Proinde

Brazil's Northern Arc ports

Practical Guidance

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Content

1. Foreword

Recent years have witnessed progressive competitiveness of Brazilian commodities, mainly soya beans and corn (maize), which exports have exceeded those of traditional grain producers, such as the United States and Argentina, making Brazil the world's largest exporter of these agricultural products.

Successive record crops and the increasing demands of the consumer markets, principally China, have led to increasing bottlenecks in the already overburdened grain ports in the South and Southeast regions, resulting in higher transportation costs and longer journeys from production areas, leading exporters to seek more viable logistics alternatives elsewhere in Brazil.

The federal administration inaugurated last January is committed to unleashing projects to improve the national transport infrastructure and streamline procedures and requirements for the participation of the private section in new logistics ventures in the country. Major grain producers and traders are investing heavily in cargo handling facilities and port terminals to improve the flow of commodities to overseas ports. The bulk of these investments are being made in ports across the still-in-development in northern part of the country, more precisely in the region known as *Arco Norte* (Northern Arc), which covers the ports in the North and Northeast regions that are closer to large producing areas in central Brazil and are becoming a competitive alternative for exports to countries in the Northern Hemisphere and Asia via the Panama Canal.

Together with the rising demand for mineral products, such as the ores mined in the Amazon, the consolidation of the Northern Arc as one of the main grain export gateways has led to an unprecedented surge in the number of barges and oceangoing vessels crossing the many rivers that form this region, with successive records of port handling and exports.

Due to the extensive geographic reach of that region and the logistical challenges its vastness imposes, the resources available, navigational hazards, safety concerns and cargo risks are still unknown for many shipowners, charterers and marine insurers who have business opportunities in that somewhat uncharted territory.

Our objective with this guide is to provide a practical overview of the main ports of Brazil's Northern Arc, the infrastructure and resources available, regional peculiarities, cargo risks, safety and security, rules governing navigation and port operations in the inland waterways and loss prevention recommendations.

As it is a huge area in constant development and river conditions change drastically all the time, much of the information here may become out of date quickly. While we strive to keep an up-to-date version of this publication available on our website, we recommend that the data provided be verified and validated by the local shipping agent or the maritime or port authority concerned before the vessel arrives at the Northern Arc.

We hope our clients and associates find this guide to be a useful source of practical information, and welcome your feedback for updates and improvements.

REPRESENTAÇÕES PROINDE LTDA.
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2. The Northern Arc

2.1. Brazilian port system

Brazil has over 7,500 Km of coastline, and over 90% of the country's foreign trade flows through the hundreds of ports and terminals that form the Brazilian port system[1]. The Brazilian rivers, lakes and lagoons together add an estimated 40,000 Km of navigable waters, of which almost half are commercially navigated inland waterways, 80% of them within the Amazon region alone[2]. The Federal Union, through the Presidency of the Republic, is responsible for the administration, management and exploration of the Brazilian port system bound by the regulatory framework of the Law of the Ports[3].

Figure 1: Main Brazilian ports and terminals. Source: ANTAQ

Other intervening authorities have jurisdiction over different aspects of the regulation and operation of the ports, and the core duties and responsibilities fall on state companies and agencies linked with the *Ministério da Infraestrutura* - MINFRA (Ministry of Infrastructure)[4].

[1] IBGE/MINFRA/ANTAQ/CIA World Factbook [retrieved 09/03/19]

[2] According to the report *Vias Economicamente Navegáveis* – VEN 2016 (Economically-Navigated Waterways) by ANTAQ, March/2018, 82.5% of the navigated waterways are in the Amazon, 7% in the Tocantins-Araguaia and 5.3% in the hydrographic region of the Paraná River

[3] Law n° 12,815 of 2013, the so-called *Lei dos Portos* (Law of the Ports) sets the guidelines for the exploitation by the federal government of the ports and port facilities operations. It is regulated by Decree n° 8,033/2013, as amended by Decree n° 9,048/2017

[4] MINFRA has been completely revamped under the new federal administration and took over functions of the now defunct Ministry of Transport. The policies and directives formulated by the MINFRA are implemented by the *Agência Nacional de Transportes Aquaviários* - ANTAQ (National Agency for Waterways Transport), a federal agency that regulates and oversees the quality of services rendered in the waterborne transport of goods and passengers, ports and port structures

The Brazilian port system currently features 37 so-called organised public ports – of which 34 are regarded as maritime ports[5]. These ports are administered either by state-run dock companies or by delegation, concession or leasing to states of the federation, municipalities and public consortia. In addition to the public ports, there are over 150 private port terminals (*Terminal de Uso Privativo* - TUP) and hundreds of cargo transhipment stations (*Estação de Transbordo de Carga* - ETC) and small-sized public port facilities (*Instalação Portuária Pública de Pequeno Porte* - IP4) spread along the Brazilian coast and inland waterways[6]. The majority of the ETCs and IP4s are in the Amazon region. [Figure 1]

About 1,120 million metric tons (mmt) of cargo were handled across Brazilian ports in 2018, a growth of about 3% over the previous year. Of this amount, nearly 823 mmt were handled in overseas trade (82% in exports and 18% in imports).

The accumulated growth in cargo handling across Brazilian ports rose by 33% over the last decade, driven mainly by the increase in the volume of solid bulk cargoes and containers. The main products moved in the ports previous year were iron ore (40% of all volumes), oil and oil products (22%), containers (10%), soya bean (9.4%), bauxite (3%) and corn (2.9%)[7].

2.2. Geographical definition

The so-called *Arco Norte* (Northern Arc, in Portuguese) broadly comprehends the transport routes from the producing areas in the countryside of Brazil to the river and maritime ports around and above the 16th parallel south. In this broad definition, the Northern Arc includes all the North and Northeast regions and part of the Central-West, encompassing sixteen of Brazil's twenty-six states.

In a much stricter geographical sense, which was adopted for the purpose of this report, the Northern Arc comprises the collective of Brazilian ports and cargo handling facilities along the Amazon rivers in the North region, including, from west to east of the arc, the ports and barge stations of Porto Velho in Rondônia (RO); Manaus, Coari and Itacoatiara in the state of Amazonas (AM); Santarém, Juruti, Trombetas, Munguba, Vila do Conde/Barcarena and Belém in Pará (PA), Santana/Macapá in Amapá (AP) and Itaqui/São Luis in the state of Maranhão (MA), in the Northeast region[8]. [Figure 2]

Brazil's Northern Arc includes the largest portion of the Amazon Rainforest and occupy almost half of the national territory; conversely, the region has the lowest demographic density, with less than 12% of the country's population, and makes only a small contribution to the national GDP and economic activity, though its growth rate in recent years has been higher than the average of other states[9].

While the southern ports continue to be the top exporting hubs for most of Brazil's agricultural production, the backlog generated by logistical bottlenecks in the face of the surge in production and trade has led exporters to look for alternative port facilities to outflow successive record-breaking grain crops, and it was then that the Northern Arc ports came into play.

[5] Under the Law of the Ports (12,815/2013) and ANTAQ Resolution n° 2,969/2013, maritime ports are organised facilities capable of handling ocean ships both in the deep-sea and cabotage navigation, regardless of their geographical location whereas river ports are facilities handling ships trading within the same river basin district or between communicating inland waterways

[6] TUP (*Terminal de Uso Privativo*) is a private port facility outside the organised port. ETC (*Estação de Transbordo de Carga*) is a private port facility for transhipment of goods in the inland navigation or cabotage. IP4 (*Instalação Portuária Pública de Pequeno Porte*) is a private port facility moving passengers or goods exclusively in the inland navigation

[7] ANTAQ 2018 Yearbook; ANTAQ online statistics [retrieved 23/03/19]

[8] Although the state of Maranhão is located in a distinct geographic region and does not benefit from the waterways of the Amazon, relying only on rail and road, its port facilities outputs huge volumes of ores extracted in the hinterlands of Pará and compete head-to-head with the Amazon ports for the soya and corn harvested in the North and Central-West regions and conveyed through the North Corridor for export

[9] *Instituto Brasileiro de Geografia e Estatística* – IBGE (Brazilian Institute of Geography and Statistics). *Empresa Brasileira de Pesquisa Agropecuária* – EMBRAPA (Brazilian Agricultural Research Corporation) [retrieved 14/03/19]

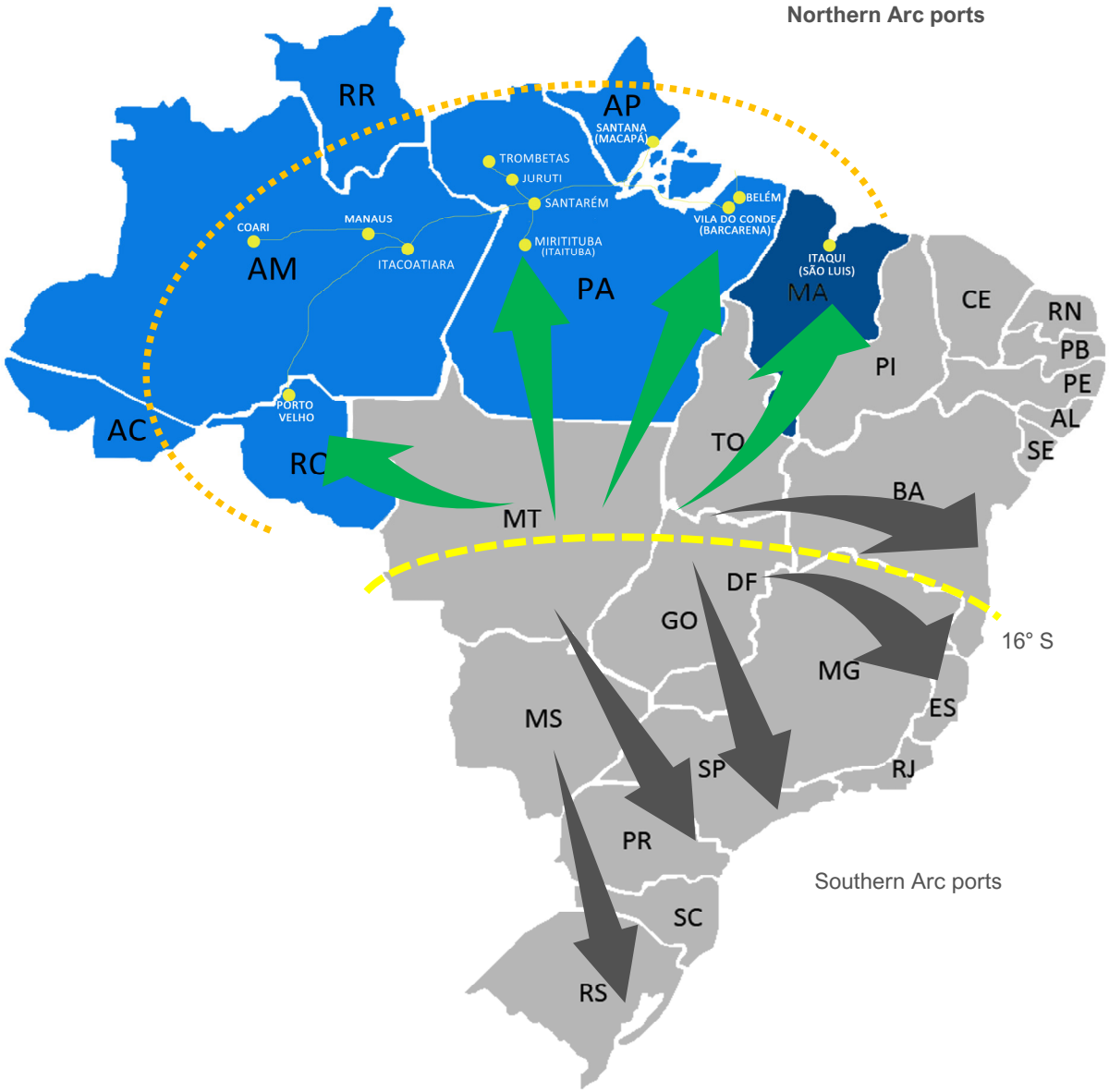

Figure 2: Brazil's main logistic corridors with the Northern Arc highlighted in blue– Source: ANTAQ/MINFRA/ANEC/USDA

The competitiveness of the region should improve in the coming years with the construction of a new railway between Sinop and Miritituba (Ferrogrão) and the planned north-western extension of the North-South Railway linking Açailândia and Vila do Conde/Barcarena. There is also a plan for a northern extension of the Carajás Railway (EFC) from Carajás to Vila do Conde. These projects will certainly alleviate key highways serving the region which are still a major challenge for truckers particularly during the rainy season in the Amazon. [Section 3.3.2]

2.3. Northern Arc's western ports

Porto Velho is the farthest river port to the west of the Northern Arc. The capital of the state of Rondônia lies in the left bank of the Madeira River and is a commercial and transportation hub that serves the Madeira-Solimões-Amazon waterways. Agriproducts trucked from Mato Grosso and Rondônia fields are transhipped in TUPs and ETCs operated by major traders such as Amaggi and Cargill to barges sailing down to Santarém, Santana and Vila do Conde/Barcarena.

Containers and trailers are also carried in barges from Porto Velho to Manaus, Itacoatiara, Santarém and beyond. Porto Velho is increasingly handling inbound shipments of fertilisers and consumer products for distribution in the North and Central-West regions. [Figure 3]

The Investment Partnerships Program (PPI) launched by the government[10] includes a project for a public concession of a stretch of about 800 Km of the BR-364 highway between the town of Comodoro in Mato Grosso and Porto Velho. The project is set to improve the trafficability and capacity of this crucial road, the only land link between the states of Acre and Rondônia and the rest of the country and consolidate the North Corridor in the Madeira Axis to outflow agriproducts[11].

The Brazilian oil giant Petrobras operates a port terminal in the remote town of **Coari** on the right bank of the Solimões River that supplies oil and LPG to its refinery downstream in Manaus.

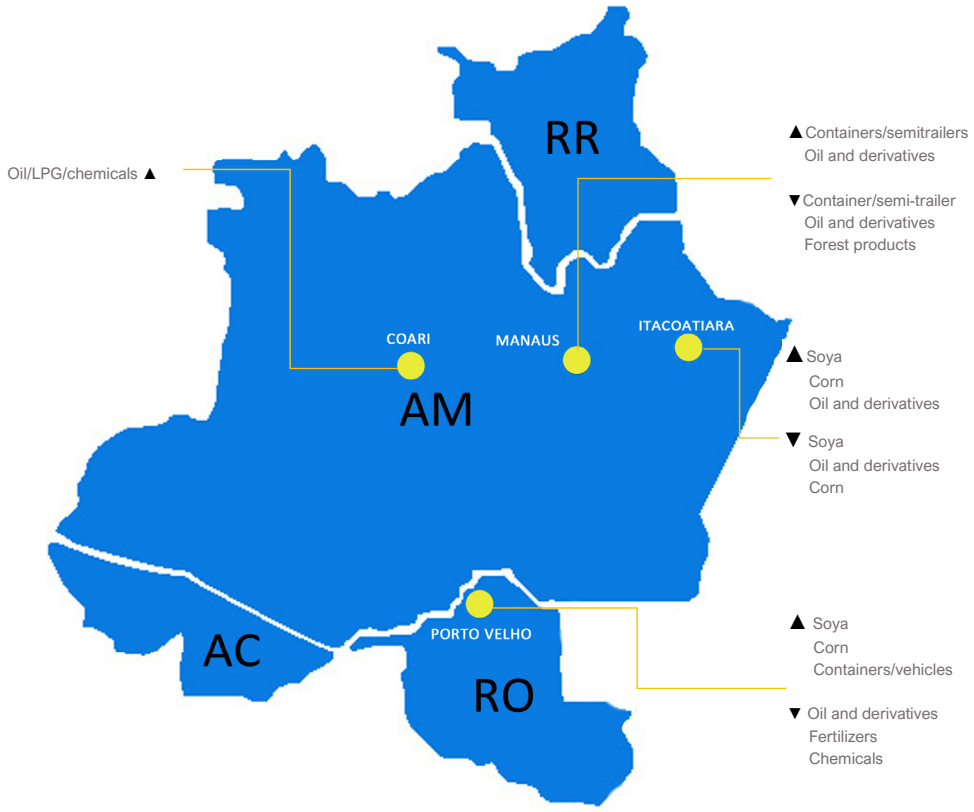

Figure 3: Main ports in the west side of the Northern Arc and main cargoes handled in 2018 (▼unloaded ▲loaded)

In the left bank of the Negro River, near the confluence with the Solimões, **Manaus** is the capital of Amazonas and seat of the federal and state courts of appeals, the 9th Naval District and Manaus Free Trade Zone with its thriving industrial park. Its public port comprises privately-operated facilities handling general cargo, trailers and semi-trailers, and includes the two largest container terminals in the region that connects the Amazon with the rest of Brazil. Here Petrobras runs the only oil refinery in the North region, which is adjacent to its liquid bulk port terminal. Manaus has the largest population of the Northern Arc and is the starting point for travelling around the western side of the Amazon region.

