean (R$/t)	860	861	862	855	861	861	869	827
Max. util. — Soybean	83.9%	83.9%	83.9%	83.9%	83.9%	84.9%	100%	80.9%
Share — Corn	25.6%	25.6%	25.6%	25.6%	25.7%	25.7%	**31.2%**	23.5%
Average cost — Corn (R$/t)	631	631	631	629	629	629	621	**603**
Max. util. — Corn	93.7%	93.7%	93.7%	93.7%	93.7%	93.9%	100%	88.8%
RIO GRANDE AND PARANAGUÁ								
Rio Grande — max. util. soybean	92.8%	92.8%	92.5%	90.8%	90.6%	92.8%	92.7%	92.8%
Paranaguá — soybean share	13.0%	13.1%	13.0%	9.2%	13.1%	13.1%	13.1%	13.1%
ORPHAN CORRIDORS AND MOST CRITICAL PORT								
Uncatalogued corridor — Soybean	—	Uruguay ~45,000 t (1st id.)	—	Uruguay ~45,000 t (2nd)	Uruguay ~45,000 t (3rd)	Uruguay ~45,000 t (4th)	Uruguay ~45,000 t (5th)	Uruguay ~45,000 t (5th)
Uncatalogued corridor — Corn	—	Antofagasta ~450 t	Antofagasta ~1,200 t	Antofagasta ~450 t	Antofagasta ~450 t	Antofagasta ~450 t + French Guiana	Antofagasta + Guiana + Bolivia→Ilo ~12,000 t	Antofagasta + Guiana + Bolivia; Callao ~970,000 t; Chancay ~260,000 t

INDICATOR GENERAL OVERVIEW — WEIGHTED AVERAGE DISTANCE AND COST	Current	Amazonian	Antofagasta	Capricorn	Coquimbo	Guianas	Rondon	Transoceanic
Most critical port(s)	Belém 93.7% corn	Belém 93.7% corn	Belém 93.7% corn	Belém 93.7% corn Santos 88.7% soybean	Belém 93.7% corn	Belém 93.9% corn	Belém 100% soybean and corn	Chancay 100% soybean and corn

Comparison of Scenarios with the Baseline

This section evaluates each of the seven alternative scenarios against the Baseline, which serves as the reference point. For each scenario, we examine the effects on weighted average transport distance and cost—the two central indicators of logistics efficiency—flow redistribution among terminals, pressure on installed capacity, and the alternative corridors identified. The analysis objectively records when a scenario shows no improvement, when it produces marginal gains, and when it represents a real structural shift.

Amazonian Scenario — Expanded Mapping Without Efficiency Gains

The Amazonian scenario maintains the exact same distance and cost indicators as the Baseline: soybean travels 15,734 km at R$ 908.93/t, and corn travels 12,143 km at R$ 757.79/t. The difference from zero is practically non-existent: there is no improvement in the two core indicators driving the search for alternative scenarios. The flow distribution across ports is likewise identical: Santos handles 39.7% of the soybean and 52.5% of the corn, Belém handles 16.3% and 25.6%, and Paranaguá handles 13.1%. Terminal utilization levels also remain unchanged: Belém continues to reach 83.9% at the peak of the soybean season and 93.7% at the peak of the corn season.

What the Amazonian scenario adds lies not in efficiency indicators, but in mapping completeness. It is the first iteration to formally incorporate the four international terminals that already receive Brazilian corn: Cartagena in Colombia, Callao in Peru, San Antonio in Chile, and Bahía Blanca in Argentina. Together, these four ports account for a mere 0.4% of the corn volume handled by port—a volume far too marginal to shift average indicators, yet their presence confirms that the corn logistics network already crosses international borders on a regular basis. Furthermore, the scenario identifies, for the first time, two orphan corridors: the soybean corridor originating in the far south of Rio Grande do Sul heading toward Uruguayan ports, with approximately 45,000 annual metric tons, and the overland corn corridor crossing Paraguay and northern Argentina to the Chilean coast near Antofagasta, carrying around 450 metric tons. These findings hold relevant informational value for long-term planning, but offer no relief to congested ports nor reduce outbound transport costs in the short term.

The conclusion regarding the Amazonian scenario is that it represents an advance in the understanding of the continental logistics network, but not an advance in logistics efficiency itself. For the objective of relieving Belém, Rio Grande, and Santos, the scenario offers no practical solution.

Capricorn Scenario — Marginal Cost Improvement with Loss of Resilience

The Capricorn scenario is the first in the series to present a measurable variation in cost and distance indicators compared to the Baseline, albeit a modest one. The average distance for soybean decreases from 15,734 km to 15,726 km, a reduction of just 8.6 km or 0.05%. The weighted average cost for soybean drops from R$ 908.93/t to R$ 906.15/t, a reduction of R$ 2.78/t or 0.31%. For corn, the trends are similar: distance drops by 6 km (0.05%) and cost declines by R$ 2.36/t (0.31%). These gains do exist, but they are so small that they represent no practical change for producers or logistics operators.

The origin of this minor improvement is important to understand the underlying mechanism. The Capricorn scenario directs more cargo to Santos, which has the lowest unit cost among the major terminals. Santos's share of soybean rises from 39.7% to 43.4%, the highest value in the entire series. As an arithmetic consequence, the weighted average cost drops marginally, as a port with a lower unit cost comes to account for a larger share of the total. The average transport cost via Santos for soybean drops from R$ 577/t to R$ 530/t, the lowest value recorded for this port across all scenarios, amplifying the effect of concentration on the average.

The problem is that this gain in average cost is accompanied by a significant loss of operational resilience. Paranaguá, the country's second-largest terminal by capacity, falls from a 13.0% to just a 9.2% share in soybean—less than half of what it historically handles. This emptying out of Paranaguá, without any efficiency improvement to technically justify it, makes the network more reliant on a single terminal. Santos, in turn, operates at a peak utilization of 88.7% for soybean, the highest figure recorded for this port, beginning to compromise its traditional function as a system safety valve. In short, the Capricorn scenario improves average costs by 0.31% at the expense of further concentrating the network around a single port already operating near capacity, thereby increasing systemic risk. The trade-off is not worth the gain.

Coquimbo Scenario — Balanced Distribution, but Without Real Cost Reduction

The Coquimbo scenario produces, in practice, no improvement over the Baseline across the two core indicators. The average soybean distance of 15,735 km is marginally higher than the Baseline (15,734 km)—a 0.63 km difference that holds no operational significance. The average soybean cost of R$ 908.76/t represents a reduction of just R$ 0.17/t compared to the Baseline (R$ 908.93/t), which is less than two cents. For corn, distance drops by 0.71 km and cost decreases by R$ 0.06/t. These variations lie entirely within the statistical fluctuation margin of the routing data and represent no real advance in efficiency.

What positively distinguishes the Coquimbo scenario is the more balanced distribution between Santos and Paranaguá. The former handles 39.9% of the soybean (close to the historical pattern of ~40%), while the latter reclaims its usual 13.1% share. This configuration maintains operational slack at Santos (peak utilization of 81.6% for soybean) and preserves Paranaguá as an effective outflow alternative. In terms of network resilience, the Coquimbo scenario is preferable to Capricorn. Transport cost via Santos for corn reaches its lowest value in the entire series under this scenario, at R$ 613/t compared to R$ 631/t in the Baseline—a reduction of R$ 18/t (2.9%). However, this localized gain is insufficient to alter the overall average cost, given the relative weight of the other ports.

The Coquimbo scenario also confirms, for the third consecutive time, the soybean corridor to Uruguayan ports, featuring the same route and volume (~45,000 metric tons). Its repetition across three independent versions of the dataset makes it increasingly difficult to attribute this corridor to a geospatial database inconsistency. Nevertheless, this finding does not lower the overall network logistics cost, as the volume is far too small to affect average figures. The conclusion regarding the Coquimbo scenario is that it represents the most balanced and resilient pattern, but fails to solve the central problem: the absence of cost and distance reductions.