Itacoatiara, on the left bank of the Amazon River, is part of the metropolitan area of Manaus and is about 4-5 hours' drive from the capital on a rather precarious two-lane road. Amaggi operates a TUP (Hermasa) that is the largest export unit in the state of Amazonas shifting agriproducts barged from Porto Velho to Panamax vessels. A TUP for liquid bulks also operates in the small town of Itacoatiara. An adhesion contract was signed with the MINFRA for the implementation, in the coming years, of a private port complex for handling of solid and liquid bulks and general cargo. [Figure 3]

[10] The *Programa de Parceria de Investimentos* - PPI (Investment Partnerships Program) was created by Law n° 13,334/2016 to expand and accelerate the transfer between the State and the private sector to ensure improvement of the public transport infrastructure, stimulate technological and industrial development and create jobs

[11] MINFRA/EPL [retrieved 16/03/19]

2.4. Northern Arc's eastern ports

Further down the right bank of the Amazon River, in the town of **Juruti**, the aluminium-making giant Alcoa World operates a port terminal dedicated to the loading of bauxite extracted from the mines in western Pará to supply the domestic and international aluminium industry.

Also handling primarily bauxite mined in the Amazon, the port terminal of **Trombetas,** in the town of Oriximiná, seats on the right bank of the Trombetas River, a tributary of the Amazon, and is operated by Minerações Rio do Norte – MRN, the largest Brazilian producer and exporter of bauxite. [Section 4.3.4]

ETCs owned by large grain traders and operators, such as Unitapajós (a joint venture of Amaggi and Bunge) and Hidrovias do Brasil in the right bank of the Tapajós River in **Mirituba**, a district of Itaituba, are moving increasingly larger volumes of agriproducts harvested in the Mato Grosso fields and trucked north on the BR-163 highway to Mirituba and from there barged down the Tapajós River to Santarém, Santana and Barcarena where the cargo is shipped on bulk carriers sailing overseas.

Santarém, in the right bank of the Tapajós near the confluence with the Amazon River, is the third largest city in the Amazon region and one of the leading export facilities of the state of Pará. It comprises a public port administered in a landlord model by *Companhia Docas do Pará* - CDP (Pará Dock Company) – the same port authority for the ports of Vila do Conde and Belém –, with sections leased out to private companies, such as Cargill, which operates a solid bulk terminal within the public port since 2003, exporting primarily soya products and corn arriving in barges from Porto Velho and Mirituba and also in trucks through the BR-163.

Barge facilities along the Tapajós River are being expanded and new projects by traders such as Louis Dreyfus Commodities are underway to further increase the cargo handling capacity of the Northern Arc ports, though the primary challenge in the region remains the shallow depth of the river in the dry season.

Under the PPI, a concession will be granted for the construction of a new rail link between the producing region of Central-West and the Northern Arc, the *Ferrovia do Grão* (Grain Railway), or simply Ferrogrão, that will connect Sinop in Mato Grosso to Mirituba in Pará and run parallel to the BR-163 to ease the traffic on this overbusy highway and boost the transport capacity and competitiveness of the North Corridor in the Tapajós Axis. [Sections 3.3.1 & 3.3.2]

The public port of **Vila do Conde** is embedded in the town of Barcarena, on the right bank of the Pará River, southwest of Marajó Island, in the metropolitan area of Belém. It features a public port administered by CDP with berths on lease for the handling of a variety of products, including alumina, bauxite, fuels, fertilisers, livestock and containers. Federal government's PPI includes a greenfield project for the leasing of a liquid bulk terminal in Vila do Conde to handle chiefly fuels to supply Brazil's North and Northeast regions.

Barcarena, just outside the limits of Vila do Conde port complex, includes three TUPs managed by trading and logistics companies (ADM, Bunge/Amaggi and Hidrovias do Brasil) that are dedicated to the handling of soya products and corn arriving in river barges and trucks for on-carriage by bulk carriers. Imerys operates a TUP in the neighbouring town of Murucupi, the world's largest kaolin processing facility responsible for almost three-quarters of the kaolin production in Brazil. Cargill has a project currently pending environmental licensing for a TUP in the nearby town of Abaetetuba to handle soya beans and corn and increment cargo operations in Porto Velho and Santarém. [Figure 4]

The second largest city in the North region, **Belém** lies on the right margin of the Guajará Bay, near the mouth of the Guamá River, in the southern part of the Amazon delta, some 120 Km from the Atlantic Ocean. It is the capital of the state of Pará and home of a public port, besides the federal and state courts of appeals, CDP headquarters, the 4th Naval District and the Port Captaincy of Pará.

Belém is the point of departure to reach the ports of the eastern Amazon, as is the case of Vila do Conde/Barcarena, reachable by car in a couple of hours, Santarém and Trombetas, accessible by one-hour long commercial flights, and the capital cities of Amapá and Maranhão (Macapá and São Luis, respectively), almost equidistant to Belém about an hour's flight away. The public port consists of concessions to companies handling oil products, general cargo, solid commodities and some containers. The PPI has recently auctioned five brownfield areas of Miramar terminal dedicated to the storage and distribution of fuels and LPG in the metropolitan region of Belém.

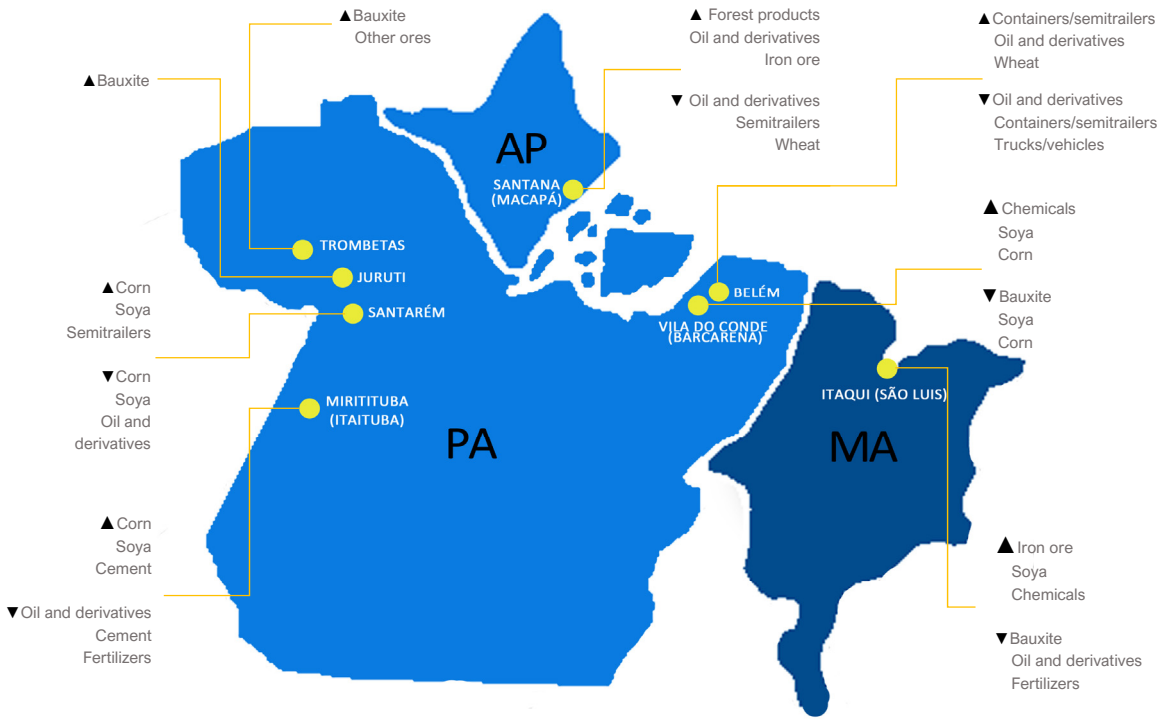

Figure 4: Ports in the east side of the Northern Arc and main cargoes handled in 2018 (▲loaded▼ unloaded)

Located on the northern channel of the delta of the Amazon River, the port of **Santana** is near Macapá, the capital of Amapá, Brazil's northernmost coastal state bounded north by part of French Guiana and northwest by the Atlantic Ocean. Santana handles mostly timber and forest products, biomass, minerals and fuels. The pilot station of Fazendinha and the point of inspections by the authorities for vessels entering the Amazon waterways through the North Bar is off Macapá. Last year, the PPI introduced a brownfield project for the leasing of a port terminal for the storage and export of wood chips, but there were no bidders, and the federal administration is now reassessing the project.

The port complex of **Itaqui** is in the city of São Luís, capital of Maranhão, in the Northeast region. It is in the Atlantic coast southeast of the mouth of the Amazon. It features a deepwater port with a wide access channel in the São Marcos Bay, consisting of a public port administered by *Empresa Maranhense de Administração Portuária* - EMAP (Maranhão Port Administration Company), comprising seven berths handling a variety of bulk cargoes, including agriproducts, wood pulp, minerals, oil and oil products. [Figure 4]

Itaqui is an important port for the import of agricultural inputs (fertilisers, coal, clinker) and cereals to supply the domestic markets of Brazil's North, Northeast and Central-West regions and can rely on an extensive rail network to connect its port facilities to the production centres. Within the structure of the port of Itaqui, the *Terminal de Grãos do Maranhão* - TEGRAM (Maranhão Grain Terminal) is operated by a consortium of major traders that imposes fierce competition on the Amazon ports for the agriproducts from the northeast of Mato Grosso, eastern Pará and Matopiba region[12], with the advantage of relying on the regularity and predictability of the rail network to serve its backport.

At the confluence of Coqueiros Strait and the Cachorro River in São Luis, and part of the organised port of Itaqui, TUP Alumar, operated by Alcoa and other aluminium-makers, handles chiefly shipments of bauxite and other inputs arriving from the Amazon ports for alumina production and export.

Vale's TUP *Terminal Marítimo da Ponta da Madeira* - TMPM (**Ponta da Madeira** Maritime Terminal) next to Itaqui is Brazil's largest export port facility by tonnage and the third largest bulk export port in the world, shipping massive quantities of ores conveyed from mines in central Pará on gigantic trains through the Carajás Railroad for loading on very large ore carriers (VLOC) and Valemax carriers of nearly 400,000 m/t deadweight. TMPM's cargo throughput has doubled since 2010 and is set to break last year's export record[13]. [Figure 4, Section 4.3.3]

[12] *Matopiba* is made up of the abbreviations of the states of Maranhão (MA), Tocantins (TO), Piauí (PI) and Bahia (BA), which main crop is soya, with other crops like corn, rice and cotton also playing an important role in this economic region

[13] ANTAQ online statistics, Australian Bureau of Statistics (ABS) [retrieved 21/03/19]; Review of Maritime Transport 2018, UNCTAD, 2018

3. Transport infrastructure

3.1. Logistic relevance

The extensive Amazon inland waterways coupled with the privileged geographic position near the farmers in central Brazil and the buyers in North America, Europe, the Middle East and Asia (via Panama), have favoured the consolidation of the Northern Arc as an economically viable logistics corridor for exports of agricultural products and minerals that do not require fast delivery times.

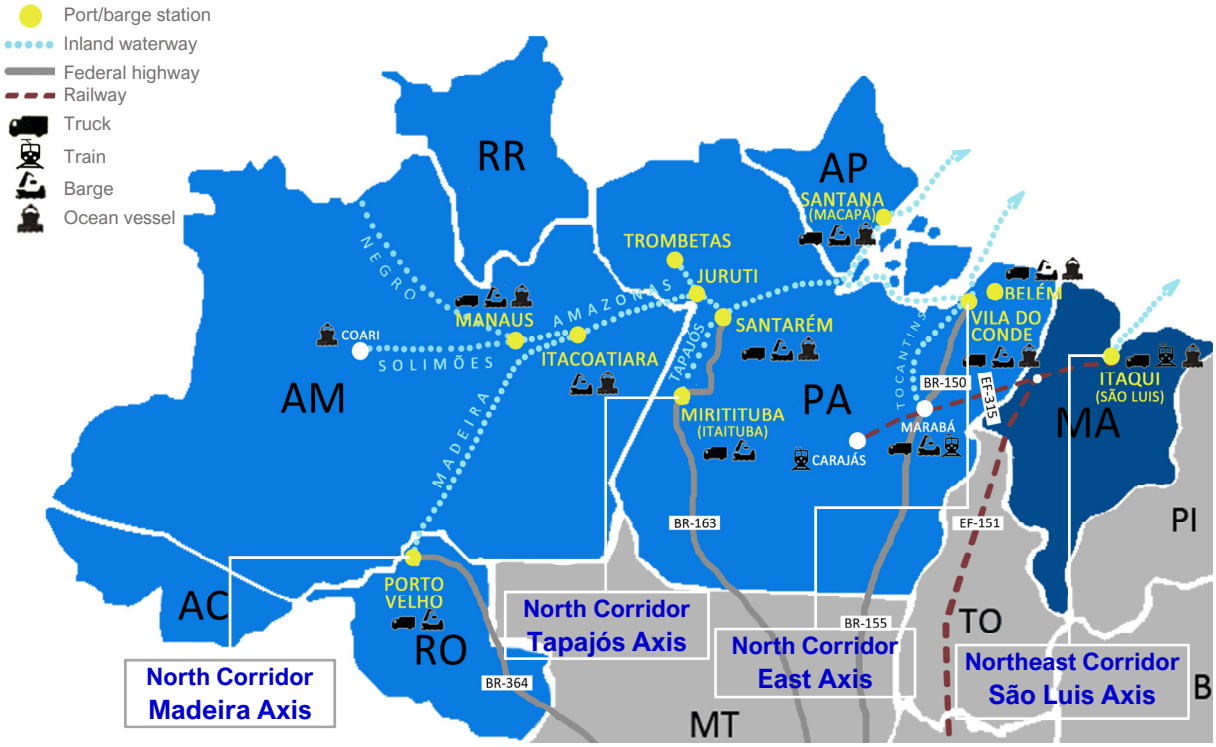

Figure 5: main transport infrastructure in the Northern Arch (no scale). Source: MINFRA/ANTAQ/CONIT/DNIT/VALEC[14]

3.2. Modal share

Over the second half of last century, Brazil opted for road haulage to flow its agricultural and industrial production, the main reason being the fast and somewhat unplanned geographical expansion of agribusiness in regions previously lacking very basic transport infrastructure. However, as the country's agricultural production is expected to continue expanding, there will also be a proportional growth in the demand for agricultural inputs, such as fertilisers and coal, with an increasing need for cost-effective and environmentally friendly alternative transport modal to the expensive roadway system.

Against this backdrop, the federal government launched a logistics plan that proposes the change of the truck-dependent transport matrix and the development of an integrated intermodal transport system to lower freight costs and cut carbon emissions. The project aims to increase the share of rail transport to 35% and waterway transport to 29%, gradually reducing road traffic by around 30%[15].

[14] CONIT is the presidential advisory body on transport polices and infrastructure while DNIT, operating under the structure of MINFRA, is responsible for the construction, maintenance and expansion and of the national transport system, including services such as dredging, buoyage, signalling and clearing of the commercially navigated inland waterways.

[15] The *Plano Nacional de Logística Integrada* – PNLI (Integrated Logistics National Plan) was launched in 2015 by the federal government with the aim of optimising the cargo handling with the use of different modes of transport in a synergic and harmonious manner

3.3. Transport corridors

There are essentially nine strategic export corridors through which various modal routes converge to ferry the mineral and vegetal production from central Brazil to the ports along the East Coast and in the Amazon. Four of these connect Central-West and Matopiba regions to the Northern Arc ports.

Two corridors flow grains trucked from Central-West to ETCs in Porto Velho, through the **North Corridor - Madeira Axis**, and to Miritituba (Itaituba), through the **North Corridor - Tapajós Axis**, wherefrom the cargo is transferred to barges towed or pushed by tugs sailing downstream to Itacoatiara and Santarém or further down to the ports of Santana and Vila do Conde/Barcarena for loading on oceangoing vessels.

A third transportation corridor leading north, the **North Corridor - East Axis**, connects Mato Grosso fields, Pará and the Matopiba to Vila do Conde and Barcarena by road. The fourth corridor, **Northeast Corridor - São Luís Axis**, flows the production from these locations by rail and road to Itaqui. [Figure 5]

3.3.1. Highways

Brazil's highway system stretches for about 1.7 million kilometres, less than 13% of which are paved roads[16]. Approximately 61% of all cargo transported in Brazil passes at some point of the logistic chain by a federal or state highway.

The few federal highways linking the grain fields and mines to the Northern Arc ports are generally in poor condition and lack infrastructure to meet the most basic needs, particularly during the so-called "Amazon Winter"[17], when road conditions are worsened. There are four main road corridors linking the grain-producing states in central Brazil to the Northern Arc ports[18]. [Figure 5]

Madeira Axis: The 4,412 Km-long BR-364 highway stretches diagonally from the southeastern state of São Paulo (SP) all the way northwest to the remote state of Acre (AC) in the upper Amazon, across the states of Minas Gerais, Goiás, Mato Grosso and Rondônia. The BR-364 is the only land connection between Acre and Rondônia and the rest of Brazil. A concession of a stretch of about 800 Km between Mato Grosso and Porto Velho is included in the government investment plan PPI.

Tapajós Axis: The BR-163 is a crucial longitudinal federal highway that links the state of Rio Grande do Sul (RS) in the South region to the hinterlands of Pará in the North. It extends for about 4,522 Km (2,642 Km paved) and crosses important grain-exporting areas. The stretch known as *Estrada da Soja* (Soya Highway) runs from the northern border of Mato Grosso until the barge stations of Miritituba in Pará for over 700 Km through the Amazon Rainforest.

The BR-163 is the only land connection between the grain fields of central Brazil to the ports in the Tapajós River. Although this mostly two-lane road is generally good in its southern stretch, the area north of Mato Grosso is potholed with precarious wood bridges along the way and about 50 kilometres of unpaved road[19].

[16] Anuário CNT dos Transportes, Estatísticas Consolidadas 2018 (CNT 2018 Yearbook, Consolidated Statistics 2018)

[17] Although the Brazilian winter is from June to September, the period from around December to May is popularly known as the "Amazon Winter" due to the heavy rainfalls that hit the region causing the softening of the thermal sensation and a slight reduction in the average temperature in relation to the other periods of the year when the heat is high. The Amazon Winter coincides with the peak of the grain crops in Central-West Brazil

[18] DNIT database [retrieved 18/03/19]

[19] DNIT/ ANTAQ/*Corredores Logísticos Estratégicos: Complexo de Soja e Milho* (Strategic Logistic Corridors: Soya and Corn Complex) MTPAC, 2017; DNIT database [retrieved 18/03/19]; DNIT BR-163 Bulletin 31 May 2019 [retrieved 02/06/19]

During the Amazon Winter, which coincides with the peak of grain exports, the unpaved stretches of the Soya Highway transform this important logistic corridor into a muddy road causing severe congestions, truck breakdowns and cargo losses leading to road closures for emergency repairs from time to time. The DNIT[20] is joining efforts with the Brazilian Army and the Federal Highway Police to maintain the trafficability of the BR-163 until the paving work is completed by early 2020. The government has a project under the PPI for the concession of the road stretch from the border between Mato Grosso and Pará to Miriituba in the Tapajós River.

East Axis: a combination of federal and state highways comprises the land corridor leading up to Barcarena and Belém in the mouth of the Amazon. BR-316, BR-010 and state highways PA-150/PA-155 lead to Vila do Conde in Barcarena. The BR-155, which runs through the southeast of Pará, also connects with the São Luís Axis at the junction with BR-222 in Marabá, a critical connection point to passenger and cargo railroads running back and forth from the Northeast region.

São Luís Axis: The 2,657 Km long (1,913 Km paved) BR-135 is the main federal highway linking the Southeast and Central-West regions with the ports complex of Itaqui in São Luis, intersecting with the BR-222 (Fortaleza/Marabá) and other federal and state highways in the Northeast region, though the railway system serving the area is the most predominant means of conveying commodities to the local ports.

3.3.2. Railways

Given that most of Brazil's regional integration started in the 1950s was based on the use of highways, rail was not given much attention until the government recently reviewed the national transportation plan and decided to change the country's transportation matrix.

The national rail network moves about one-quarter of all cargo freights in Brazil, often with a low backhaul, and comprises some 30,576 Km of tracks. Most railways are operated by private companies under concessions from the Federal Union and the majority operate in the midwest and south of Brazil.

Five railways operate in the Northern Arc region; two are short, privately-run industrial railroads in bauxite mines in the Amazon and three are large federal railways connecting the port complexes of Itaqui and Ponta da Madeira with the east of Pará, Matopiba and the south of the country hauling minerals, agriproducts and general cargo[21].

Ferrovia Norte Sul - FNS (EF-151): The North-South Railway (FNS) is a federal concession projected to become the backbone of the national railway system. It runs along the North-South axis and currently spans about 1,537 Km of tracks linking Anápolis in the Central-Western State of Goiás to Açailândia in Maranhão, where it connects with the EFC towards Itaqui and Ponta da Madeira and will soon also connect with the FTL.

[20] The *Departamento Nacional de Infraestrutura de Transportes* – DNIT (National Department of Transport Infrastructure) is a federal autarchy linked with the Ministry of Infrastructure (MINFRA) responsible for the maintenance, construction and surveillance of the infrastructure of transport and the National Transport System

[21] MINFRA/ANTT/VALEC/VLI/CNI/CSN/FTL [retrieved 23/03/19]

The northern section of the FNS extends for 720 Km from Açailândia down to Porto Nacional near Palmas in Tocantins (TO) and is operated by Vale's VLI. The 855 Km long central section from Porto Nacional-TO to Anápolis, currently managed by state rail operator VALEC. A stretch of about 682 Km of tracks is due to be completed in 2019 to connect Anápolis to Estrela D'Oeste in the state of São Paulo (SP), where it will link up with the southern rail networks.

A long-term concession of 1,537 Km between Porto Nacional and Estrela D'Oeste is set for auction under the government's PPI, and the best bidder will operate with right-of-way to other rail networks in the north and south ends. A study is being prepared for the construction of a northwest extension from Açailândia with about 477 Km of tracks to Vila do Conde in Barcarena. When all the planned sections are completed, it will be possible to establish a railway connection between the ports of Santos in the south and the ports of Itaqui and Vila do Conde.

Estrada de Ferro Carajás - EFC (EF-315): The Carajás Railroad (EFC) is a federal railroad about 892 Km long operated by Vale to bring ores from its open pit mines in the Carajás region to TMPM in train compositions up to 3.3 kilometres in length. EFC moves minerals and fuels as well as passengers. It connects to the FNS and will have a connection to the FTL in the future. Vale plans a new extension linking Carajás to Vila do Conde in Barcarena to double production of its giant mine in Serra Sul Carajás and ease the burden of TMPM.

Ferrovia Transnordestina Logística - FTL: The Trans-Northeastern Logistics Railway (FTL) is a public concession with about 1,190 Km of tracks linking the port of Itaqui to the ports of Northeastern ports of Pecém and Mucuripe (Fortaleza) in Ceará. Cargoes such as wood pulp, fuel, cement, etc., originating in the Matopiba region, are carried across the FTL, which is operated by Transnordestina Logística, a subsidiary of Brazilian steelmakers Companhia Siderúrgica Nacional - CSN.

The **Estrada de Ferro Juruti - EFJ** (Juruti Railway) is a 57 Km long railway owned by Alcoa that links its bauxite mines in Juruti to its port in the Amazon River. The **Estrada de Ferro Trombetas - EFT** (Trombetas Railway) of only 35 Km in length is a private railway operated by Minerações Rio do Norte (MRN) to transport bauxite from its mine in the region of Oriximiná to Trombetas loading facility in the right bank of the Trombetas. [Sections 3.3.1 and 4.3.4]

CSN and the federal government are building the 1,753-Km long **Ferrovia Nova Transnordestina - FNT (EF-232/EF-116)** (New Trans-Northeastern Railway) to connect the town of Eliseu Batista in the state of Piauí to the ports of Pecém and Suape in the Northeastern state of Pernambuco. FNT will also connect with the FNS in Porto Franco in the future with its main cargo profile comprising of solid bulks in general.

Federal government's PPI includes a greenfield project for the construction and operation, in a vertical mode, of the **Ferrovia do Grão - Ferrogrão (EF-170)** (Grain Railway), a new rail link between northern Mato Grosso and the Tapajós-Amazon waterways in the North Corridor[22].

[22] The Ferrogrão will be composed of about 933 Km of tracks linking Sinop-MT with the ETCs of Miritituba-PA along the Tapajós River running parallel to the BR-163 highway. The project includes a 177-Km extension from southern Sinop to Lucas do Rio Verde-MT. A consortium formed by major commodity traders (ADM, Amaggi, Bunge, Cargill and LDC) is among the potential stakeholders of the project. Source: MINFRA/ANTT/VALEC/PPI [retrieved 23/03/19]

3.3.3. Inland waterways

Brazil has twelve hydrographic regions (river basin districts)[23] with about 40,000 Km of navigable waters, half of them comprising commercially navigated waterways. Three of these districts are within the Northern Arc: Amazon draining east, Tocantins-Araguaia flowing to the north, and the Western Northern Atlantic draining to the northeast[24]. The Amazon accounts for some 16,049 Km (82,5%), and the Tocantins-Araguaia comprises 1,371 Km (7%)[25] of inland waterways. [Figure 6]

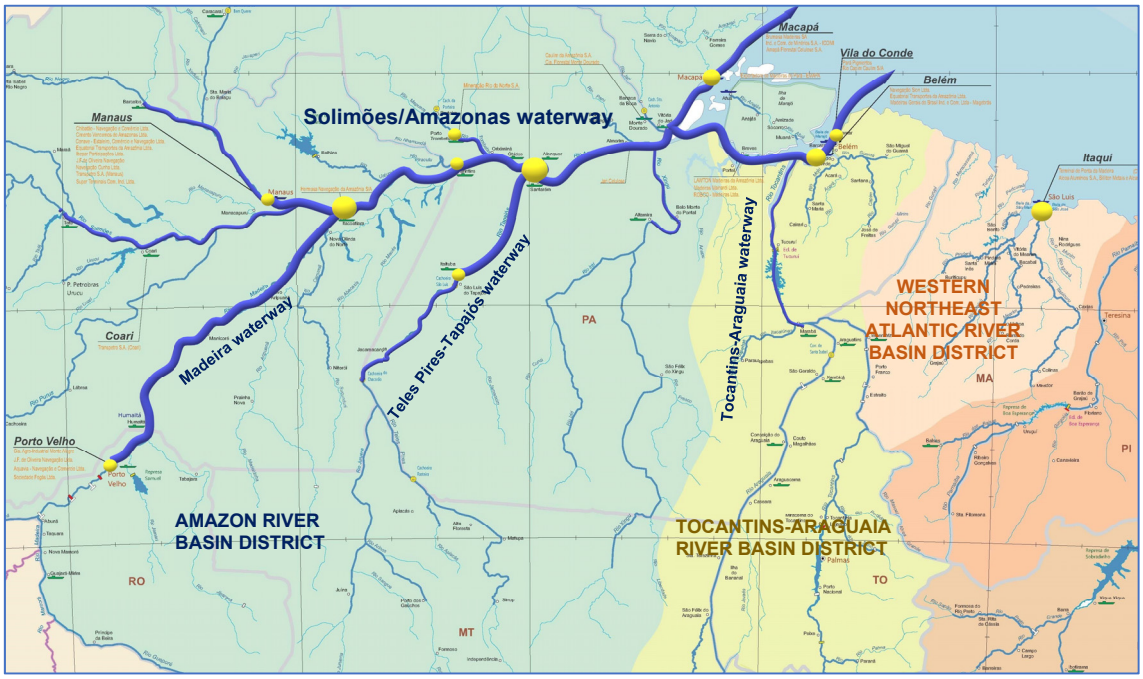

Figure 6: main commercially navigated inland waterways corridors in the Northern Arch. Source: MINFRA/ANTAQ/CNRH

The depths along the Amazon River and its tributaries vary dramatically between the dry and rainy seasons. Some of the rivers may rise twenty meters or higher at the peak of the Amazon Winter. There are changes in the courses of some waterways at certain times of the year and over time. In recent years, there has been a decrease of almost 12% in the length of the commercially navigated inland waterways, which has been attributed to the low hydrometric levels caused by a rainfall deficit, and a general lack of confidence by the private sector in the navigability and operational profitability of some waterways that require interventions such as dredging, rock blasting and navigation signage.

Despite the decrease in the length of the commercial inland waterways, the traffic is increasing consistently, boosted by successive record crops shipped through the Northern Arc river ports. A survey conducted by the MINFRA showed that export commodities transported by road, often involving large volumes hauled over long distances, would be better suited for inland waterway transportation, where the longer the journey, the higher the savings. The rivers of the Amazon offer favourable conditions for navigation without the need for major civil works[26]. ANTAQ reached the same conclusion and identified viable inland waterways for sustainable commercial exploitation in the Amazon and Tocantins-Araguaia river basin districts[27].

[23] National Hydrographic Division established by the *Conselho Nacional de Recursos Hídricos* - CNRH (National Council of Water Resources)

[24] *Conjuntura dos Recursos Hídricos no Brasil 2017*, (Conjuncture of the Water Resources in Brazil 2017), by the National Water Agency - ANA

[25] *Vias Economicamente Navegáveis* – VEN 2016 (Economically-Navigated Waterways) a research by ANTAQ, March 2018

[26] The *Plano Hidroviário Estratégico* – PHE (Inland Waterways Strategic Plan) of 2013 is a plan devised by the MTPAC (now MINFRA) with the objective of improving the transport of goods and passengers by inland waterways and reduce costs and environmental impacts

[27] The *Plano Nacional de Integração Hidroviária* – PNIH (National Plan for Waterway Integration was conceived by ANTAQ and launched in 2013 for the study on Brazilian waterways and port facilities to evaluate the creation of waterway terminals on stretches of water that have already been commercially navigated or are potentially navigable

About 65% of all goods and passengers transported in the Brazilian inland waterways pass through the **Amazon River Basin** that covers a vast geographical area of dense rainforest and abundant watersheds. It features three main transport axes in the North Corridor (Madeira, Solimões-Amazonas and Teles Pires-Tapajós waterways) that flow down to the mouth of the Amazon River in the Marajó Island to meet the Atlantic Ocean. [Figure 6]

Given the precariousness or merely the absence of land connections, and the scarcity and high cost of air travel in the region, waterborne transport is the primary way to move people, vehicles and goods around this enormous but sparsely populated region.

In addition to containerships, bulk carriers and tankers engaged in the cabotage and oceangoing trade, the river scene is crowded with fishing boats, ferries and barge tows carrying vehicles, containers and trailers. Small boats and canoes used as a means of personal transport or engaged in the riverside commerce are constant and require utmost attention from passing ships and barges.

Peculiar transport systems that are common in the Amazon rivers include flat-decked ferries, locally known as "*Ro-Ro Caboclo*", which are self-propelled or pushed/towed by tugs that carry trucks, trailers and semitrailers between riverside towns bridging roadway gaps in the Amazon. Also typical in the regional river traffic are the "swimming warehouses", flat-bottomed ferries with flexible, weatherproof side walls and roof for storage and transport of breakbulk and general cargoes. Barge tows, which are convoys of river barges moored together in a variety of configurations and carrying capacities to shuttle fuel and solid bulks between barge stations and river ports, and to supply the riverine industries and communities. [Figures 7 & 8]

Figure 7: (left) "Ro-Ro Caboclo"; (right) "swimming warehouse". Source: Bertolini/Combitrans

Figure 8: barge tows in the inland waterways. Source: Globo Rural

The **Tocantins-Araguaia River Basin** is the second largest of Brazil but features only a few stretches that are commercially navigable. Even though the prospects for commercial navigation are good, the Tocantins-Araguaia waterway presents several natural obstacles along its course, such as sandbanks and extensive rocky outcrops that hinder safe navigation, especially during the dry season. It also faces environmental disputes for the construction of hydroelectric power plants, lock systems and other civil works that are required for this waterway to be navigated to its fullest potential and become another viable transport corridor in the Northern Arc[28]. [Figure 6]

[28] DNIT has a project for dredging of a 300-Km stretch of the Tocantins River (between Marabá and Baião in Pará) and the blasting of the Pedral do Lourenço, a 43-Km long rocky outcrop, to allow the continuous traffic of riverboats and barge tows in a stretch of 500 Km between Marabá and the port of Vila do Conde in Barcarena for shifting of agriproducts, livestock and mineral products for export

4. Cargo profile

4.1. Market share

The ports of the Northern Arc[29] collectively handled some 343 million metric tons (mmt) of cargo in 2018, accounting for almost one-third of all freight moved in Brazilian ports that year. Around 257 mmt of this volume was in foreign trade (95% in exports), where Northern Arc's contribution has consistently increased over the last few years.

While the national ports experienced an overall increase of about 3% in relation to the volume of cargo handled in and out in 2017 and an accumulated growth of 33% since 2010, the volume of the Northern Arc ports grew by 9.5% in relation to the previous year, with an accumulated growth of 77% when compared to the 2010 figures.

The share of private ports in cargo handling across the Northern Arc rose from 29% in 2010 to 87% in 2018, with a substantial growth in inland navigation, mainly due to the triplication in the number of cargo handling facilities along the Tapajós and Madeira Rivers, which have experienced a staggering volume accumulated increase of 325% compared to 2010[30]. It is estimated that volumes of cargo handled within the inland waterways of the Amazon will rise even further over the next years as new cargo handling installations and transport corridors are being built in the region.