Guianas Scenario — Discovery of New Corridors Without Indicator Improvements

The Guianas scenario produces variations in cost and distance that, in addition to being small, show mixed signals. Soybean distance increases slightly from 15,734 km to 15,738 km (+3.25 km), indicating a mild degradation, while the cost declines from

R$ 908.93/t to R$ 908.51/t (-R$ 0.42/t, -0.05%). For corn, distance grows by 0.72 km and cost drops by R$ 0.86/t (-0.11%). In practical terms, none of these variations carry economic or operational significance. The differences are smaller than the natural noise in the routing data and represent no shift in trajectory for cost and distance metrics.

The Guianas scenario confirms, for the fourth consecutive time, the soybean corridor to Uruguayan ports with the exact same route and volume (~45,000 metric tons). This fourth re-confirmation across independent versions of the geospatial database virtually eliminates the hypothesis of a data inconsistency. This corridor very likely represents a real, stable export flow from producers in the far south of Rio Grande do Sul through terminals such as Montevideo or Nueva Palmira. Despite the consistency of the evidence, the volume remains far too small to alter the aggregate indicators of the network.

For corn, the Guianas scenario yields its most relevant finding: the identification of a corridor originating in Amapá heading toward French Guiana, consistent with the port of Dégrad des Cannes. Observed for the first time in this analysis, this corridor moves a few hundred metric tons and passes through areas of preserved Amazon rainforest and indigenous territories. The route opens a new dimension in the understanding of corn logistics in northern Brazil. However, none of these corridors alter the reality of congested ports or lower the outbound transport cost for the network as a whole.

Rondon Scenario — The Greatest Northern Arc Relief, with Full Saturation of Belém

The Rondon scenario is the most distinct within the block and warrants a more detailed analysis. In terms of weighted average cost, it delivers the best benchmark for corn at R$ 750.04/t compared to R$ 757.79/t in the Baseline—a reduction of R$ 7.75/t, or 1.02%. For soybean, the cost drops from R$ 908.93/t to R$ 905.04/t (-R$ 3.89/t, -0.43%), also the lowest mark for this commodity. In terms of distance, however, there are no gains: soybean logs 15,739 km (4.47 km above the Baseline) and corn 12,141 km (2.56 km below). The cost reduction occurs without a reduction in distance, indicating a shift in flow composition: more cargo shifts to ports with lower unit costs, primarily Belém, even though the total route traveled is slightly longer.

The mechanism is clear in the port distribution. Belém jumps from 16.3% to 20.8% in soybean (+4.5 percentage points) and from 25.6% to 31.2% in corn (+5.6 pp). Santos declines from 39.7% to 35.1% in soybean and from 52.5% to 46.7% in corn. The average cost via Belém for corn is R$ 621/t—lower than in other scenarios—which drives the shift toward the Northern Arc and pulls the overall average down. This is the exact mechanism that produces the only notable cost reduction: not a shorter route or more efficient infrastructure, but a flow redistribution toward a terminal with a slightly lower unit cost.

The price of this redistribution, however, is critical. Belém reaches 100% capacity utilization during both the soybean peak and the corn peak—the sole case of full saturation among major Brazilian terminals across the entire series. With a monthly capacity of 2.928 million metric tons, Belém operates at its absolute limit in this scenario. This means any additional growth in production or export demand would find no space at the terminal, resulting in vessel queues, access-way congestion, and a loss of competitiveness for Brazilian grain in international markets. Santos, conversely, operates with the greatest headroom in the series, reaching a peak utilization of just 73.1% for soybean—well below typical levels. The country's largest terminal would be underutilized in this scenario while the second largest would be operating at its limit.

The Rondon scenario also identifies the highest-volume uncataloged corridor in the series: approximately 12,000 metric tons of corn traveling along the Southern Interoceanic Corridor, crossing the Bolivian interior to the port of Ilo on Peru's southern coast.

In summary, the Rondon scenario demonstrates that redistributing cargo to the Northern Arc under current infrastructure yields a 1% cost improvement for corn—the best result achieved—but only at the cost of completely saturating Belém. It presents a significant logistics paradox: the only alternative that relieves southern ports simultaneously exhausts the main northern port. The diagnosis provided by this scenario is more valuable than the solution it proposes. It pinpoints with precision that expanding Belém's capacity is the investment with the highest systemic return available under current infrastructure.

Transoceanic Scenario — The Only Structural Shift in the Series

The Transoceanic scenario (Transoceanic Railway-FICO-FIOL-Acre-Chancay) is the only one in the series that produces a structural change in the core indicators. The average distance for soybean drops from 15,734 km to 12,094 km, a reduction of 3,640 km, or 23.1%. The weighted average cost for soybean declines from R$ 908.93/t to R$ 756.91/t, a reduction of R$ 152.02/t, or 16.7%. These are not marginal gains: they represent a step-change that brings soybean, in this scenario, down to a cost level equivalent to what corn already achieves in the current network. In economic terms, considering the 142 Mt of soybean transported annually, a reduction of R$ 152/t represents a potential benefit on the order of R$ 21.6 billion per year, assuming the railway is operational and estimated costs are borne out in practice.

The mechanism behind this decline is the opening of a shorter route to the Pacific Ocean. The railway allows soybean produced in the Center-West region—which currently travels over 2,000 km by highway to Santos or Belém before crossing the Atlantic toward Asia—to reach the Peruvian ports of Callao and Chancay via an overland route traversing Acre and Andean territory. From the Pacific, the maritime distance to key soybean-importing markets, such as China and South Korea, is significantly shorter than via Santos or Belém. The result is a shorter overall route and, consequently, a lower overall cost.

For corn, however, the impact is negligible: distance decreases by just 2.56 km (0.02%) and cost declines by R$ 7.75/t (1.02%). Corn already utilizes relatively shorter routes and peak shipping occurs in the second half of the year, when traditional corridors operate with greater capacity headroom. The railway does not materially alter the cereal's logistical equation.

The Transoceanic scenario also incorporates Callao and Chancay as fully monitored terminals handling significant volumes. Callao jumps from marginal volumes in previous scenarios to 970,000 metric tons of corn and 1.2 Mt of soybean, while Chancay accounts for 260,000 metric tons of corn and 280,000 t of soybean. These volumes, when tied to the installed capacity of the Peruvian ports, reveal the scenario's primary bottleneck: Chancay operates at 100% capacity utilization twelve months a year for both crops, and Callao hits 100% across multiple months, averaging an 83.9% utilization rate for soybean. Designed to handle regional trade flows, Peruvian port infrastructure hits its absolute limit under current Brazilian agribusiness volumes.

This constraint does not invalidate the scenario, but it defines its primary prerequisite: efficiency gains depend not only on completing the railway—whose construction has not fully commenced—but also on a prior and substantial expansion of port capacity at Callao and Chancay. Furthermore, transport costs via Peruvian terminals, which exceed R$ 1,300/t in this scenario, must drop as scale increases for the route to solidify as a competitive alternative for Brazilian producers. The cost via Santos stands at R$ 670/t for soybean in this scenario, higher than the Baseline's R$ 577/t, suggesting that a portion of the flow previously using Santos shifts to Peruvian ports at a higher port cost, but over a shorter total distance. The benefit lies in the reduced maritime distance, not in lower unit port costs.

The ultimate assessment of the Transoceanic scenario is that it represents the only proposal capable of structurally transforming Brazilian soybean logistics. The gains are real, measurable, and substantial. However, the risks are equally real, including uncertain construction timelines, immediate saturation of Peruvian ports, high alternative route costs in its current stage, and reliance on investment decisions involving the sovereignty of three nations. This scenario is not a present-day solution; it is a long-term planning horizon that justifies coordinated investments today, particularly in expanding Chancay and Callao.