The ports in the Amazon region together handled about 107 mmt of cargo in 2018, where 42 mmt (39% of the total) were moved in inland navigation (cargo shifted between ETCs and river ports), 41 mmt (38%) in ocean-going navigation and 24 mmt (23%) in cabotage. The profile of the cargo moved through the Amazon ports comprised of 73% of solid bulk, 15% liquid bulk, 7% containers and 5% general cargo, including trucks, trailers and semi-trailers transported regionally.

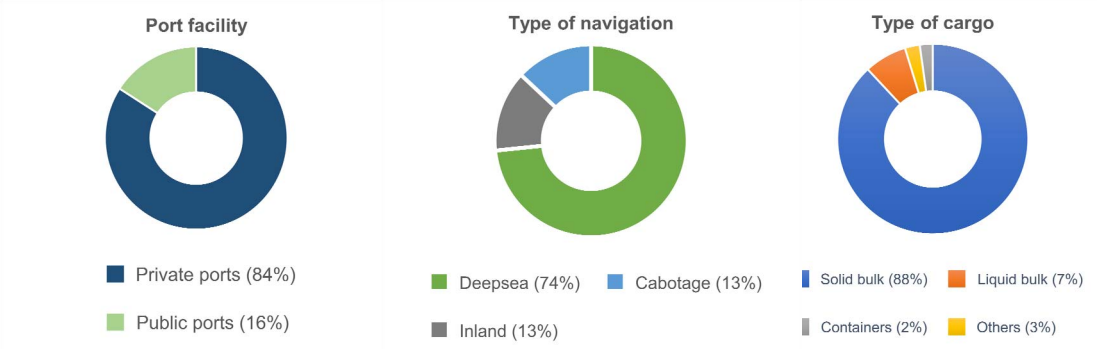

Figure 9: Cargo handled in the Northern Arc in 2018 by navigation and cargo type, in mmt. Source: ANTAQ

The seaports of Itaqui and TMPM in Maranhão handled 235 mmt of cargo volume in 2018, 216 mmt in oceangoing navigation and 19 mmt in cabotage navigation. 96% of this amount consisted of solid bulks, 3% liquid bulks and 1% general cargo. [Figure 9]

4.2. Cargo handling volumes

Iron and manganese ore exports from TMPM in Itaqui maintain Vale's port facility in Maranhão comfortably as the main export unit in the country in terms of cargo tonnage. TMPM moved over 198 mmt of minerals last year, a record figure which corresponds to 58% of all cargo handled across the Northern Arc in 2018[31]. [Figure 10]

[29] Unless otherwise stated, for the purpose of the cargo handling statistics in this report, the Northern Arc comprises all ports and cargo transhipment stations (ETC) located in the North Region (states of Rondônia, Amazonas, Roraima, Amapá and Pará) plus the port complex of Itaqui and TMPM (state of Maranhão) in the Northeast Region, which are outside the Amazon river basin

[30] ANTAQ online statistics [retrieved 23/03/19]

[31] ANTAQ 2018 statistics report; ANTAQ online statistics [retrieved 24/03/19]

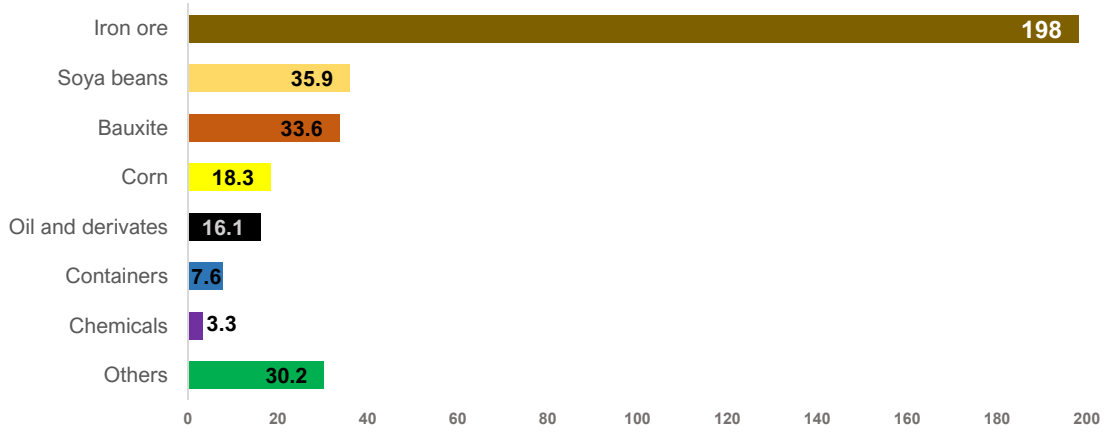

Figure 10: Main cargoes handled in the Northern Arc in 2018, in mmt. Source: ANTAQ

More than 32% of Brazil's seaborne freight in the international commerce in 2018 was moved in and out of the Northern Arc region, which ports handled some 257 mmt of mineral and agricultural commodities. Leading export items from these ports were iron ore (79%), soya beans (8%), bauxite (4%), corn (3%) and chemicals; main imports comprised of fertilizers (29%), oil and oil products (21%), caustic soda (14%), mineral coal (9%) and wheat (8%). [Figure 11]

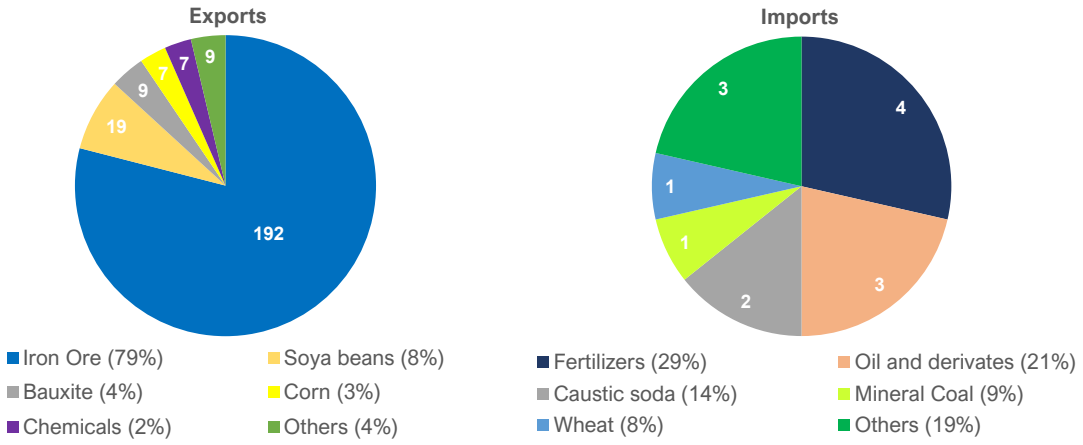

Figure 11: Imports & exports in the Northern Arc in 2018 by cargo type, in mmt. Source: ANTAQ

On the west side of the Northern Arc, the aggregate of the overseas cargo moved across the Amazon ports and terminals last year was 41 mmt (7 mmt in and 34 mmt out), the main exports featuring soya beans (32.3%), bauxite (26.1%), corn (17.1%) and chemicals (9.7%), and primary type of imports consisted of containers (27.3%), fertilizers (22.3%), oil and derivates (11.1%) and caustic soda (9.5%)[32].

On the east side, about 216 mmt of the volumes moved in Itaqui last year were in foreign trade (7 mmt in and 209 mmt out), with main export commodities consisting of iron ore (91.9%), soya bean (4.1%) and chemical products (1.7%); main imports were oil and derivates (35%), fertilizers (27.1%), caustic soda (18.5%) and mineral coal (8.8%).

4.3. Cargo profile trends

Aside from the vast quantities of iron ore exported from Itaqui, regular bauxite shipments from Trombetas and Juruti down to Vila do Conde, Itaqui and overseas contribute to keeping the ports of the Northern Arc occupied. Brazil had a substantial development in the productivity of its soya bean and corn crops, which together account for more than 90% of the national agricultural production, and boosted exports of these commodities in increasing volumes, drastically changing the Northern Arc cargo profile.

[32] ANTAQ online statistics [retrieved 25/03/19]

For the first time, the volumes of bauxite regularly extracted from the Amazon mines and shipped from the local ports over the past four decades have been surpassed by the amount of soya exported through the Northern Arc. Corn shipments have also picked up and are helping to increment the flow of agricultural commodities through the ports of the region.

In the wake of the increasing production, the volumes of oilseed moved in and out of the national ports went up from 38 million metric tons (mmt) in 2010 to an unprecedented 102 mmt in 2018, an increase of 268% in port handling. In the same period, corn volumes shipped from all Brazilian ports tripled from 11 mmt to 34 mmt, a staggering 309% increase in the shifting of this cereal. [Figure 12]

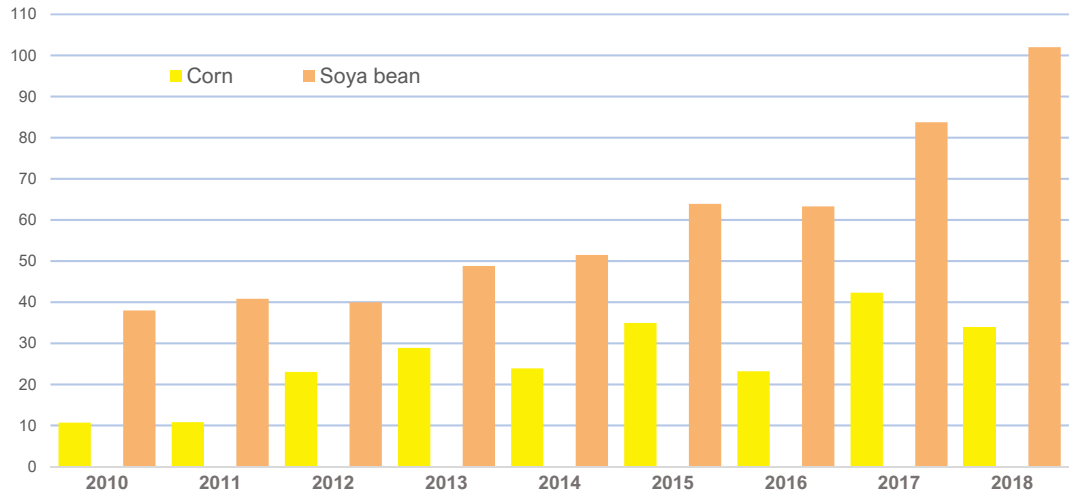

Figure 12: soya bean and corn handled in Brazilian ports and terminals between 2010 to 2018, in mmt. Source: ANTAQ

Arco Norte's share of Brazilian exports of soya beans and corn more than doubled in this decade, from a 10% market share in 2010 to a whopping 25% last year, when about 26 mmt (out of a total of 106 mmt) of these commodities were exported through one of its ports[33]. [Figure 13]

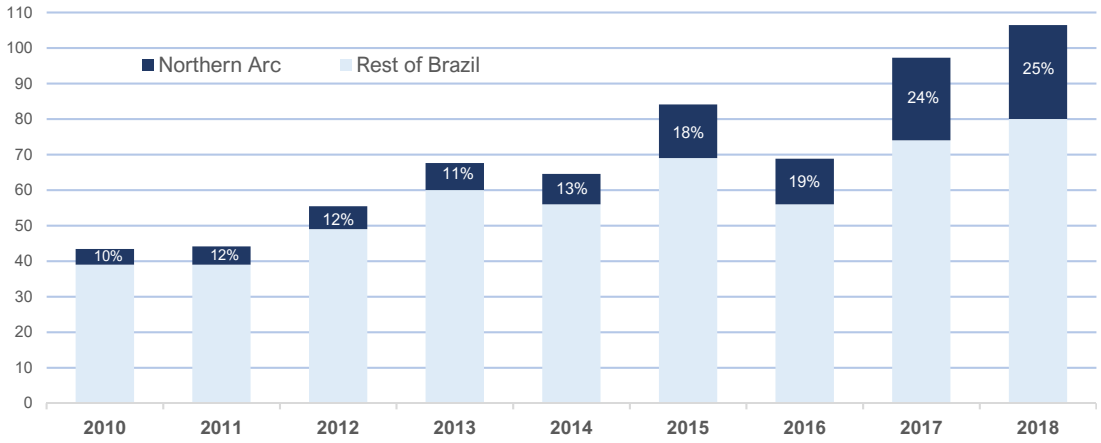

Figure 13: Northern Arc's share of soya bean and corn exports from 2010 to 2018, in mmt/share in % of the total. Source: ANTAQ

4.3.1. Soya beans

The world's leading leguminous seed is also the most profitable crop in Brazil and covers about a quarter of the gross value of the national agricultural production, driving the continuing expansion of the grain fields, predominantly those located across the states of Mato Grosso, Paraná, Rio Grande do Sul, Goiás and Mato Grosso do Sul.

[33] ANTAQ 2018 Yearbook; 2010-2017 *Anuário Estatístico de Transporte* - MTPAC (Transports Statistics 2010-2017 by MTPAC, now MINFRA); ANTAQ online statistics [retrieved 01/04/19]

Brazilian soya bean production jumped from 75 mmt in 2010/11 to a record 119 mmt in the 2017/2018 crop (up 59%). Exports volume went up 152%, from 33 mmt to 83 mmt in the same period, and the commodity remains comfortably at the top of the ranking as the country's main export product[34]. Higher yields in productivity and competitiveness with other world suppliers are thanks to the use of technology, new harvesting techniques and advanced logistics solutions adopted by farmers and traders. Because oilseeds have strong liquidity and are marketed with a rather attractive profit margin when compared to other crop commodities, the producers continue to invest in the expansion of plantations and productivity rates.

Largest soya bean exporter in recent years, Brazil was also the top producer of the oilseed in 2017/18 and went head to head with neighbouring Argentina as the world's second largest exporter of soya bean oil and soya bean meal, after the United States. Brazil may lag slightly behind the Americans in 2018/19 to return to the top of the ranking – or narrow the gap – in the next marketing season, depending on the influence of the climate and how the U. S. - China trade dispute unfolds[35]. The Asian country is the largest oilseed importer and has bought more than three-quarters of all Brazilian soya bean exports last season[36]. [Figure 14]

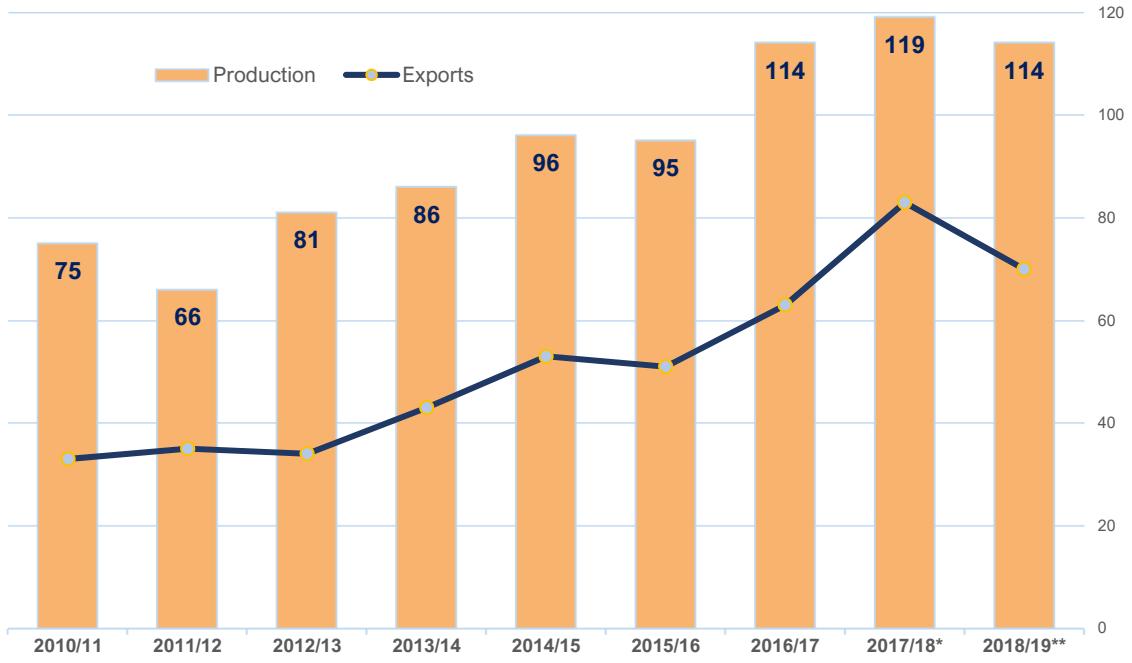

Figure 14: Brazilian soya bean production and exports 2010-2018, in mmt (* estimated; ** projected). Source: ANTAQ/CONAB/FAOSTAT

Over 102 mmt of soya beans were handled throughout the Brazilian port system in 2018 with the main port complexes being Santos (20%), Paranaguá (15%), Rio Grande (14%), Barcarena (9%), Itaqui (8%) and Itacoatiara (5%), the latter three within the Northern Arc, whose share in the port handling of soya bean was around 35% last year[37]. [Figure 15]

[34] *Acompanhamento da Safra Brasileira de Grãos, Vol.6, Safra 2018/2019, Sexto Levantamento, Março/2019* - CONAB (Follow Up of the Brazilian Grain Crop, Vol.6, Crop 2018/2019, Sixth Assessment, March/2019 - CONAB; ANTAQ online statistics [retrieved 01/04/19]; Food and Agriculture Organization Corporate Statistical Database – FAOSTAT [retrieved 01/04/19]; Ministry of Economy online statistics [retrieved 01/04/19]

[35] In July 2018, China imposed a 25% duty on U.S. soya bean shipments in retaliation for similar measure taken by the U.S. on Chinese imports

[36] World Agricultural Supply and Demand Estimates – WASDE-586, Foreign Agricultural Service/United States Department of Agriculture – USDA, March/2019; Oilseeds: World Markets and Trade, Foreign Agricultural Service/USDA, March/2019; ANTAQ online statistics [retrieved 01/04/19]; FAOSTAT statistics [retrieved 01/04/19]

[37] ANTAQ online statistics [retrieved 01/04/19]

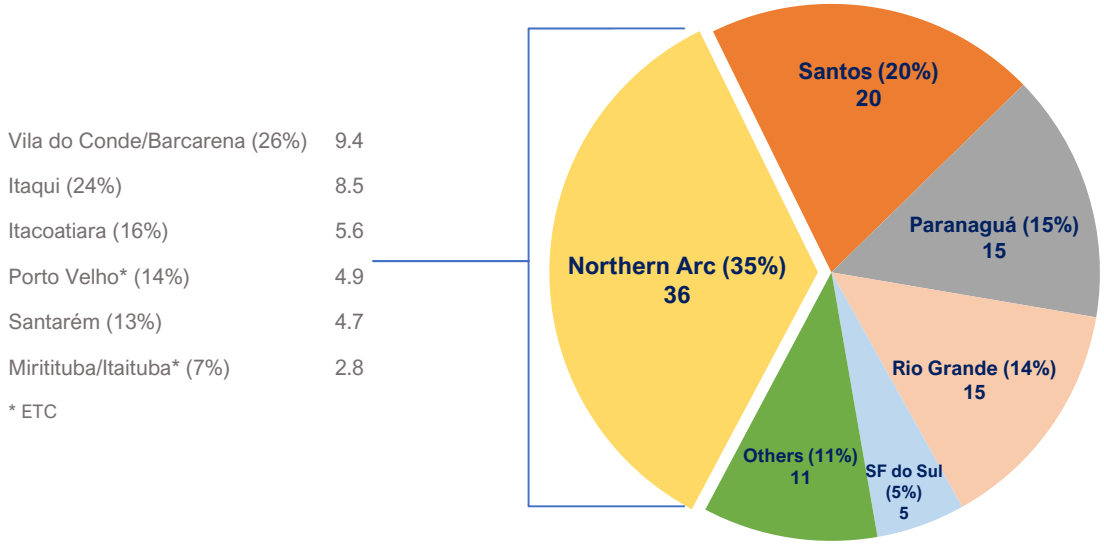

Figure 15: Northern Arc ports' share in soya bean port handling 2018, in mmt (% of market share). Source: ANTAQ

In terms of exports, 83 mmt of the soya bean were shipped abroad last year, with 26% of the shipments leaving from the port of Santos, followed by Paranaguá (18%), Rio Grande (16%), Itaqui (10%) and Barcarena (7%). A quarter of soya bean exports was shipped through the *Arco Norte*. [Figure 16]

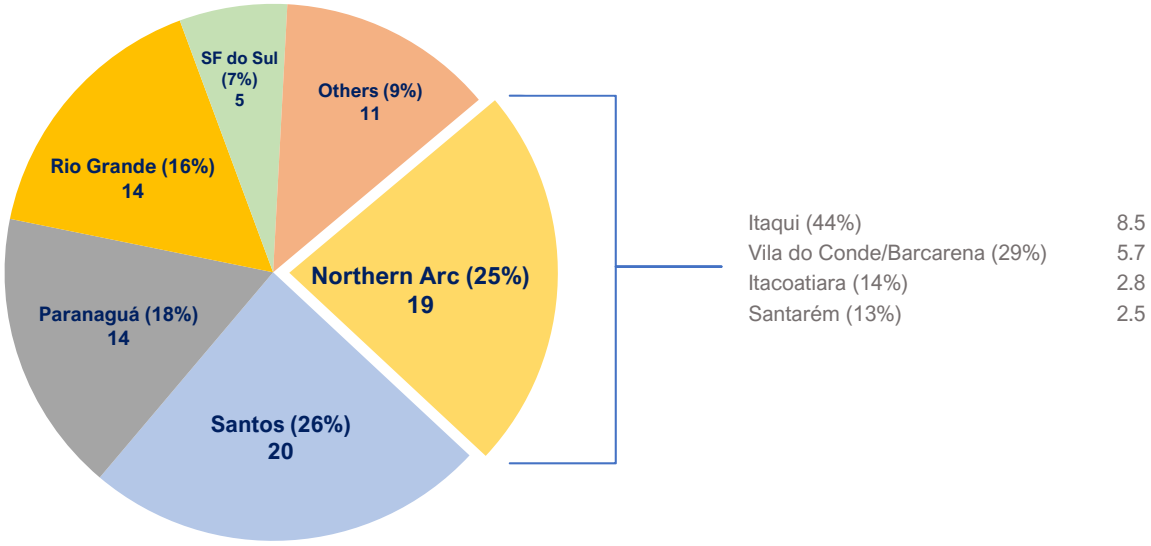

Figure 16: Northern Arc ports' share in soya bean exports 2018, in mmt (% of market share). Source: ANTAQ

The Northern Arc collectively handled nearly 36 mmt of soya beans in 2018, 7.6 mmt in cargo transhipment stations (ETCs) in Porto Velho and Miritituba/Itaituba. About 19.4 mmt of the soya bean handled in the region were shipped overseas, mainly from Itaqui (44%), Barcarena (29%), Itacoatiara (14%) and Santarém (13%). [Figure 16]

The leading exporting units in the Northern Arc were *Terminal de Grãos do Maranhão* (Tergram) in Itaqui, Amaggi's *Terminal Graneleiro Hermasa* (Hermasa) in Itacoatiara, Cargill's *Terminal Fluvial de Granéis Sólidos de Santarém* (Cargill TGS) in Santarém, and ADM's *Terminal de Grãos Ponta da Montanha* (TGPM), Amaggi/Bunge joint venture Unitápajos' *Terminal Portuário Graneleiro de* Barcarena-*Terminais Portuários Fronteira Norte* (Terfron), and Hidrovias do Brasil's *Terminal Vila do Conde* (Hidrovias do Brasil) in Barcarena[38]. [Figure 17]

[38] ANTAQ online statistics [retrieved 01/04/19]

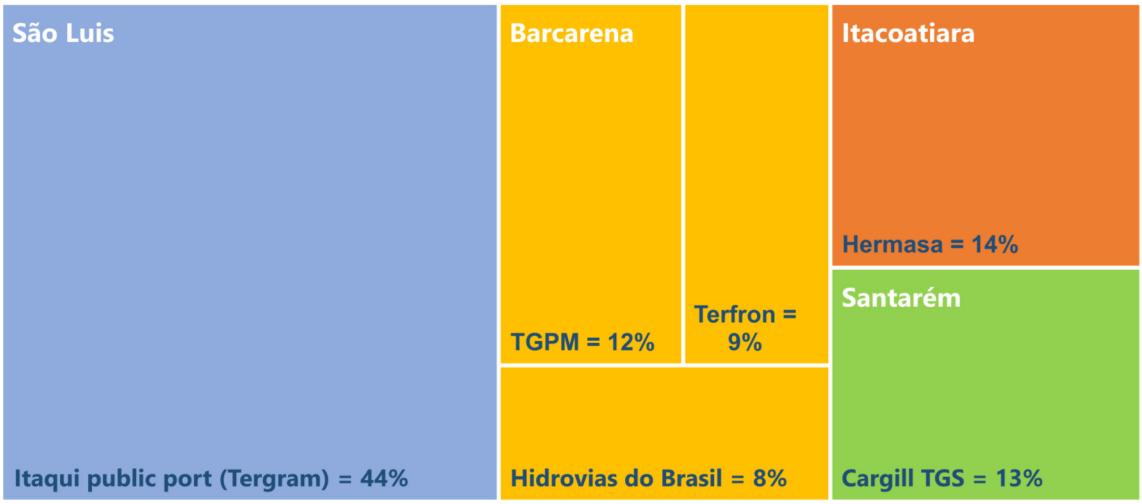

Figure 17: Northern Arc's main port facilities handling soya bean exports in 2018, % of 19.4 mmt. Source: ANTAQ

CONAB[39] and the USDA predict that due to circumstantial climatic adversities faced by some producing regions, notably the states of Mato Grosso do Sul, Goiás and Paraná, the 2018/19 harvest should be lower than last year's bumper crop[40], yet, it should still be a formidable marketing year, matching or surpassing the 2016/17 figures, and exports should continue on the rise. While cargo volumes in Brazilian ports grew less than 2% in the first quarter of 2019 compared to the same period of last year, soya bean port handling is up 24% year-on-year.

4.3.2. Corn (maize)

Brazil is the world's third-largest yellow corn grower, after the United States and China, and the second exporter of the cereal behind the U.S. followed closely by Argentina. The grain cereal yields the second highest gross value of the agricultural production and is harvested in two crops across the fields of the states of Mato Grosso, Paraná, Goiás, Minas Gerais and Mato Grosso do Sul among others[41]. Although it relies heavily on the animal feed sector, the maize is increasingly employed in the growing corn-based ethanol industry.

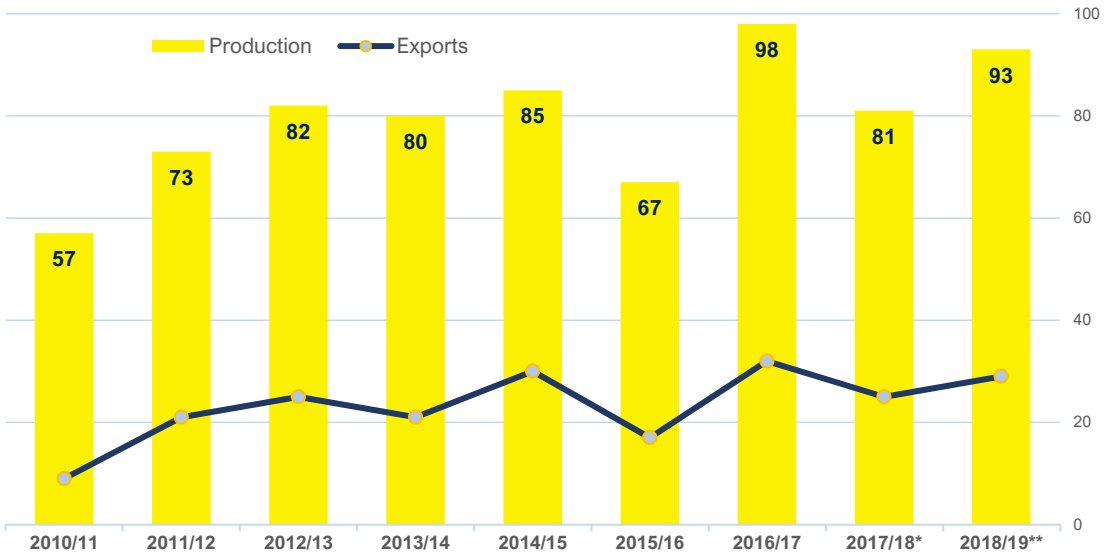

Figure 18: Brazilian yellow corn production and exports 2010-2019, in mmt (* estimated; ** projected). Source: ANTAQ/CONAB/FAOSTAT

[39] *Companhia Nacional de Abastecimento* – CONAB (National Food Supply Agency) is a public company under the purview of the Ministry of Agriculture, Livestock and Supply – MAPA that controls and regulates the stocks of staple food and commodities

[40] Imports and exports figures disclosed by the Brazilian and international authorities and traders may not balance due to differences in marketing years, shipments in transit and reporting discrepancies

[41] The initial growing season of the corn is known as "summer crop" (or "first-crop"), which competes with soya beans and results in lower yields when compared with the "winter crop" (or "second-crop"), usually harvested from June through September

Domestic production almost doubled between the 2010/11 and 2016/17 growing seasons, when production yielded a record 98 mmt (in both harvests), of which 32 mmt were exported. In the 2017/18 season, production dropped sharply to 81 mmt with only 25 mmt of the cereal being exported, because the corn fields literally lost ground to soya bean crops and some producing regions suffered from a prolonged drought. [Figure 18]

Last year, about 34 mmt of corn were handled by Brazilian ports, mainly through Santos (37%), Barcarena (18%), Santarém (12%), Itaituba (9%), Porto Velho (8%) and Itacoatiara (4%). The Northern Arc ports together covered 54% of last year's corn port handling. [Figure 19]

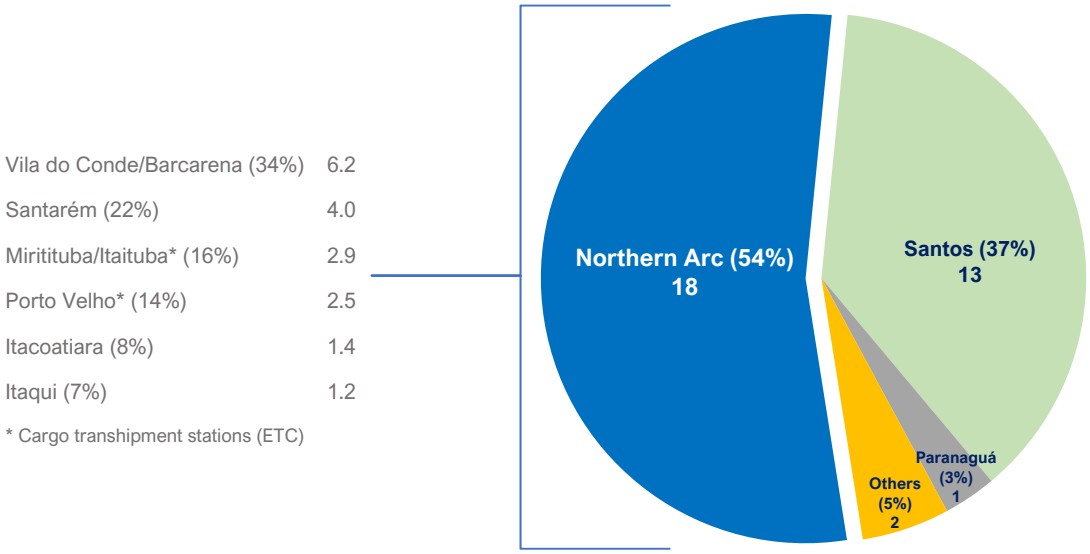

Figure 19: Northern Arc ports' share in yellow corn port handling 2018, in mmt (% of market share). Source: ANTAQ

Approximately 23 mmt of corn were exported in 2018, mostly to Iran (27%), Vietnam (13%), Spain (9.6%) and Egypt (8.6%), with the port of Santos leading the ranking of exports with more than half of Brazilian corn shipments, ahead of the ports of Barcarena (14%), Santarém (9%), Itaqui (5%) and Paranaguá (5%). Northern Arc's aggregate throughput accounted for almost one-third of all last year's corn exports, with Barcarena, Santarém and Itacoatiara handling the highest corn volumes in the region[42]. [Figure 20]

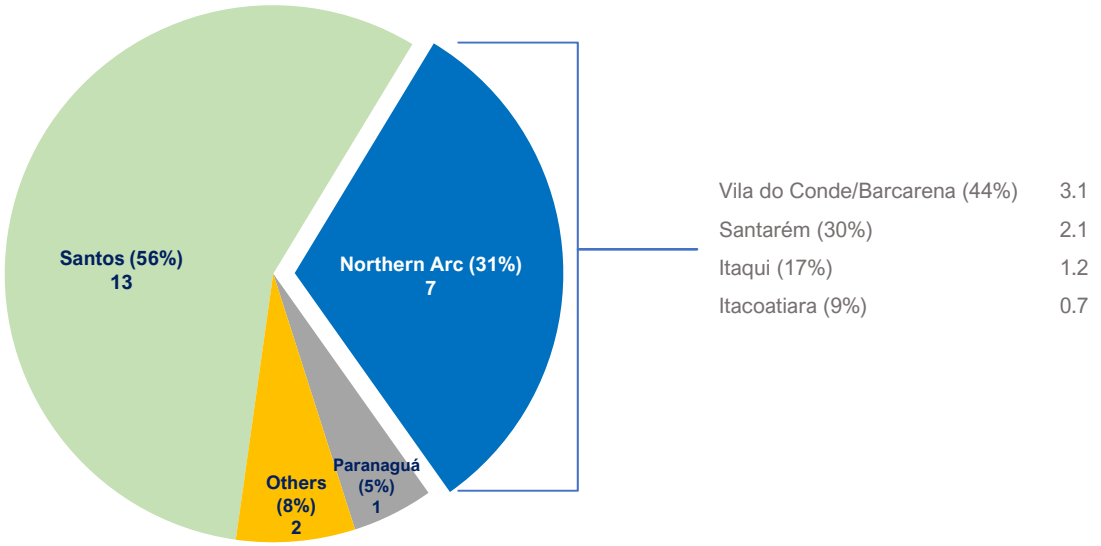

Figure 20: Northern Arc ports' share in yellow corn exports 2018, in mmt (% of market share). Source: ANTAQ