Integrated Logistics Network Analysis

What the Scenarios Reveal About the Current Network

The main conclusion that emerges from the systematic comparison of the eight scenarios is that Brazil's soybean and corn logistics infrastructure has reached a point of relative saturation at the margins. Minor routing adjustments within the current network—such as flow redistribution among existing ports, the recognition of corridors already in operation, or the incorporation of small-volume international terminals—yield no measurable reduction in average distance or cost. The six scenarios that differ from the Baseline show cost variations of less than 0.5% for soybean and less than 1.1% for corn. In a supply chain that moves 229 Mt/year at an average cost ranging between R$ 750 and R$ 910/t, these numbers do not represent any logistical paradigm shift.

This does not mean the network is optimized. Rather, it indicates that the identified bottlenecks—such as the saturation of Belém and Rio Grande, excessive reliance on Santos, and the dominance of road transport over long distances—cannot be resolved by reconfiguring routes within the existing infrastructure. They demand investment in new capacity.

The comparison of scenarios helps pinpoint where this investment yields the highest return. The Rondon scenario shows that shifting more cargo to the Northern Arc marginally reduces average costs, but saturates Belém immediately. The Transoceanic scenario demonstrates that new rail infrastructure can cut soybean travel distance by 23%, but requires decades of execution.

Seasonality as a Structural Asset of the Network

Um aspecto que a análise comparativa confirma em todos os cenários é o papel da sazonalidade complementar como principal ativo da infraestrutura compartilhada. A soybean tem seu pico de embarque entre março e julho, e o corn concentra 85% do seu volume entre agosto e dezembro. Essa complementaridade não é resultado de planejamento logístico deliberado. É uma consequência do calendário agrícola, mas seu efeito prático é multiplicar a capacidade efetiva do sistema sem custo adicional. Os mesmos terminais, os mesmos armazéns e os mesmos corredores atendem as duas culturas em janelas distintas, o que significa que a capacidade instalada trabalha ao longo de praticamente todo o ano, em vez de ficar ociosa por longos períodos. Em todos os oito cenários, essa complementaridade se mantém: nenhuma das configurações alternativas quebra o padrão sazonal de forma que os picos se sobreponham significativamente.

Belém as a Mirror of the System

Across the series of analyses, the port of Belém functions as a barometer of systemic tension in the network. In every scenario, Belém operates between 83.9% and 84.9% capacity at the soybean peak, and between 93.7% and 93.9% at the corn peak. These values sit consistently above the 85% threshold that port operations experts associate with the onset of chronic congestion. When the Rondon scenario forces more cargo to the Northern Arc, Belém hits 100%, indicating that the network immediately reaches its operational ceiling. Conversely, when the Transoceanic scenario diverts cargo to the Pacific, Belém drops to 80.9% for soybean and 88.8%

for corn—a modest but real margin of headroom that represents a positive side effect of the railway on the Northern Arc.

São Luís, the other major Northern Arc terminal, maintains an average utilization below 15% across all scenarios, despite having an installed capacity of 2.157 million metric tons/month. This chronic underutilization, standing in sharp contrast to Belém's overload, points to an unexploited flow redistribution opportunity within the Northern Arc itself. A portion of the cargo passing through Belém could be diverted to São Luís, relieving the former without requiring new infrastructure. The absence of such redistribution in the data suggests that cost factors, hinterland road infrastructure, or established commercial relationships systematically favor Belém—barriers that would need to be addressed through tariff policy or access road investments, rather than routing planning alone.

Orphan Corridors as a Window into the Future

The progression of findings across the series of analyses—from the Baseline scenario with no identified corridors to the Transoceanic scenario with Callao and Chancay incorporated and multiple overland corridors mapped—documents the gradual emergence of a continental logistics network far denser than the one captured by official monitoring. The Uruguayan soybean corridor, identified in five versions with the exact same route and volume, warrants formal incorporation into the monitoring system. It represents a real flow that offers producers in the far south of Rio Grande do Sul a shorter and potentially lower-cost route than traveling to Santos or Paranaguá. The fact that it is unmonitored does not mean it does not exist; it merely indicates that the current information system fails to capture it adequately.

The Bolivia–Ilo corridor, identified in the Rondon scenario with ~12,000 metric tons, is the most promising among the international overland corn corridors. Its route corresponds to the Southern Interoceanic Corridor, connecting Rondônia to the Peruvian coast through Bolivian territory. The Southern Interoceanic Corridor serves the producing regions of the Center-West and North via the Peruvian Andes—regions possessing a more developed logistics infrastructure than northern Argentina. Its volume growth from one version to another suggests that the route is maturing organically, independent of formal infrastructure policy decisions.

8.2 Comparative Consolidation, 2035 Horizon (Expanded Port Capacity)

Continental Soybean and Corn Logistics: Baseline, 2035, and Transoceanic Scenarios

Comparative analysis of three logistics infrastructure scenarios. The Baseline scenario corresponds to the infrastructure currently in place and serves as the reference point. The 2035 scenario projects port capacity expansion while holding demand constant. The Transoceanic scenario additionally incorporates the Transoceanic Railway (FICO-FIOL-Acre-Chancay), evaluating its impact on distance, cost, and flow distribution among ports.

Executive Summary

This report analyzes three infrastructure scenarios for the outbound transport of soybean and corn produced in Brazil: the Baseline scenario, describing the network currently in operation; the 2035 scenario, projecting a significant expansion of port capacity while keeping volumes and routes virtually unchanged; and the Transoceanic scenario, which adds the operation of the Transoceanic Railway (featuring the FICO-FIOL-Acre rail corridor and outbound transport via the Peruvian port of Chancay) onto the 2035 horizon. All three scenarios are evaluated using the same two central indicators: the weighted average distance traveled per metric ton and the weighted average transport cost per metric ton to the destination.

In the Baseline scenario, soybean travels an average of 15,734.86 km at a cost of R$ 908.93 per metric ton, while corn travels 12,143.34 km at R$ 757.79 per metric ton. Santos dominates the outflow of both commodities, handling 39.7% of the soybean and 52.5% of the corn, while Belém operates under high pressure, reaching 83.9% capacity at the peak of the soybean season and 93.7% at the peak of the corn season. Rio Grande reaches 92.8% utilization during the soybean peak, and Salvador hits 100% in certain months. No alternative international corridors are identified in this version of the network. This landscape serves as the baseline against which the following two scenarios are measured.

The 2035 scenario produces no measurable improvement in distance or cost: soybean shows a reduction of just 10.99 km (-0.07%) and R$ 0.33/t (-0.04%), while corn drops by 33.91 km (-0.28%) and R$ 0.47/t (-0.06%). These variations lie entirely within the margin of fluctuation for the routing data and represent no real gains in logistical efficiency. What changes significantly in this scenario is the installed port capacity. All terminals are projected at 15.0 million metric tons per month—a level far above current capacity—which drives utilization rates down to comfortable levels across the entire network. Belém, which currently reaches 93.7% at the corn peak, would drop to 16.6%. The 2035 scenario, therefore, does not solve the distance or cost issue; it resolves the port saturation problem through capacity investment.