[42] Follow-Up of the Brazilian Grain Crop, Vol. 6, Crop 2018/2019, Sixth Assessment, March/2019 - CONAB; World Agricultural Supply and Demand Estimates - WASDE-586, Foreign Agricultural Service/USDA, March/2019; Oilseeds: World Markets and Trade, Foreign Agricultural Service/USDA, March/2019; Situation and Outlook Report - FDS-19C, Economic Research Service/USDA March/2019;ANTAQ online statistics [retrieved 01/04/19]; FAOSTAT [retrieved 06/04/19]

The leading corn exporting facilities within the Northern Arc were *Cargill TGS* and the contiguous public port of Santarém (29%), *Hidrovias do Brasil*, (18%), *Terfron* (14%) and *TGPM* (12%) in Barcarena, *Tergram* (17%) in Itaqui and *Hermasa* in Itacoatiara (9%)[43]. [Figure 21]

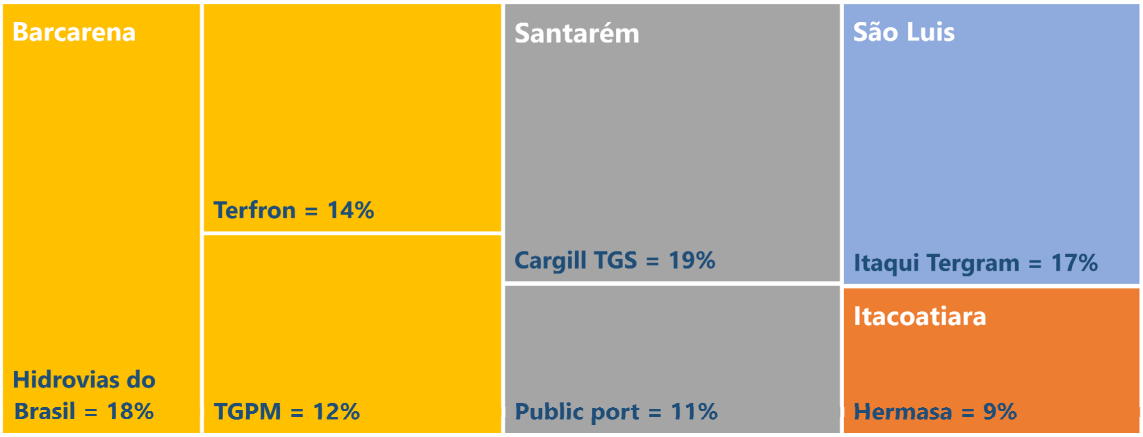

Figure 21: Northern Arc's main port facilities handling yellow corn exports in 2018, % of 7 mmt. Source: ANTAQ

The forecast for 2018/19 is a record global corn trade, with a Brazilian production above 93 mmt, 29 mmt for export, meaning 14% higher than last season[44]. Thus far this year, handling of corn throughout Brazilian ports went up 17% as compared with the corresponding period of last year[45].

4.3.3. Iron ore

Brazil has the third largest high-grade iron ore reserves in the world, after Australia and Russia, and is second only to Australia in production volume. The abundant mineral is Brazil's third main export item in terms of revenue (after soya bean and petroleum) and is plentiful in the states of Minas Gerais and Pará which together answer for 90% of the national production. Largest commodity in tonnage, iron ore covered around 58% of all Brazilian exports last year (675 mmt)[46].

Brazilian miner Vale dominates the national iron ore market and operates, directly or through subsidiaries, all mining, production and logistics operations. Vale's port terminals handled more than 96% of all Brazilian iron ore exports in 2018.

Iron ore extracted from the mines in the southeast of Minas Gerais is transported by rail to the port terminals in the states of Espirito Santo (Tubarão) and Rio de Janeiro (Itaguaí, Ilha Guaíba and Porto Sudeste, in Sepetiba Bay) where the mineral is shipped on bulk carriers sailing to Asian and European ports. The production of the Carajás mining complex in the state of Pará is shifted by rail down the Carajás railway to TMPM in Itaqui, which doubled its throughput since 2010 and currently handles almost half of all Brazilian iron ore exports. [Figure 22]

About 407 mmt of the iron mineral were carried across Brazilian ports in 2018, of which 391 mmt exported to China (54%), Japan (5.8%), Malaysia (5.4%) and the Netherlands (4.9%). In the first three months of 2019, iron ore shipments from TMPM Itaqui had increased 10% year-on-year, and the upward trend is expected to continue for the rest of the year[47].

[43] ANTAQ online statistics [retrieved 06/04/19]

[44] Imports and exports figures may not balance due to differences in marketing years, shipments in transit and reporting discrepancies

[45] ANTAQ online statistics [retrieved 03/04/19]; Ministry of Economy online statistics [retrieved 06/04/19]

[46] *Anuário Mineral Brasileiro - Principais Substâncias Metálicas 2018* (Brazilian Mineral Yearbook - Main Metallic Commodities 2018), *Agência Nacional de Mineração* - ANM (National Mining Agency), Mar/2019; ANTAQ online statistics [retrieved 06/04/19]

[47] ANTAQ online statistics [retrieved 06/04/19]; Ministry of Economy online statistics [retrieved 06/04/19]

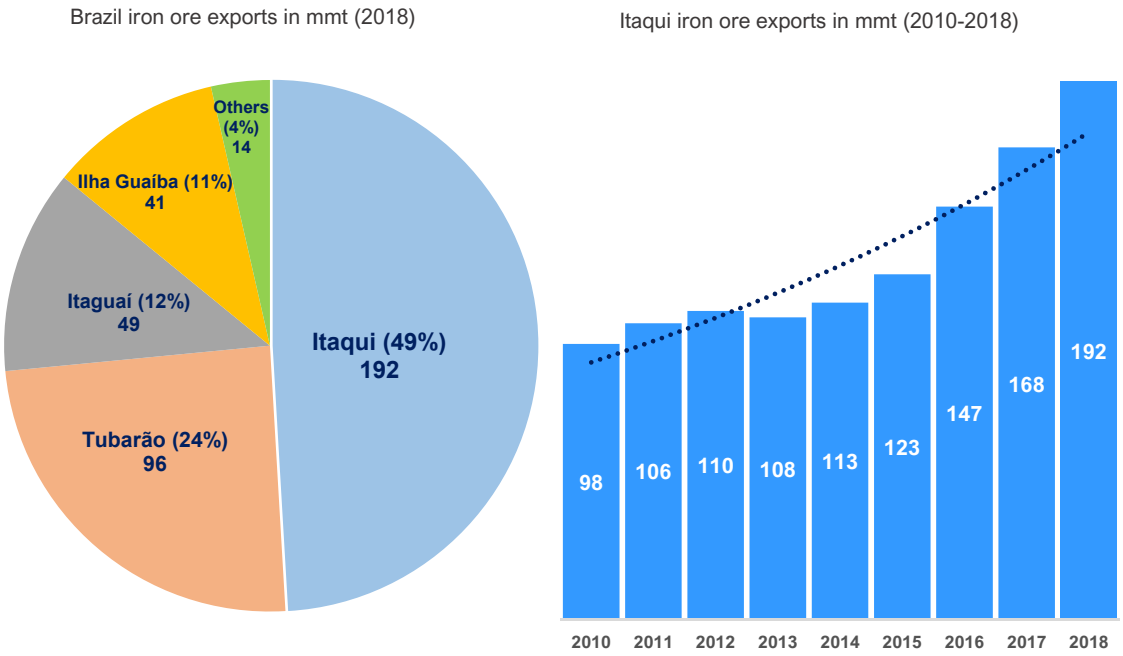

Figure 22: Brazilian iron ore exports 2018 (left) and TMPM Itaqui exports 2010-18, in mmt (% of market share). Source: ANTAQ

4.3.4. Bauxite

Bauxite ranks second behind iron ore as the most abundant metallic mineral available in Brazil, which holds the third largest deposits after Guinea and Australia. Brazil is the fourth global bauxite producer, and its reserves are of the prime quality with over 40% aluminium dioxide content. It is a cargo which may, under certain conditions, liquefy. [Section 5.2]

More than 90% of the Brazilian bauxite mines in operation are located in the state of Pará, where regular aluminium ore shipments depart from the river ports of Trombetas and Juruti to supply the domestic aluminium-making industry in Barcarena and São Luis in Maranhão, which retains about three-fourths of the local production[48].

Three multinational conglomerates operating in the Northern Arc dominate more than 95% of the national bauxite production. Minerações Rio do Norte (MRN), a joint venture including Vale, Rio Tinto, Alcoa and Norsk Hydro, is the bauxite production and export leader, extracting the aluminium ore from the Oriximiná mines and shipping it in barges and bulk carriers from its port terminal in Trombetas to Vila do Conde. Norwegian mining giant Norsk Hydro flows its bauxite production from the Paragominas mines in northeast Pará through a 244 Km pipeline down to its alumina refinery (Alunorte) in Barcarena, which also receives bauxite shipments from Trombetas through the port of Vila do Conde. American aluminium-maker Alcoa ships bauxite from its Juruti mines in northwest Pará through its private port terminal in the Amazon River. Alcoa is the major shareholder of the alumina refinery Alumar in São Luis and operates a port terminal in Itaqui taking in shipments of bauxite, caustic soda and fuels and shipping out alumina produced locally[49].

About two-thirds of all bauxite shipments depart from Trombetas and one-third from Juruti. These two Amazon ports feed the national aluminium industry through Vila do Conde (Hydro's alumina-maker Alunorte and primary aluminium-maker Albras) and Itaqui (Alumar São Luis), and also supply bauxite to overseas markets. [Figure 23]

[48] Mineral Commodity Summaries, 2018, U.S. Geological Survey (USGS), Jan/2018; World Metal Statistics 2018, USGS, Jan/2018; Bauxite in Brazil - Responsible Mining and Competitiveness, *Associação Brasileira do Alumínio* - ABAL (Brazilian Aluminium Association), Apr/2017; Brazilian Mineral Yearbook - Main Metallic Commodities 2018, ANM, Mar/2019

[49] Alcoa Alumina World/Alcoa Brasil/Norsk Hydro/MRN websites [retrieved 08/04/19]

Last year, leading importers of the Brazilian aluminium ore were Canada (33%), China (19%), Ireland (18%), India (9%) and the United States (8.6%).

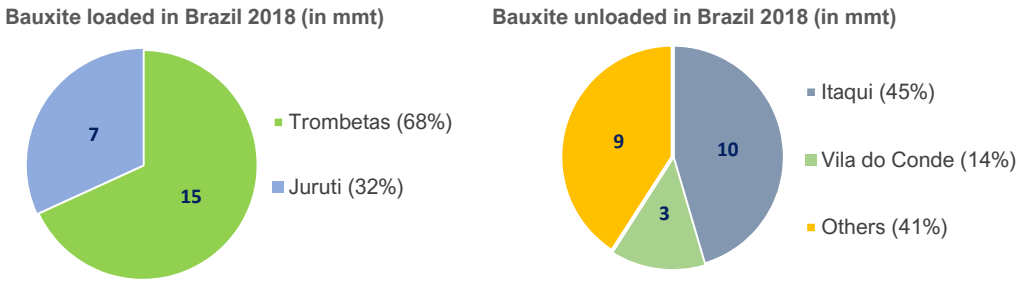

Figure 23: Bauxite loaded and unloaded in Brazilian ports in 2018, in mmt/% of the share. Source: ANTAQ

Handling of bauxite in Brazilian ports and its share in exports remained relatively stable throughout this decade, with a downward trend in the last two years. In 2018, almost 34 mmt of bauxite were moved around the ports of the region, about 73% in the cabotage and 27% in oceangoing navigation[50]. [Figure 24]

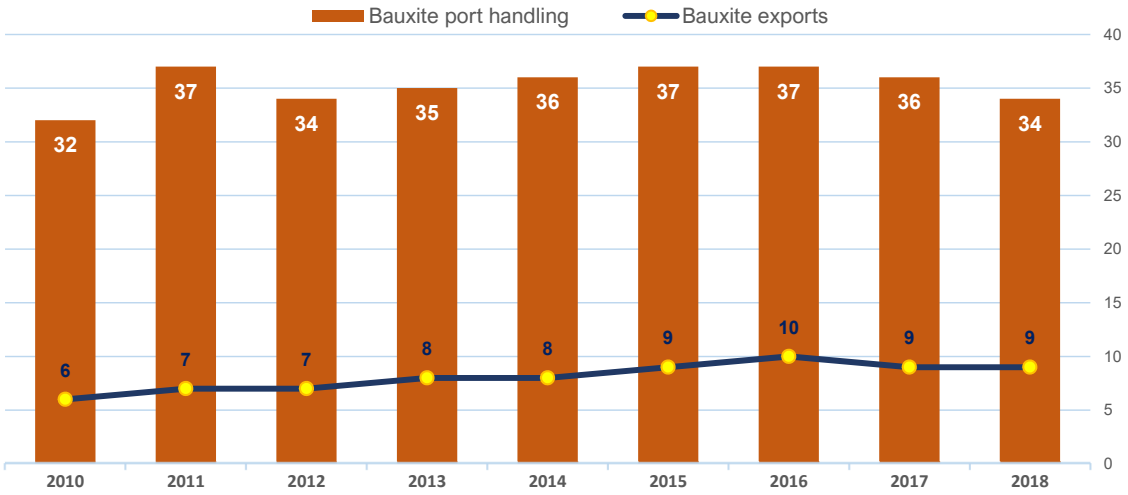

Figure 24: bauxite port handling and exports 2010-2018, in Mt. Source: ANTAQ

As from March 2018, Hydro's Alunorte and its mines in Paragominas operated, by federal court order, at one-half of production capacity until the completion of public enquiries and legal proceedings on allegations and claims brought by environmental regulators, after an alleged overflow of bauxite waste that would have caused pollution in the rivers of the town of Barcarena[51].

As a result of the halving of alumina production, there was a 50% cut in primary aluminium production at Albrás Barcarena, of which Norsk Hydro is the major shareholder and Alunorte the sole supplier of alumina. Alunorte eventually signed a term of adjusted conduct with the public prosecutors and the state government of Pará agreeing on independent assessments to ensure the plant's ability to resume safe operations. In May 2019, the embargoes imposed on the criminal and civil proceedings were lifted, and Hydro's Alunorte, Albrás and Paragominas units initiated the process to resume production. On the other hand, the embargo on the use of the newly developed bauxite solid residue deposit area (DRS2) remains in force[52].

[50] Mineral Industries Survey, Bauxite and Alumina in the Fourth Quarter 2018, USGS, Apr/2018; Brazilian Mineral Yearbook - Main Metallic Commodities 2018, ANM, Mar/2019; ANTAQ online statistics [retrieved 08/04/19]; Ministry of Economy online statistics [retrieved 08/04/19]

[51] After intense rainfall and floods in Barcarena in February 2018, concerns from environmental authorities on alleged leakage of harmful effluents from bauxite waste impounds, the Federal Court of Pará ordered the halving of the production of alumina and placed an embargo on the new bauxite solid residue deposit area (DRS2). Source: Hydro [retrieved 03/06/19]

[52] Source: Hydro website [retrieved 03/06/19]

4.4. Liquid bulk cargoes

Over 203 mmt of oil and derivatives were handled in Brazilian ports in 2018, making petroleum products the second type of freight in volume, behind iron ore, and the second revenue in FOB value. 68% of the oil and by-products were transported in cabotage and 29% in oceangoing navigation.

Oil products comprise the third type of cargo moved in the Northern Arc in volume, after solid minerals and agriproducts. In 2018, about 16 mmt of oil and derivatives were handled in the region, mainly in Itaqui (39%), Manaus-Itacoatiara (37%) and Vila do Conde-Belém (13%).

Other liquid bulk cargoes frequently transported in the Northern Arc ports are caustic soda, LPG, chemical products and ethanol fuels.

4.5. Containers & trailers

More than 10 million TEUs[53] carrying 107 mmt of cargoes were handled in Brazilian ports in 2018, a 7.2% increase to the previous year. The ports that stood out in container handling were Santos (32%), Paranaguá (7.6%), Navegantes (7.3%) and Rio Grande (7.3%).