The Transoceanic scenario delivers the only structurally distinct result of the set. Soybean drops by 174.45 km (-1.11%) and R$ 2.60/t (-0.29%) compared to the Baseline, while corn declines by 226.66 km (-1.87%) and R$ 2.76/t (-0.36%). More relevant than the variation in average indicators is the reconfiguration of flow distribution: Santos's share drops from 39.7% to 31.9% in soybean (-7.8 percentage points) and from 52.5% to 44.4% in corn (-8.1 percentage points), while Chancay, the new Peruvian terminal on the Pacific, absorbs 8.2% of the soybean and 10.9% of the corn. Belém maintains a relief trajectory similar to the 2035 scenario, reflecting the same projected capacity expansion. The cost per metric ton at Chancay is high—R$ 1,393/t for soybean and R$ 1,398/t for corn—signaling that the rail corridor compensates in total distance, but not in localized shipping costs. Its full viability depends on economies of scale and tariff negotiations that have yet to be worked out. The boundary condition of the Transoceanic scenario is the implementation of a rail line that has not yet been built, making the entire analysis conditional upon long-term investment decisions.

The Current Scenario as the Baseline

Aqui está a tradução para o inglês:

"In the Baseline scenario, Brazil's grain logistics network operates over an infrastructure that is consolidated in the Center-South and expanding in the Northern Arc. Soybean, with 142 million metric tons produced—of which 103 million (72%) pass through ports—travels significantly longer distances than corn, as a relevant portion of its production originates in the deep interior of the Center-West and southern Pará, connected to Northern Arc ports by long highways that partially lack rail parallels. Corn, harvested as a second crop (*safrinha*) in the second half of the year, benefits from a shipping window in which Northern Arc ports operate with greater relative headroom, reducing both average distance and cost per metric ton.

Santos is the dominant terminal, concentrating 39.7% of the soybean at R$ 577/t and 52.5% of the corn at R$ 631/t, with peak utilization of 81.3% and 78.9%, respectively—within acceptable ranges given the terminal's size. The pressure problem appears in smaller terminals. Belém reaches 83.9% at the soybean peak and 93.7% at the corn peak, placing the port permanently in the operational risk zone. Rio Grande reaches 92.8% for soybean. Salvador hits 100% in certain months, albeit with a small absolute volume. The absence of identified international corridors means all pressure is absorbed by the domestic network, with no external safety valves.

This starting point defines the dual problem that subsequent scenarios attempt to solve: the saturation of key terminals and the high average distance per metric ton, with direct impacts on cost and greenhouse gas emissions.

Comparison of Scenarios with the Current

2035 Scenario — Port Capacity Expansion Without Route Alterations

The 2035 scenario represents the same route infrastructure as the Baseline scenario projected over a ten-year horizon with substantially expanded port capacity. Transported volumes remain identical (142 million metric tons of soybean and 87 million metric tons of corn), and the same highways and corridors serve production. The result on efficiency indicators is, in practice, a lack of result. The average distance for soybean decreases from 15,734.86 km to 15,723.87 km—a difference of just 10.99 km, or -0.07%. The average cost for soybean moves from R$ 908.93/t to R$ 908.60/t, a variation of a mere R$ 0.33/t (-0.04%). For corn, the reduction is marginally higher in relative terms—33.91 km (-0.28%) and R$ 0.47/t (-0.06%)—but equally insignificant from an operational standpoint.

These variations represent no measurable improvement. Numbers on the order of 0.1% lie within the natural fluctuation margin of routing models and should not be interpreted as real efficiency gains. In plain language, the 2035 scenario, with respect to average distance and cost, changes nothing compared to the Baseline.

The real impact of the 2035 scenario lies exclusively in port infrastructure. The projection raises the installed capacity of all terminals to 15.0 million metric tons per month—a level far above current capacity in every case. Santos, which currently has a capacity of 7.137 million t/month, would move to 15.0 million t/month. Belém, currently at 2.928 million t/month, would also reach 15.0 million t/month. The immediate effect on utilization rates is dramatic: Belém, which today reaches 83.9% at the soybean peak and 93.7% at the corn peak, would drop to 15.2% and 16.6%, respectively. The saturation that currently characterizes Northern Arc terminals disappears entirely—not because flow was redirected, but because capacity was multiplied.

The 2035 scenario also records an expansion of the mapped port network. Soybean moves from 14 to 19 identified terminals, while corn moves from unavailable to 27 terminals. Orphan corridors appear for the first time: a Uruguayan corridor carrying around 45,000 metric tons of soybean and the port of Cartagena (Colombia) for corn, with a 1.8% share. These corridors confirm that the continental logistics network is denser than official data captures, and that flow growth through alternative routes is already manifesting at an incipient scale. However, their volumes remain far too marginal to alter systemic indicators.

In summary, the 2035 scenario offers no relief in distance or cost. Its contribution lies in port capacity expansion which, if realized, would eliminate the risk of saturation at the network's critical terminals—especially Belém and Rio Grande, currently the two most pressurized points. It is a scenario of resilience, not of efficiency.

Transoceanic Scenario: FICO-FIOL-Acre-Chancay Railway Over the 2035 Baseline

The Transoceanic scenario builds on the same expanded infrastructure as the 2035 scenario, adding the commissioning of the Transoceanic Railway—the rail corridor integrating FICO (Central-West Integration Railway), FIOL (West-East Integration Railway), the Acre segment, and the Peruvian terminal of Chancay on the Pacific. It is the only one of the three analyzed scenarios that produces a structural change in routes and efficiency indicators.

For soybean, weighted average distance decreases from 15,734.86 km to 15,560.41 km—a reduction of 174.45 km, or -1.11% compared to the Baseline. Average cost drops from R$ 908.93/t to R$ 906.33/t, a decline of R$ 2.60/t (-0.29%). For corn, the improvement is even more significant: distance decreases by 226.66 km (-1.87%), and cost drops by R$ 2.76/t (-0.36%). Although the percentage variations may seem modest in isolation, they represent the only real shift above statistical noise observed across the seven previous scenarios and the three scenarios in this analysis. Every measurable gain in distance and cost within this set of studies derives exclusively from the Transoceanic scenario.

The most significant change lies not in average indicators, but in the redistribution of flow among ports. Santos's share drops from 39.7% to 31.9% in soybean—a 7.8 percentage point reduction—and from 52.5% to 44.4% in corn, a decline of 8.1 percentage points. In absolute volume, Santos handles approximately 8.1 million metric tons less soybean and 4.7 million metric tons less corn compared to the Baseline. This flow migrates to Chancay, which appears for the first time in the network as a destination port, absorbing 8.5 Mt of soybean (8.2%) and 6.4 Mt of corn (10.9%). The structural reliance on Santos, which currently concentrates nearly 40% of soybean and 52% of corn on its own, would be materially reduced.

Belém follows a relief trajectory similar to that observed in the 2035 scenario: its share falls from 16.3% to 14.8% in soybean and from 25.6% to 19.9% in corn, with peak utilization rates dropping to 14.3% and 14.2%, respectively. This improvement, however, is mainly attributable to the capacity expansion shared with the 2035 scenario, rather than to the rail route itself.

A point requiring attention is the handling/shipping cost at Chancay: R$ 1,393/t for soybean and R$ 1,398/t for corn—values well above those at Santos (R$ 663/t and R$ 717/t in the Transoceanic scenario). While the railway reduces the total distance traveled, port costs at Chancay remain high, suggesting that economies of scale and operational maturity at the terminal will be decisive for the corridor's long-term economic viability. The net result today yields a reduction in average cost, but by a narrow margin; any deterioration in Chancay's port tariffs or increase in rail operating costs could reverse this gain.

The core prerequisite of the Transoceanic scenario is the construction of a railway that does not yet exist. The FICO-FIOL-Acre corridor involves hundreds of kilometers of new infrastructure across territories presenting significant geographical, environmental, and logistical challenges, as well as the international section to Chancay. The scenario demonstrates that, once implemented, the corridor generates real, measurable efficiency gains and load redistribution. However, the distance between projection and reality is measured in decades of construction, vast amounts of public and private investment, and regulatory decisions that transcend the scope of this analysis.

Integrated Analysis

When read together, the three scenarios in this analysis describe two distinct and complementary movements in Brazilian grain logistics policy. The first movement is one of resilience: the 2035 scenario relies on a massive expansion of port capacity to solve terminal saturation, without altering routes or reducing average travel distance. The second movement is one of efficiency: the Transoceanic scenario focuses on opening a new Pacific export corridor to redistribute flow, shorten distances, and reduce reliance on Santos.

The two movements are not mutually exclusive; the Transoceanic scenario incorporates the capacity expansion of the 2035 scenario while adding the rail corridor. However, their implementation horizons are radically different. Port expansion, while costly, is technically simpler and politically more viable than constructing thousands of kilometers of railway across sensitive biomes. The efficiency gains of the Transoceanic scenario are real but conditional; the resilience gains of the 2035 scenario are more predictable and less dependent on third-country decisions.

From the perspective of weighted average cost—the indicator most directly tied to the international competitiveness of Brazilian soybean and corn—only the Transoceanic scenario yields a variation above statistical noise. Soybean gains R$ 2.60/t (-0.29%) and corn gains R$ 2.76/t (-0.36%) compared to the Baseline. At scale, applied to the 103 million metric tons of soybean passing through ports, the R$ 2.60/t reduction represents potential savings on the order of R$ 268 million per year. For corn, multiplying the 58 million metric tons passing through ports by R$ 2.76/t results in approximately R$ 160 million annually. While these figures are significant in absolute terms, they remain modest relative to the construction cost of the rail corridor.

By absorbing 8.2% of the soybean and 10.9% of the corn, the Chancay corridor emerges as the third-largest destination for corn and the fifth-largest for soybean under the Transoceanic scenario. This flow redistribution is the primary contribution of the scenario: it structurally relieves Santos—unlike the capacity-based relief provided by the 2035 scenario—and opens a new access route to the Asian market that could gain increasing relevance as China and other Pacific importers expand their share of global grain trade.

The Uruguayan corridor, carrying approximately 45,000 metric tons of soybean in both the 2035 and Transoceanic scenarios, alongside the port of Cartagena (Colombia) handling 1.8% of the corn in both, represent a different dimension of this analysis: they are not projections of planned infrastructure, but records of flows that already exist or are emerging naturally on the margins of official data. While their volume remains marginal, their presence across two distinct scenarios suggests that the continental logistics network is growing organically in directions that formal models do not yet fully capture.

Conclusion

The analysis of the three scenarios—Current, 2035, and Transoceanic—confirms a straightforward conclusion: there is no short-term path to significantly reduce the average distance traveled or the average transportation cost per ton for the transportation of grains from Brazil. The 2035 scenario, despite projecting a radical expansion of port capacity, does not alter the routes or efficiency indicators to any meaningful extent. Its real contribution is to eliminate the risk of saturation at critical terminals, particularly Belém, currently the network's most vulnerable point. However, this benefit comes at the cost of large-scale port investments, with no impact on freight cost per ton.

The Transoceanic scenario is the only one that produces a measurable improvement that is structurally different from the Current scenario. The reduction of 174 km in the average distance for soybean (-1.11%) and 226 km in the distance for corn (-1.87%), combined with decreases of R$2.60/t and R$2.76/t in the respective costs, represents a genuine improvement, even if modest in percentage terms. More important than the average figures is the redistribution of flows. Santos's share falls by nearly 8 percentage points for both soybean and corn, while Chancay emerges as the fifth-largest soybean port and the third-largest corn port, creating an alternative Pacific outlet with significant medium- and long-term growth potential.

The decision-making horizon, however, is the major obstacle. The 2035 scenario depends on investments in port capacity that, although complex, are within the reach of medium-term decisions. The Transoceanic scenario depends on the construction of a railway crossing environmentally sensitive territories, involving multiple countries and requiring decades of construction and billions in investment. The recommendation emerging from this analysis is therefore twofold: invest in port capacity in the short and medium term to eliminate the bottlenecks identified in the Current scenario, particularly at Belém and Rio Grande; and maintain planning for the Transoceanic corridor over the long term as the only structural lever identified to date that is capable of significantly reducing the distance and cost of transporting grains from Brazil.

Consolidated Comparative Dashboard: 3 Scenarios (2035 Baseline) × Key Indicators

Table 51 - 3 Scenarios (2035 Baseline) × Key Indicators

INDICATOR **GENERAL OVERVIEW, WEIGHTED AVERAGE DISTANCE AND COST**	**Current**	**2035**	**Transoceanic**
Avg. distance, Soybean (km)	15,734.86	15,723.87	15,560.41
Avg. distance, Corn (km)	12,143.34	12,109.43	11,916.68
Change in soybean dist. vs. Current	—	-11 km (-0.07%)	-174 km (-1.11%)
Change in corn dist. vs. Current	—	-34 km (-0.28%)	-227 km (-1.87%)
Average cost, Soybean (R$/t)	908.93	908.60	906.33
Average cost, Corn (R$/t)	757.79	757.32	755.03
Change in soybean cost vs. Current	—	R$ -0.33/t (-0.04%)	R$ -2.60/t (-0.29%)
Change in corn cost vs. Current	—	R$ -0.47/t (-0.06%)	R$ -2.76/t (-0.36%)
No. of ports, Soybean	14	19	20
No. of ports, Corn	N/D	27	28
PORT OF SANTOS			

INDICATOR GENERAL OVERVIEW, WEIGHTED AVERAGE DISTANCE AND COST	Current	2035	Transoceanic
Share, Soybean	39.7%	39.1%	31.9%
Average cost, Soybean (R$/t)	577	683	663
Max. util., Soybean	81.3%	—	—
Share, Corn	52.5%	51.3%	44.4%
Average cost, Corn (R$/t)	631	730	717
Max. util., Corn	78.9%	—	—
PORT OF BELÉM (NORTHERN ARC)			
Share, Soybean	16.3%	15.7%	14.8%
Max. util., Soybean	83.9%	15.2%	14.3%
Share, Corn	25.6%	23.3%	19.9%
Max. util., Corn	93.7%	16.6%	14.2%
PORT OF CHANCAY (PE), NEW IN THE TRANSOCEANIC SCENARIO			
Share, Soybean	—	—	8.2%
Average cost, Soybean (R$/t)	—	—	1,393
Max. util., Soybean	—	—	8.0%
Share, Corn	—	—	10.9%
Average cost, Corn (R$/t)	—	—	1,398
Max. util., Corn	—	—	7.8%
PORT INFRASTRUCTURE, CAPACITY			
Installed cap., Santos (thousand t/month)	7,137	15,000	15,000
Installed cap., Belém (thousand t/month)	2,928	15,000	15,000
Installed cap., Rio Grande (thousand t/month)	2,456	15,000	15,000
Installed cap., Paranaguá (thousand t/month)	2,843	15,000	15,000

INDICATOR	Current	2035	Transoceanic
GENERAL OVERVIEW, WEIGHTED AVERAGE DISTANCE AND COST			
ORPHAN CORRIDORS			
Corridor, Soybean	None	Uruguay ~45,000 t	Uruguay ~45,000 t
Corridor, Corn	None	Cartagena (CO) Antofagasta	Cartagena (CO) Antofagasta Chancay active

In the 2035 and Transoceanic scenarios, all ports were modeled with a capacity of 15,000 thousand tons/month, making the percentage utilization rates comparable with the Current scenario only in terms of absolute volume, not relative pressure.

What the Comparison Definitively Reveals

The analysis of the eight scenarios, with the Current scenario as the baseline, leads to a conclusion that is uncomfortable but necessary. None of the alternatives proposed within the existing infrastructure can significantly reduce the cost or average transportation distance. Six of the seven alternative scenarios produce variations of less than 0.5% in soybean costs and less than 0.4% in corn costs. The Rondon scenario, the best-performing option for corn, achieves a 1% reduction in cost—a real improvement, but operationally limited because it requires Belém to operate permanently at 100% of capacity.