During the same period, the growth in container handling in the Northern Arc was 17%, with over 538 thousand TEUs moved (7.3% of Brazil's total), in cabotage (53%), deep sea (37%) and inland navigation (10%). The only relevant container operations in the region were in Manaus (*Porto Chibatão* and *Super Terminais*), main container hub in northern Brazil covering 83% of the movements in the area, followed by Vila do Conde (Santos Brasil's *Convicon*) with 16%. ETCs from Porto Velho, which barge containers to Manaus and Belém, account for less than 2% of the container movements across the Northern Arc. The port of Itaqui is slowly moving more containers from liners engaged in the cabotage trade.

River ferries otherwise known as "Ro-Ro Caboclo" are a peculiarity of the Amazon inland waterways not seen elsewhere in Brazil. Last year, these barges carried more than 3 mmt of goods packed in trailers and semitrailers between the ports of Vila do Conde/ Belém (49%), Manaus (32%), Santarém (9%) and Porto Velho (6%)54. [Figure 8]

[53] TEU = Twenty-foot equivalent cargo unit

[54] ANTAQ online statistics [retrieved 08/04/19]

5. Cargo risks

5.1. Local factors

Strictly speaking, there are no specific trends or problems affecting the condition, quality and suitability for safe carriage of cargoes commonly shipped at the Northern Arc which are also not seen elsewhere in Brazil; however, some local factors can – and often do – cause or influence cargo-related incidents and aggravate the overall costs of cargo damages, their assessment and control.

5.1.1. Weather and climate

The Northern Arc comprises an immense geographic area spanning different hydrographic regions around the equator, with a variable environment across its vast landscape, featuring high averages of air temperature and humidity and elevated precipitation indexes most of the year. It is during the prolonged rainy season in the region that the incidence of weather-related cargo damage is higher, either due to dampness that affects the cargo during haulage to the ports or during storage; sometimes even by sudden and heavy rainstorms that catch vessels with their hatches open causing water ingress into the holds. [Table 1]

	Porto Velho			Manaus			Macapá			Belém			São Luis		
▲ Highest/driest	T		P	T		P	T		P	T		P	T		P
▼ Lowest/wettest	Min. – Max. (°C)		(mm)	Min. – Max. (°C)		(mm)	Min. – Max. (°C)		(mm)	Min. – Max. (°C)		(mm)	Min. – Max. (°C)		(mm)
Jan	22°	31°	**321**	23°	31°	264	23°	30°	306	22°	31°	386	24°	30°	244
Feb	22°	32°	316	**23°**	30°	290	**23°**	29°	342	22°	31°	413	**23°**	29°	373
Mar	22°	32°	274	23°	31°	**335**	23°	29°	**408**	**22°**	30°	**447**	23°	29°	428
Apr	22°	32°	251	23°	31°	311	24°	30°	379	23°	31°	353	23°	30°	**476**
May	21°	32°	127	23°	31°	279	24°	30°	362	23°	31°	306	23°	30°	317
Jun	19°	32°	50	23°	31°	115	23°	30°	220	22°	32°	155	23°	30°	173
Jul	**18°**	33°	**24**	23°	31°	85	23°	31°	182	22°	32°	156	23°	30°	131
Aug	19°	34°	36	23°	**33°**	**47**	23°	32°	98	22°	32°	126	23°	31°	29
Sep	21°	**34°**	120	24°	33°	74	23°	32°	43	22°	32°	145	24°	31°	23
Oct	22°	33°	193	24°	33°	113	24°	**33°**	**32**	22°	**32°**	**115**	24°	**31°**	**8**
Nov	22°	33°	225	24°	32°	174	24°	32°	59	22°	32°	118	24°	31°	11
Dec	22°	32°	319	24°	31°	220	23°	31°	133	22°	32°	203	24°	31°	77
Average	**21°**	**32°**	**188**	**23°**	**31°**	**192**	**23°**	**31°**	**214**	**22°**	**32°**	**244**	**23°**	**30°**	**191**

Table 1: Average monthly temperature (T) and precipitation (P) in the Northern Arc capitals. Source: Climatempo/INPE

The Amazon in the west side of the Northern Arc is Brazil's rainiest region with precipitation and humidity levels growing in intensity and frequency between December and May, a period which local people termed the Amazon Winter (due to the softening of thermal sensation compared to the dry season). The mean daily temperature averages 27°C with the rainfalls peaking in March, more prevalent around the mouth of the Amazon River, where the ports of Vila do Conde (Barcarena), Belém and Santana (Macapá) are located.

Itaqui (São Luis) on the east end of the Northern Arc, lies between the tropical wet climate and the tropical savanna climate in a region featuring a longer and more pronounced dry season, particularly between August and early December, when precipitation is rather low, in sharp contrast to the predominantly wet climate of the Amazon ports. Conversely, during the rainy season in the state of Maranhão, from about February to May, cloudy weather and heavy rainfalls are routine, with April recording the highest precipitation index[55].

5.1.2. Cargo surveying and testing resources

Most facilities handling weather-sensitive or potentially hazardous commodities in the Northern Arc are in remote areas deep in the Amazon jungle, with difficult access. Some ports require several hours of travel, sometimes days, to be reached by surveyors and experts.

[55] Climatempo 30-year precipitation and temperature historic series data [retrieved 20/04/19]

Despite continuous investments in laboratory facilities and education and training of surveyors in recent years, there is still limited availability of cargo surveying and testing capabilities in the Northern Arc region. Cargo expertise and material resources are not always readily accessible in this vast geographic region where mobility is restricted.

There are only a few experienced surveyors available locally who, most of the time, are employed by cargo interests. Likewise, there is a general lack of independent laboratories capable of performing more sophisticated tests on the mineral and agricultural commodities traded in the region. Frequently, cargo experts need to be rushed from more developed centres in the Northeast and Southeast of Brazil, or even from abroad, to assist in assessing and managing cargo-related incidents. Given the scarcity of cargo testing facilities, cargo samples often need to be flown to other parts of Brazil for independent analysis, thereby increasing the outlays.

5.2. Mineral commodities risks

Cargo liquefaction associated with the carriage of certain solid bulk cargoes is a well-known but recurrent problem. Fine-particled ores laden with a sufficiently high moisture content are prone to liquefy, even if they are not listed in the International Maritime Solid Bulk Cargoes Code (IMSBC Code)[56] as liquefiable cargoes, and this may result in the cargo shifting and sloshing during the voyage, leading to a loss of stability sufficient enough to capsize the vessel, sometimes with fatal consequences.

Intercargo identified 53 shipwrecked bulk carries in the last ten years, where 202 crewmembers lost their lives. Half of these seafarers were killed in accidents associated with failure (liquefaction and shifting) of the cargo, responsible for sinking at least nine bulkers since 2008, six of them carrying Indonesian nickel ore, two with iron ore loaded at India and one with bauxite from Malaysia[57].

In response to recurring problems, the IMSBC Code was revised to add a new schedule for "**iron ore fines**"[58] and to amend the individual schedule for **iron ore**, with the former classified as "Group A" cargo (may liquefy if shipped with moisture content higher than the transportable moisture limit - TML[59]) and the latter classified as "Group C" cargo (not liable to liquefy and without chemical hazard)[60].

There are no reports of shipping casualties attributable to liquefaction or shifting of iron ore cargoes loaded in Brazilian ports in the last ten years; although, early this decade there have been accounts of alleged liquefaction incidents involving vessels carrying fines loaded at TMPM in Itaqui and a now decommissioned port facility then operated by Anglo American in Santana[61]. Since then, there have been no public reports of significant failure of iron ore cargoes, even though exports of this mineral from the Northern Arc have doubled over this period; however, it should be considered that suspected cases of cargo liquefaction may not always be reported to the public authorities.

[56] The IMSBC Code was adopted in 2008 and made mandatory in 2011 under the provisions of the 1974 SOLAS Convention. It classifies solid bulk cargoes (except grains) as Group A (may liquefy if shipped at a moisture content in excess of their transportable moisture limit - TML); Group B (may possess chemical hazards) and Group C (neither liable to liquefy nor possesses chemical hazards)

[57] Bulk Carrier Casualty Report, Years 2008 to 2017 and the Trends, International Association of Dry Cargo Shipowners - Intercargo, Feb/2018

[58] Under the IMSBC Code (2018), Appendix 1, iron ore fines contain both 10% or more of fine particles less than 1mm in diameter and 50% or more of fine particles less than 10mm in diameter, with the content of goethite less than 35%

[59] Transportable moisture limit (TML) is the maximum moisture content (MC) that a liquefiable cargo may display without being at risk of liquefying while transported in a bulk carrier not complying with the special provisions of subsection 7.3.2 of the IMSBC Code. It is calculated as 90% of the Flow Moisture Point (FMP), i.e., the moisture content at which a flow state develops. The cargo moisture content must always be below the TML

[60] IMO Circular MSC.1/Circ.1454/Rev.1 "Guidelines for developing and approving procedures for sampling, testing and controlling the moisture content for solid bulk cargoes which may liquefy", IMO, Jun/2015. Although the new schedule did only become mandatory from Jan/2017, the Brazilian Maritime Authority (DPC) chose to adopt it as early as Dec/2013, when the iron ore fines mined in Carajás and shipped at TMPM in Itaqui began to be classified as Group A and dealt with in accordance with the relevant provision of the Code

[61] "Loss Prevention Circular No.06-11: Cargo liquefaction problems – sinter feed from Brazil", Gard P&I, Jun/2011 [retrieved 22/04/19]

Although **bauxite**[62] is currently classified as a Group C cargo, that is, neither prone to liquefaction nor a chemical hazard, there are certain grades of the aluminium ore containing a higher proportion of fines and sufficiently high moisture content which may, under certain conditions, cause the bauxite to liquify. In the wake of the tragic loss of the bulk carrier "BULK JUPITER", sank off the coast of Vietnam in 2015 while carrying Malaysian bauxite to China[63], the International Maritime Organisation (IMO) has researched the matter and acknowledged that the disaster may have been caused by cargo liquefaction – or, more precisely, **cargo dynamic separation**[64] – and that certain grades of bauxite should be treated in accordance with the provisions of the IMSBC Code for Group A cargoes. A new test procedure for determining the TML for bauxite was developed and submitted to the IMO Member States for approval along with the drafts of a new individual schedule for Group A bauxite (referred to as "**bauxite fines**"[65]) and amendments to the schedule for Group C bauxite. If adopted, such revisions will become effective as of January 2021.

There were reports a few years ago of suspected liquefaction of bauxite cargoes loaded in the Amazon, a condition possibly aggravated by long-lasting precipitation, without significant consequences besides delays and additional costs to unload the shipment[66]. Northern Arc's bauxite majors have voluntarily adhered to the IMO recommendations and their cargo testing protocols, and the Directorate of Ports and Coasts (DPC) approves the certification procedures[67].

Shipments of 'wet' bauxite under Group A are regularly shipped at the ports of Trombetas and Juruti.

The **manganese ore**[68], shipped mostly from the Northern Arc ports of Itaqui and Vila do Conde[69] is a Group C cargo that may at times display properties of Group A cargo and, as such, scheduled as **manganese ore fines** in the IMSBC Code[70].

Even though iron, bauxite and manganese ores of a specific particle size may fall under Group C and, as such, do not present a risk of liquefaction, these high-density bulk cargoes may still cause **structural damage** to the vessel due to overstressing of the tanktop resulting from very fast loading rates adopted by some port facilities, such as TMPM Itaqui, which can load a dozen thousand tonnes of ores every hour. Loading and trimming of such heavy cargoes must, therefore, be made strictly under the provisions set out in the IMSBC Code.

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[62] Appendix 1 of the IMSBC Code describes bauxite as a mineral with moisture content between 0% and 10% comprising 70% to 90% lumps varying in size between 2.5mm to 500mm and 10% to 30% powder

[63] The Bahama-flagged BULK JUPITER sank off the coast of Vietnam in Jan/2015 with only one of its 19 crewmembers surviving while carrying a cargo of bauxite from Kuantan (Malaysia) to Qingdao (China). Although the root cause of the loss is not confirmed, it is believed to have been caused by cargo liquefaction (IMO Circular CCC.1/Circ.2/Rev.1, Sep/2017; "Gard Insight: Update on Group A Bauxite That Can Cause Vessel Instability", Gard P&I, Mar/2017; "Global Bauxite Working Group Report on Research into the Behaviour of Bauxite During Transportation", IMO CCC 4/5/8, Jul/2017 [retrieved 22/04/19]

[64] "Dynamic Separation of Cargoes", Australian Maritime Safety Authority- AMSA, Jul/2018 [retrieved 22/04/19]

[65] IMO Circular CCC.1/Circ.2/Rev.1, Sep/2017 classifies as Bauxite Fines under Group A bauxite containing more than 30% of fine particles less than 1mm and more than 40% of particles less than 2.5mm, though the cargo may be carried as Group C if the shippers certify that the moisture freely drains from the cargo so that the degree of saturation is not liable to reach 70%

[66] "West of England Bulletin: Brazil - Liquefaction of Bauxite Cargoes", West of England P&I, Mar/2012; Brazil: "Skuld Bulletin: Amazon Bay - Liquefaction of Bauxite Cargoes, Skuld P&I, Mar/2012; "North of England Bulletin: Brazil - Risk: Bauxite with a High Moisture Content Loaded at Trombetas, Brazil, May be Prone to Liquefaction", North of England P&I, Jan/2015, updated Nov/2018; "Standard Bulletin: Bauxite Cargo Liquefaction Risk Revisited, Standard P&I, Mar/2015; "Bulk Cargo Liquefaction, Norwegian Hull Club, Oct/2015; "Gard Loss Prevention Bulletin: Loading of Bauxite and Other Cargoes that May Liquefy", Gard P&I, Nov/2015 [retrieved 22/04/19]

[67] Mineral ore cargoes prone to liquefaction or other instabilities handled in Brazilian waters must have their testing and certification procedures for determining MC and TML approved by the Brazilian Navy's Directorate of Ports and Coasts (DPC) in accordance with NORMAM-05/DPC *Normas da Autoridade Marítima para Homologação de Material* (Maritime Authority Norms for Approval of Material)

[68] Appendix 1 of the IMSBC Code describes manganese as a mineral with moisture content up to 15% with fine dust to 250mm in size

[69] Brazil exported 2,5 million tonnes of manganese ore in 2018, mostly from TMPM Itaqui (52%) and Vila do Conde/Barcarena (46%), ANTAQ online statistics [retrieved 22/04/19]

[70] IMSBC Code describes manganese ore fines of Group A as cargo containing both 10% or more of fine particles less than 1mm and 50% or more of particles less than 10mm. Notwithstanding these provisions, manganese ore may be carried as a Group C if it does not exhibit a FMP

Basic recommendations for loading of minerals which may liquefy:

- Consult the IMSBC Code to check the information of the individual schedule against the cargo declaration to be obligatorily provided by shippers, before loading, to state the moisture content (MC) and the transportable moisture limit (TML) of the parcel of cargo intended to be loaded
- Carefully check the shippers' cargo declaration – if the MC is above the TML, loading is not permitted
- Sight and sample the stockpiles before the commencement of loading, where possible
- Carefully observe the start of loading and look and listen for signs of splashing of the cargo on the tank top and over the bulkheads, as this may indicate a change in the cargo state
- Conduct "can tests" regularly before and during loading and make sure to log the result and take before and after photographs (the date, time and cargo hold must be identified in the pictures)
- A photographic report should be made by the crew detailing every stage of the operation and the apparent cargo condition throughout loading operation
- If the master is concerned about the apparent condition and suitability of the cargo, if the can test fails or if the shipper did not provide the obligatory cargo declaration, he should stop the operation and report the problem to the shipowner, charterer, P&I club, port operator and shippers and lodge a note of protest

5.3. Agricultural commodities risks

Depending on the moisture content and temperature of the cargo at loading, there is a risk that the oilseed will deteriorate due to the microbiological action that will develop during the sea voyage. The higher the moisture content and temperature, and the longer the passage, the faster the rate of deterioration, particularly in the form of fungi growth and self-heating[71].

In addition to the sea passage, which can reach about forty days (between the Amazon and China), vessels arriving with soya beans from Brazil often have to wait at anchor for several weeks until the perishable cargo is discharged, resulting in the oilseed being confined in the cargo holds for months.

As the inland cargo conveyance from central Brazil to the northern ports can take several weeks and expose the commodity to high temperature, relative humidity and precipitation indexes, the soya bean shipped in that region tends to present an inherently higher risk of being damaged during sea carriage than that shipped elsewhere in Brazil, due to the potentially **high moisture content and high temperature** of the soya bean shipped in the North, particularly during the rainy season. [Table 1]

Brazilian soya beans are usually marketed according to the standard specifications of the ANEC contracts[72], which provide for maximum moisture content of 14%. However, the soya beans loaded at the Northern Arc ports tend to reach or at times even exceed 13% of moisture content with an average temperature above 23°C at the peak of the wet season.