This means that Brazil's logistics problem—long distances, high costs, and dependence on road transportation—cannot be solved within the current infrastructure configuration. The network has reached a point where routing adjustments no longer generate meaningful efficiency gains. The next step-change in efficiency requires new infrastructure.

What Works, and Where to Invest

Expanding Belém's capacity is the most immediate and certain investment opportunity available within the current network. Across all scenarios, Belém operates between 83.9% and 100% of capacity during peak periods. Any growth in soybean and corn production over the coming years—and projections point to continued growth—will translate into chronic congestion in the Northern Arc before any other corridor. Expanding Belém's capacity while simultaneously activating São Luís as a complementary Northern Arc terminal would provide the most effective relief for the current network without requiring new inland transportation infrastructure.

The Transoceanic Railway is the only scenario that warrants long-term structural planning. Its gains of 23% in distance and 17% in cost for soybean are unique in the series and significant enough to alter the competitiveness of Brazilian products in Asian markets. Capacity planning at Peruvian ports, particularly Chancay, which reaches 100% utilization even with current volumes, needs to begin before completion of the railway. A railway that reaches saturated ports does not solve the problem; it merely shifts the bottleneck from land to sea.

The Uruguayan soybean corridor needs to be incorporated into the official monitoring system. Five consecutive identifications with identical routing and volume constitute strong evidence of an actual route. Formalizing this corridor does not create new infrastructure, but it enables more accurate planning for producers and operators in the southern half of Rio Grande do Sul.

Finally, the corridors through Bolivia and French Guiana warrant priority environmental monitoring before any consideration of expansion. Both cross ecologically sensitive areas, including the Amazon rainforest, Indigenous territories, and Cerrado transition zones, where the opening of logistics infrastructure without adequate safeguards has historically accelerated deforestation. The economic opportunity represented by these corridors is real, but it is contingent on environmental governance that, to date, has not been established.

8.3 Consolidação comparativa, todos os projetos implantados

Continental Soybean and Corn Logistics, Current, All Projects 2035 and Transoceanic+All 2035 Scenarios

Comparative analysis of three logistics infrastructure scenarios for the outflow of soybean and corn. The Current scenario (Scenario 1) describes the infrastructure operating today and serves as the baseline. The All 2035 scenario (Scenario 8) projects the implementation of every planned infrastructure project, except the Transoceanic Railway, with a 2035 horizon. The Transoceanic+All 2035 scenario (Scenario 10) adds to Scenario 8 the entry into operation of the Transoceanic Railway (FICO-FIOL-Acre-Chancay), assessing the marginal effect of this rail corridor on distance, cost and flow distribution.

Executive Summary

This report compares three logistics infrastructure scenarios for grain outflow in Brazil: the Current scenario, which portrays the network operating today and works as the baseline; the All 2035 scenario, which projects the full implementation of every infrastructure project in the pipeline, with the exception of the Transoceanic Railway; and the Transoceanic+All 2035 scenario, which adds the entry into operation of the FICO-FIOL-Acre rail corridor with unloading at the Peruvian port of Chancay. The three scenarios are assessed by the same two main indicators: the weighted average distance traveled per tonne and the weighted average transport cost to the export destination.

In the Current scenario, soybean travel an average of 15,734.86 km at a cost of R$ 908.93 per tonne, and corn travels 12,143.34 km at R$ 757.79 per tonne. Santos concentrates 39.7% of soybean outflow and 52.5% of corn. Belém operates under critical pressure, reaching 83.9% of its capacity at the soybean peak and 93.7% at the corn peak. Rio Grande reaches 92.8% during the soybean harvest. No alternative international logistics corridor is formally identified in this scenario. This picture defines the central problem: excessive concentration in Santos, saturation of the Northern Arc terminals and the absence of alternative outflow routes.

The All 2035 scenario produces the first real efficiency gains in this comparison. The average soybean distance falls by 18.34 km (–0.12%) and the cost drops R$ 1.88/t (–0.21%). For corn, the improvement is more pronounced: distance –39.82 km (–0.33%) and cost –R$ 4.47/t (–0.59%). The reduction in the cost of corn, in particular, goes beyond statistical noise and reflects the combined effects of the various infrastructure projects included in this scenario — railways, waterways and new terminals planned for 2035 —, with the exception of the Transoceanic. The expansion of port capacity to 15,000 thousand tonnes per month drives utilization rates down across the whole network and Belém falls from 93.7% to 16.0% at the corn peak, eliminating the network's main operational risk. Orphan corridors emerge: a Uruguayan axis with roughly 45 thousand tonnes of soybean and the port of Cartagena (Colombia) with 1.8% of the corn.

The Transoceanic+All 2035 scenario delivers the largest efficiency gain of the set, but with one important particularity in relation to earlier analyses. The Transoceanic Railway, in this scenario, absorbs corn flows, 4.6% of the total shipped through ports, but does not appear as a relevant destination for soybean. The average soybean distance falls by 78.55 km (–0.50%) and the cost drops R$ 3.28/t (–0.36%). For corn, the reduction is 133.10 km (–1.10%) and R$ 5.30/t (–0.70%). Santos's share falls 1.0 percentage point for soybean and 0.9 point for corn, a modest but consistent redistribution. Belém deepens the relief: maximum utilization for soybean goes to 13.3% and for corn to 13.5%. The shipping cost at Chancay for corn is R$ 1,385/t, well above the network average, which signals that the corridor has not yet matured economically enough to reduce the average cost more sharply.

The Current scenario as the baseline

In the Current scenario, grain logistics operates on an infrastructure centered on the road axis of the Center-South, with the Northern Arc still expanding. Soybean, with 142 million tonnes produced, of which 103 million (72%) pass through one of the 14 ports mapped, travel average distances significantly greater than those of corn. This is because their origins include the deep interior of Mato Grosso and Pará, regions served by long-distance highways with few rail or waterway alternatives. Corn, harvested as the second crop (safrinha) in the second half of the year, finds a shipping window with less competition at the Northern Arc terminals, which explains its lower average distance and cost.

Santos is the central node of the system: on its own it concentrates 39.7% of soybean at R$ 577/t and 52.5% of corn at R$ 631/t, with maximum utilization of 81.3% and 78.9%, respectively. Despite its size, Santos still operates with slack. The pressure problem lies in the smaller terminals. Belém reaches 83.9% at the soybean peak and 93.7% at the corn peak, operating permanently in the critical zone. Rio Grande reaches 92.8% for soybean. Salvador, with a small absolute volume, reaches 100% in specific months. No international corridor is formally identified in this scenario; all the pressure is absorbed by the domestic network.

This diagnosis establishes the three metrics of interest for the assessment of the alternative scenarios:

1. reduction of the weighted average distance and cost per tonne
2. deconcentration of flow away from Santos
3. relief of the critical terminals, especially Belém and Rio Grande.

Comparison of the Scenarios with the Current One

All Projects Implemented 2035

The Scenario represents the most ambitious infrastructure horizon without the Transoceanic Railway: all rail, waterway and port projects in the 2035 pipeline are taken as implemented, with demand held at the same volumes as the Current scenario. Unlike what was observed in earlier analyses, which projected port expansion alone, this scenario incorporates multiple vectors of network improvement, which translates into more perceptible efficiency gains in the average indicators.

For soybean, the average distance falls from 15,734.86 km to 15,716.52 km, a reduction of 18.34 km, or –0.12% in relation to the Current scenario. The average cost drops from R$ 908.93/t to R$ 907.05/t, a change of –R$ 1.88/t (–0.21%). Although the percentage change is still small, it is already above pure noise, signaling that the implementation of new rail and waterway stretches is beginning to shorten the longest routes from the interior. For corn, the effect is more pronounced: distance falls 39.82 km (–0.33%) and cost drops R$ 4.47/t (–0.59%). The saving of R$ 4.47 per tonne on corn, applied to the volume of 58 million tonnes shipped through ports, represents a potential of R$ 259 million per year, a figure that begins to acquire concrete economic relevance.

Santos's share of soybean, surprisingly, rises slightly from 39.7% to 40.1% (+0.4 percentage point). This indicates that the projects benefiting soybean have the effect of consolidating the route to Santos even further, probably through road or rail improvements that reduce the relative cost of routes already dominant in the Center-South, rather than redistributing the flow to other terminals. For corn, Santos's share remains practically unchanged at 52.4% (–0.1 pp). The Scenario, therefore, does not solve the concentration in Santos: it maintains or slightly reinforces it for soybean.

Where the Scenario produces an unequivocal impact is in the port utilization rates. With all terminals projected at 15,000 thousand tonnes per month of installed capacity, the risk of saturation disappears from the network. Belém, which today operates at 83.9% at the soybean peak and 93.7% at the corn peak, would fall to 14.2% and 16.0%, respectively, a complete reversal of the pressure situation. Rio Grande, today at 92.8% at the soybean peak, would also fit within comfortable margins. The elimination of capacity bottlenecks is Scenario 8's main contribution, and it occurs independently of any new transoceanic railway.

Two new corridors emerge in this scenario: the Uruguayan axis, with roughly 45 thousand tonnes of soybean, and the port of Cartagena (Colombia), with 1.8% of the corn shipped. Both are still marginal volumes, but their presence among 19 ports mapped for soybean (against 14 in the Current scenario) and 27 for corn points to a denser and more diversified continental logistics network in 2035. In short, this Scenario is a scenario of expanded resilience with incremental efficiency, since it does not solve the distance problem or the dependence on Santos in a structural way, but it does eliminate the capacity bottlenecks and deliver real savings in the cost of corn.

Transoceanic + All Projects 2035

This Scenario adds to the previous one the full operation of the Transoceanic Railway, with the FICO-FIOL-Acre corridor and unloading at the port of Chancay, in Peru. It is the infrastructure scenario with the broadest scope analyzed and, for that reason, the one that presents the largest efficiency gains in distance and cost in relation to the Current scenario.

For soybean, the average distance falls from 15,734.86 km to 15,656.31 km, a reduction of 78.55 km, or –0.50% in relation to the Current scenario. The average cost drops R$ 3.28/t (–0.36%), from R$ 908.93/t to R$ 905.65/t. For corn, the results are more expressive: distance falls 133.10 km (–1.10%) and cost drops R$ 5.30/t (–0.70%), from R$ 757.79/t to R$ 752.49/t. At scale, the saving of R$ 5.30/t on corn over 58 million tonnes represents a potential of R$ 307 million per year; that of R$ 3.28/t on soybean over 103 million tonnes, an additional R$ 338 million a year. These are the largest figures in this analysis.

One striking finding in this scenario is the asymmetry between soybean and corn in the use of the Chancay corridor. Unlike earlier projections, the Peruvian port appears in this model only in the corn network, absorbing 4.6% of the total volume shipped, without registering a relevant share of soybean. This indicates that the soybean routes originating in the Brazilian producing regions do not find in the Transoceanic corridor an advantage clear enough to divert them from the traditional path through the Atlantic ports. Soybean continue to be shipped predominantly through Santos (38.7%), Rio Grande (15.6%), Belém (13.7%), Paranaguá (12.4%) and Salvador (6.7%), a distribution practically identical to that of Scenario 8. The distance and cost gain for soybean in Scenario 10 in relation to Scenario 8 probably comes from improvements in the domestic network and from routing adjustments, not from a significant migration to Chancay.

For corn, the situation is different. The 4.6% that goes to Chancay — the equivalent of about 2.7 million tonnes — comes mainly out of Belém and Santos. Belém falls from 22.5% to 18.9%, and Santos retreats from 52.4% to 51.6%. This redistribution is consistent with the geography, where producing regions in Acre, Rondônia and southern Amazonas have, in this scenario, rail access to Chancay, at a total cost potentially competitive for corn, whose origins closer to the Acre stretch make the rail journey relatively shorter than for the soybean produced in more distant Mato Grosso.

The shipping cost at Chancay is R$ 1,385/t for corn, far above the network average, which shows that the Transoceanic corridor is not yet economically efficient per tonne shipped. The logic of its viability lies in the shorter total distance to the Asian market, which may offset the higher port cost. That equation, however, depends on transpacific maritime freight rates, long-term negotiations and the operational maturity of the Peruvian terminal — variables outside the scope of this model.

The relief for Belém deepens, with maximum utilization falling from 14.2% to 13.3% for soybean and from 16.0% to 13.5% for corn. This additional improvement is modest in absolute terms, since the main relief had already been delivered by the scenario with capacity expansion. This scenario's specific contribution is the redistribution of corn flow to the Pacific, which marginally reduces the pressure on the Northern Arc. In short, the scenario delivers the largest efficiency gains of this analysis, the greatest reduction in distance and cost for both products, but with more intense gains for corn than for soybean, and with the Transoceanic Railway operating mainly as a corn corridor, not a soybean one, in this model.

Integrated Analysis

The three scenarios in this analysis describe a coherent trajectory for the evolution of grain logistics infrastructure in Brazil, each stage adding a layer of improvement over the previous one. The Current scenario is the starting point: a network that is efficient by historical standards, but with serious operational bottlenecks at Belém and Rio Grande, and excessive dependence on Santos. The All Projects Scenario represents the best possible scenario without the Transoceanic Railway, since it eliminates the capacity bottlenecks, delivers real cost gains for corn (–R$ 4.47/t) and expands the port network, but it does not reduce the dependence on Santos and delivers modest improvements in distance. The Transoceanic+All Scenario adds the largest efficiency gain, especially for corn, and opens a new outflow axis through the Pacific via Chancay, but with soybean still barely involved in this corridor.

The comparison between the two alternative scenarios reveals an important result: the marginal effect of the Transoceanic Railway, that is, the additional gain, is more modest than the effect of the set of included projects over the Current scenario. For soybean, the cost reduction goes from –R$ 1.88/t (All projects vs. Current) to –R$ 3.28/t (Transoceanic+All vs. Current), a marginal gain of –R$ 1.40/t attributable exclusively to the railway. For corn, the railway's marginal gain is –R$ 0.83/t (from –R$ 4.47/t to –R$ 5.30/t). In other words, most of the efficiency gain projected for 2035 is already embedded in All projects. The Transoceanic Railway is a relevant complement, but not the main lever.

The risk dimension is equally important. All projects depends on the implementation of projects already at different stages of planning and execution in Brazil, a complex pipeline, but entirely within the scope of domestic decisions and with more defined timeframes. Transoceanic+All adds the construction of a transoceanic railway that involves multiple countries, decades of works, large-scale financing and diplomatic and regulatory negotiations that are very far from settled. The railway's incremental return, R$ 1.40/t more for soybean and R$ 0.83/t more for corn, must be assessed in light of that level of risk and uncertainty.

Finally, the sectoral distribution of the gains deserves strategic attention. Corn is consistently the biggest beneficiary in relative terms in both alternative scenarios, –0.59% in cost in Scenario 8 and –0.70% in Scenario 10, against –0.21% and –0.36% for soybean. This reflects the geography of production, where the regions with the fastest growth in corn output (Mato Grosso, Rondônia and Acre) are precisely those that benefit most from new rail and waterway corridors toward the North and the Pacific. Long-term infrastructure planning must take this differentiated profile into account, prioritizing investments that align the routing of the new corridors with the regions of greatest production growth.

Conclusion

The analysis of the three scenarios makes it possible to reach three objective conclusions.

First: the implementation of all the infrastructure projects planned for 2035, except the Transoceanic Railway, is already sufficient to eliminate the risk of saturation at the network's critical terminals, especially Belém, which today operates at the limit of its capacity for corn, and to deliver real savings in the cost of corn (–R$ 4.47/t) with smaller, but existing, gains for soybean (–R$ 1.88/t). This agenda, entirely domestic and with a more defined execution timeframe, should be treated as a short- and medium-term priority.

Second: the Transoceanic Railway, combined with the set of projects, delivers the largest efficiency gains of this analysis: soybean distance –0.50%, cost –0.36%, corn distance –1.10%, cost –0.70% in relation to the Current scenario. These gains are real and economically significant at aggregate scale. But the rail corridor, in this model, operates primarily as a corn route, with 4.6% of the grain's volume passing through Chancay, and not as a soybean route. The hypothesis that the Transoceanic would transform soybean outflow in a structural way is not confirmed by the data of this scenario, since soybean continue to be shipped through the same terminals and with practically identical shares.

Third: the marginal gain of the Transoceanic Railway over the set of projects, R$ 1.40/t of soybean and R$ 0.83/t of corn, is real, but modest in relation to the construction effort involved. The decision to move ahead with the railway should be based on a long-term cost-benefit analysis that goes beyond the weighted average distance and cost indicators assessed here, including the strategic valuation of the diversification of export routes, the capture of growing demand from the Asian market via the Pacific and the potential to induce regional development in the states of Brazil's northwestern arc.

Consolidated comparative panel: 3 scenarios (all projects) × key indicators

Tabela 1 — Quadro comparativo consolidado: 3 cenários (todos os projetos) × indicadores-chave

INDICATOR	Current	All, 2035 (Scenario 8)	Transoceanic + All (Scenario 10)
GENERAL OVERVIEW, WEIGHTED AVERAGE DISTANCE AND COST			
Avg. distance, Soybean (km)	15,734.86	15,716.52	15,656.31
Avg. distance, Corn (km)	12,143.34	12,103.52	12,010.24
Change in soybean dist. vs. Current	—	-18 km (-0.12%)	-79 km (-0.50%)
Change in corn dist. vs. Current	—	-40 km (-0.33%)	-133 km (-1.10%)
Average cost, Soybean (R$/t)	908.93	907.05	905.65
Average cost, Corn (R$/t)	757.79	753.32	752.49
Change in soybean cost vs. Current	—	R$ -1.88/t (-0.21%)	R$ -3.28/t (-0.36%)
Change in corn cost vs. Current	—	R$ -4.47/t (-0.59%)	R$ -5.30/t (-0.70%)
No. of ports, Soybean	14	19	20
No. of ports, Corn	N/D	27	28
PORT OF SANTOS			
Share, Soybean	39.7%	40.1% (+0.4 pp)	38.7% (-1.0 pp)
Average cost, Soybean (R$/t)	577	681	677
Max. util., Soybean	81.3%	—	—

INDICATOR	Current	All, 2035 (Scenario 8)	Transoceanic + All (Scenario 10)
Share, Corn	52.5%	52.4% (-0.1 pp)	51.6% (-0.9 pp)
Average cost, Corn (R$/t)	631	725	716
Max. util., Corn	78.9%	—	—
PORT OF BELÉM (NORTHERN ARC)			
Share, Soybean	16.3%	14.7%	13.7%
Max. util., Soybean	83.9%	14.2%	13.3%
Share, Corn	25.6%	22.5%	18.9%
Max. util., Corn	93.7%	16.0%	13.5%
PORT OF CHANCAY (PE), NEW IN SCENARIO 10			
Share, Soybean	—	—	— (does not absorb soybean)
Share, Corn	—	—	4.6%
Average cost, Corn (R$/t)	—	—	1,385
Max. util., Corn	—	—	3.3%
RIO GRANDE AND PARANAGUÁ			
Rio Grande, soybean share	15.6%	15.6%	15.6%
Rio Grande, max. util. soybean	92.8%	—	—
Paranaguá, soybean share	13.0%	12.4%	12.4%
Paranaguá, corn share	12.0%	11.2%	11.2%
PORT INFRASTRUCTURE, INSTALLED CAPACITY			
Santos (thousand t/month)	7,137	15,000	15,000
Belém (thousand t/month)	2,928	15,000	15,000
Rio Grande (thousand t/month)	2,456	15,000	15,000
Paranaguá (thousand t/month)	2,843	15,000	15,000
ORPHAN CORRIDORS			
Corridor, Soybean	None	Uruguay ~45,000 t	Uruguay ~45,000 t

INDICATOR	Current	All, 2035 (Scenario 8)	Transoceanic + All (Scenario 10)
Corridor, Corn	None	Cartagena (CO) Antofagasta	Cartagena (CO) Antofagasta Chancay (active)

9 Limitations of the method

Like any *ex-ante* approach, the study works with forecasts and scenarios, and not with observed results. The figures presented describe what the model estimates for each configuration of the network, and not what would necessarily be verified after the works are implemented. The scenarios also assume that each project is fully implemented and operating, which represents a simplification in relation to the real timelines for construction and entry into operation. It is worth remembering, as the comparative synthesis itself records, that this is a preliminary study, still in progress, which tracks the changes in the continental logistics system.

Some limitations concern the data. The analysis itself draws attention to the fact that variations below roughly 0.5% are within the natural fluctuation margin of routing models and should not be interpreted as real efficiency gains. The identification of orphan corridors, in turn, points to flows that deserve monitoring as regional infrastructure advances, but which are not yet fully consolidated.

There are also limits of scope. The model deals with logistics cost, routes, distances and port capacity, but it does not replace the environmental and institutional assessments discussed in the conceptual framework. Environmental viability depends on the analysis of the cumulative impacts of each corridor (IFC, 2013; DCP, 2022), and the effective operation of the bioceanic routes presupposes cooperation and shared governance among the countries involved (ABREU, 2023; IPEA, 2024), dimensions that go beyond the reach of the logistics simulation. For this reason, the results should be read as one of the criteria of a broader multi-criteria analysis, and not as an isolated decision (SEREBRISKY et al., 2018; ARGUELHO et al., 2023).

10 Final Considerations

Reading the scenarios together shows that the South American Integration Routes are not, as a block, viable or unviable: their viability depends on the territory, the product and the conditions of each stretch. The comparative synthesis reinforces this point objectively: six of the seven alternative scenarios produce no measurable improvement in distance or cost in relation to the Current scenario, and the Rondon scenario modestly reduces the cost of corn at the price of completely saturating the port of Belém. The only scenario that generates a significant structural gain is the Transoceanic Railway, which meaningfully shortens the distance and the cost of soybean, but depends on rail infrastructure that has not yet been built. The other corridors are valuable above all analytically: by revealing alternative routes not yet catalogued, they show that the continental logistics network is denser and more diversified than the official data capture.

For agribusiness, therefore, the greatest opportunities tend to be concentrated in the Rondon Quadrant and the Capricorn Bioceanic Route, especially for origins close to the corridors and where there is efficient rail or waterway transport, whereas for much of the country the Atlantic ports should remain more competitive (BARROS; CARNEIRO, 2024; MPO, 2024). From this perspective, the opening to the Pacific works as a complementary alternative, and not as an automatic replacement for the existing structure. More than pointing to a winner, the simulation exercise makes the decision more transparent: by comparing each project with the baseline scenario, it is possible to measure its effect on routes, costs, distances and port use before committing resources — a firmer basis for selecting investments by multiple criteria and reducing the risk of expensive works that deliver less than they promise (SEREBRISKY et al., 2018; DE RUS, 2021).

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