Another environmental factor affecting the condition and quality of the soya beans – or corn –, often neglected by the vessel's crew and the port operators, is the unstable and ever-changing weather, particularly during the Amazon Winter when sudden and heavy rains are frequent. It is somewhat common for vessels to be caught by surprise by sudden rainstorms with one or more of their cargo holds opened either because of a failure in the closing of the hatch covers or account of a defect of the shoreside loading equipment preventing its removal from within the holds for the closing of the hatches.

[71] Brazil and Uruguay: Soybeans with High Moisture Content, Skuld – November 2016; Loss Prevention Briefing: Soya Beans – Cargo Damage Claims in China, The North of England P&I – July 2017; Industry Expertise: Carriage of Soya Beans, The Standard Club – April 2019

[72] *Associação Nacional dos Exportadores de Cereais* – ANEC (National Association of Grain Exporters) publishes Contracts ANEC 41 (Brazilian Soyabeans – FOB Contract for Parcels) and ANEC 42 (Brazilian Soyabeans – FOB Contract for Full Cargo) provides for a maximum moisture content of 14%. ANEC standard contracts can be downloaded at www.anec.com.br

Because the new grain terminals in the Northern Arc are designed to load solid bulk cargoes and do not have cargo unloading equipment readily available, **rainwater damage** can be a rather costly incident and generate extra costs and expenses well above the market value of the affected cargo, since discharge of damaged cargo may involve extra expenses with vessel's shifting (pilotage, towage and wharfage) and rental of cargo discharge equipment.

Basic recommendations for loading of agriproducts:

- Prepare cargo holds to meet "grain clean" (or "food grade") standard
- Submit hatch-covers to a weather-tightness test (by ultrasound or hose test) before loading and make sure that the closing mechanisms are working properly
- Prepare a passage plan including the ventilation strategy to be adopted during the voyage, which should be implemented before the commencement of cargo loading
- Keep a detailed log of weather measurements (outside temperature, R.H., rain times and dew point) and ventilation from berth to berth
- Carefully check the shippers' cargo declaration and other cargo-related documents
- Consider arranging light and loaded draft survey to ascertain eventual cargo quantity discrepancies
- Consider arranging a pre-loading survey to monitor the condition of the cargo during loading, draw cargo samples and take readings of moisture content and temperature at regular intervals
- Prepare a photographic report covering every stage of the operation, including the apparent cargo condition throughout loading, trimming, fumigation and sealing of holds, if any
- Maintain a constant weather lookout throughout loading operation and establish means of prompt communication with shoreside personal (including hand signals to overcome language barrier) for loading to be discontinued and holds closed before the start of rain
- If the master is concerned about the apparent condition and suitability of the cargo, then he should stop the operation, report the problem to the shipowner, charterer, agents, port operators and shippers, lodge a note of protest and consider seeking P&I assistance

6. Navigation

6.1. Port traffic control

Federal laws govern the traffic of vessels within Brazilian jurisdictional waters, and the matter is regulated by a set of standards issued by the Directorate of Ports and Coasts (DPC)[73], and rules established in international conventions ratified by Brazil. At regional level, norms and procedures of navigation safety, pilotage and traffic control are set forth by local Port and River Captaincies.

The Brazilian Navy exercises the naval control of the maritime traffic through the SISTRAM system[74], which aims to assist in SAR efforts, distressed vessels and emergency medical evacuation.

6.2. Entering the Northern Arc

Vessels arriving from abroad bound for the ports upstream of the Western Amazon (Manaus, Itacoatiara, Santarém, Juruti, Trombetas, etc.) gain access through the Barra Norte (North Bar) of the Amazon River, northwest of Marajó Island. Mandatory inspections of incoming vessels are conducted during working hours at Fazendinha Pilot Station, near Santana. Vessels arriving from the southern ports (or from the region of Belém) to call at the river ports may cross the Barra Sul (South Bar) or the Region of the Straits southeast of Marajó Island towards the Amazon River. [Figure 25]

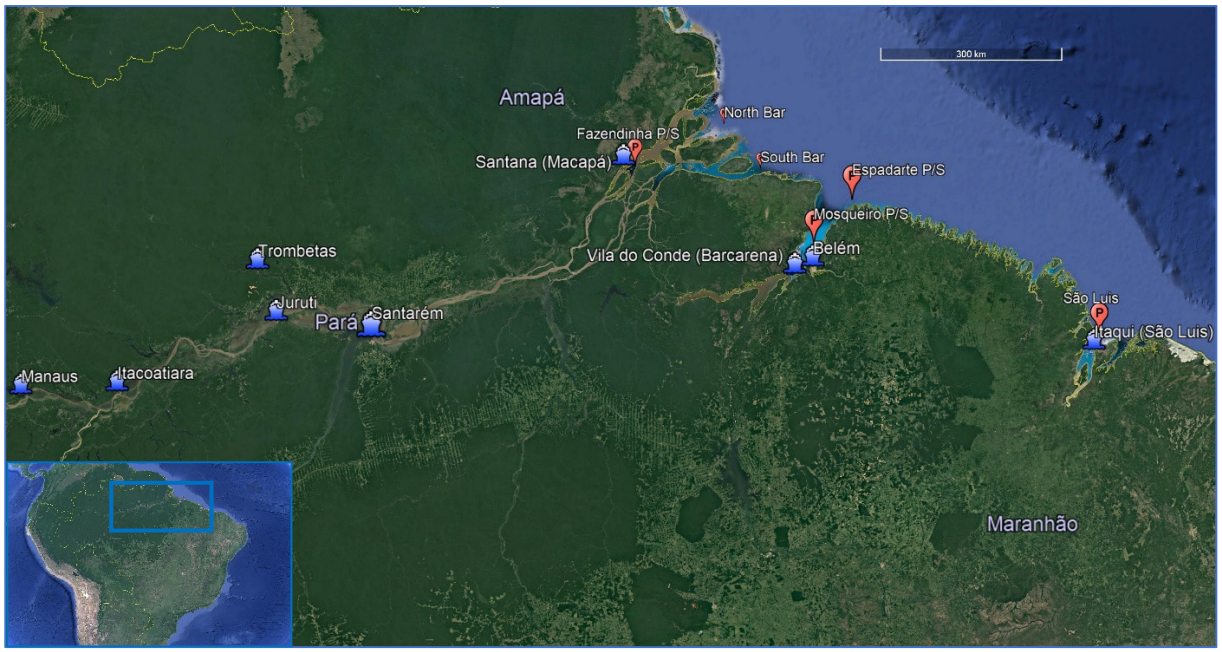

Figure 25: Pilot stations in the Northern Arc ports. Source: Google Earth/MINFRA

The river ports of the Eastern Amazon (Belém, Outeiro, Miramar, Vila do Conde/Barcarena, etc.), southeast of the Marajó Island, are accessible by the Quiriri (or Marajó) Channel, which is the most common choice for self-piloted vessels not carrying dangerous goods, or through the Espadarte (or Taipu) Channel at the mouth of the Pará River, where pilotage is mandatory. The port facilities of São Luis (Itaqui, Ponta da Madeira and Alumar), in Maranhão, are reachable through the deep waters of the São Marcos Bay with partly compulsory pilotage. [Figure 26, Table 2]

[73] The main rules governing maritime traffic and navigation are Law 9,537 of 1997 (regulated by Decree 2,596/1998), which provides for the safety of waterway traffic; NORMAM-02/DPC: *Normas da Autoridade Marítima para Embarcações Empregadas na Navegação Interior* (Maritime Authority Standards for Ships Engaged in Inland Navigation); NORMAM-04/DPC: *Normas da Autoridade Marítima para Operação de Embarcações Estrangeiras em Águas Jurisdicionais Brasileiras* (Maritime Authority Standards for Operation of Foreign Ships in Brazilian Jurisdictional Waters) and NORMAM-08/DPC: *Normas da Autoridade Marítima para Tráfego e Permanência de Embarcações em Águas Jurisdicionais Brasileiras* (Maritime Authority Standards for Traffic and Permanence of Ships in Brazilian Jurisdictional Waters), issued by the DPC

[74] *Sistema de Informações Sobre o Tráfego Marítimo* – SISTRAM (Maritime Traffic Information System) is managed by the Brazilian Navy's *Centro Integrado de Segurança Marítima* – CISMAR (Integrated Centre for Maritime Safety) and regulated by NORMAM-08/DPC. Adherence to the system is compulsory for all merchant vessels calling at national ports or passing through Brazilian territorial waters

6.3. Pilotage

Pilotage is a matter regulated by the DPC that delegates to the *Conselho Nacional de Praticagem* – CONAPRA (National Pilotage Council) the duty to control and supervise pilotage services in Brazil. According to the relevant statutes and regulations[75], the pilot is a professional adviser to the vessel's captain and the presence of a pilot on board does not relieve the captain of his overriding authority and responsibility for safe navigation, preservation of human life, the environment and property on the vessel.

The national port system is divided into 21 *Zonas de Praticagem* - ZP (Pilotage Zones) operated by certified pilots, mostly organised in associations, four of them covering the Northern Arc. [Table 2]

Pilotage Zone	Area of coverage
ZP-1 **Fazendinha-AP ↔ Itacoatiara-AM**	From the North Bar, between parallel 00°03'S (Fazendinha P/S) upriver the Amazon (towards Santana, Santarém, Juruti, Trombetas and Itacoatiara), including the access from the South Bar and the Region of the Straits and Belém, and upriver Mosqueiro P/S. Pilotage is compulsory between Fazendinha and Itacoatiara and between Mosqueiro and Itacoatiara, and optional between the North Bar (Buoy #2 of Curuá Channel) and Fazendinha (parallel 00°03'S)
ZP-2 **Itacoatiara-AM ↔Tabatinga-AM**	From Itacoatiara to Tabatinga, where pilotage is compulsory. Vessels arriving with pilots from ZP-1 sailing upriver from Itacoatiara are required to change to ZP-2 pilots
ZP 3 **Belém-PA ↔ Barcarena-PA**	From Quiriri Channel or Espadarte in the Pará River; from the Xingu Bank in the Lower Espadarte until Belém and Vila do Conde (Barcarena). Pilotage in the Quiriri is not compulsory (unless the vessel carries dangerous goods). Pilotage in the Espadarte Channel is mandatory throughout its length [Figure 25]
ZP 4 **São Luís-MA**	Cover all the ports in the State of Maranhão and is divided in two stretches: the first between the access to the port channel near Buoy #1 until the vicinities of Buoy #19 where pilotage is facultative; the second stretch between Buoy #19 and the port terminals of Alumar, Itaqui and TMPM. Pilotage is compulsory for vessels with DWT ≥ 100,000 m/t or draft ≥ 11 m beyond 2.3 nm northeast of Buoy #19

Table 2: Northern Arc's pilotage zones. Source: DPC/CONAPRA

Two pilots (plus eventual pilot practitioners) are required for river passages lasting longer than six hours, which is the case of most of the Amazon ports, with the pilots working on six-hour shifts.

Use of tugboats is required for berthing and unberthing manoeuvres in most of the Northern Arc's ports. Some terminals require tugboats (sometimes also pilots) to standby throughout the vessel's stay.

6.4. Draft restrictions

Although the Amazon River has an average depth of about 50 metres, with some stretches as deep as 100 metres during the rainy season, the maximum draft in the Amazon ports (Manaus, Itacoatiara, Juruti, Trombetas and Santarém, among others) is limited to 11.50 m (freshwater, hightide) due to the existing restriction in the North Bar. The minimum under keel clearance (UKC) along the rivers is generally 0.5 m, with vessels carrying dangerous goods or pollutants observing a 1 m UKC and navigate with the guidance of a pilot.[76]

[75] Brazilian Commercial Code (Law 556/1850); NORMAM-12/DPC: *Normas da Autoridade Marítima para Serviços de Praticagem* (Maritime Authority Standards for Pilotage Services) by the DPC; Law 9,537/1997, known as *Lei de Segurança do Transporte Aquaviário* – LESTA (Waterway Transportation Safety Act)

[76] *Normas e Procedimentos da Capitania Fluvial da Amazônia Ocidental* – NPCF-CFAOC-2012, as amended (Standards and Procedures of the River Captaincy of the Western Amazon); *Normas e Procedimentos da Capitania dos Portos da Amazônia Oriental* – NPCP-2015, as amended (Standards and Procedures of the Port Captaincy of the Eastern Amazon)

The draft limitation in the Pará River for vessels sailing from the ports of Vila do Conde and Barcarena along the Quiriri towards the Atlantic Ocean is currently 13.50 m (12.20 m without pilotage); however, some specific conditions must be fulfilled if one chooses to sail with this draft[77]. [Figure 26]

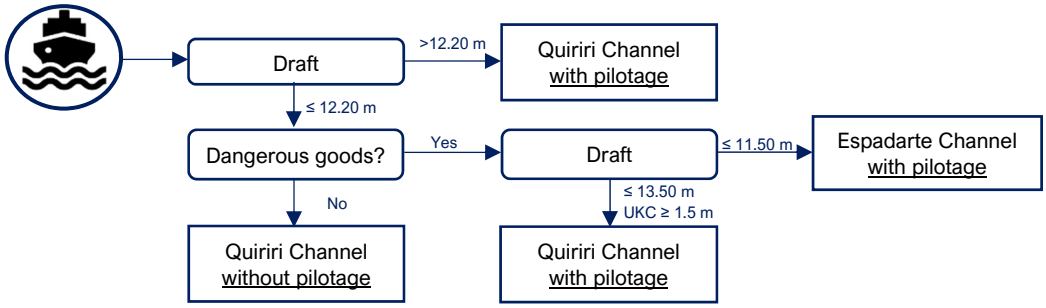

Figure 26: entering the Pará River towards the ports of Belém and Vila do Conde/Barcarena (Source: DPC/CONAPRA)

The maximum draft at the seaports of Maranhão (Itaqui, TMPM and Alumar) currently varies from 10 m up to 23 m depending on which terminal the vessel will berth.

6.5. Nautical charts

The passage from the North Bar up the Amazon is charted and marked with river signalling. Nautical charts issued by the Directorate of Hydrography and Navigation[78] cover the commercially navigated waterways in the Amazon region. Complementary information is provided by way of notices to mariners and navigational warnings circulated by the Brazilian Navy.

Exemption of paper nautical charts is allowed on the Amazon when the vessel is equipped with Electronic Charts Display and Information System (ECDIS), using Official Electronic Nautical Charts (ENC), and a second ECDIS as a backup of the primary system as established by IMO. Charts in RASTER format are not accepted to comply with this requirement unless the ship is engaged in inland navigation[79].

6.6. Ballast water

When introduced for the first time in 2005, the DPC standards for ballast water management (BWM), NORMAM-20/DPC, which largely mirrored the provisions of the IMO BWM Convention[80], contained special requirements for vessels sailing the Amazon and Pará Rivers to undertake two exchanges of ballast water, the first to avoid the transfer of exotic and/or pathogenic organisms, and the second to reduce the salinity of the ballast water[81]. In 2014, DPC updated the BWM regulation, when it withdrew the requirement for a second ballast water exchange for entering the Amazon Basin[82].

The current version of the Brazilian BWM regulation[83] maintains that vessels sailing between river ports of distinct river basin districts (hydrographic basins) when navigating by sea, perform a ballast water exchange as described in the regulation if they do not have an operational BWM system with a valid certificate. [Figure 6]

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[77] Under Ordinance 15/CPAOR of 18/02/19, the Harbour Master of the Eastern Amazon authorised vessels to sail with a draft of 13.50m along the Quiriri Channel and, temporarily and on a trial basis, with a maximum draft of 13.80m, providing certain conditions are met

[78] *Diretoria de Hidrografia e Navegação* – DHN (Brazilian Navy's Directorate of Hydrography and Navigation)

[79] NORMAM-28/DHN: *Normas da Autoridade Marítima para Navegação e Cartas Náuticas* (Maritime Authority Standards for Navigation and Nautical Charts) by the Directorate of Hydrography and Navigation - DHN

[80] IMO Resolution A.868(20) and the 2004 International Convention for the Control and Management of Ship's Ballast Water and Sediments, adopted by Brazil in 2005 (entered into force worldwide in 2017)

[81] Under IMO Circular BWM.2/Circ.1 dd. 22/09/2005 and now-revoked NORMAM-20/DPC of 2005, vessels arriving from abroad or from a distinct river basin sailing in the Amazon were required to carry out a second ballast water exchange in the stretch between 20 metres isobathic and Macapá (Fazendinha P/S) for vessel sailing upstream of the Amazon River; vessels entering the Pará River should carry out the exchange at least 60 n.m. from Salinópolis and as far as the lighthouse at Ponta do Chapéu Virado (Mosqueiro Island)

[82] All the ports of the Northern Arc are within the Amazon River Basin, except those in the state of Maranhão

[83] NORMAM-20/DPC (1st Revision, 2014): *Normas da Autoridade Marítima para o Gerenciamento da Água de Lastro de Navios* (Maritime Authority Standards for Ship's Ballast Water Management) by the DPC

Discharge of ballast water in Ecologically Sensitive Areas and Units of Nature Conservation or any other protected areas, as plotted in the nautical charts, is strictly prohibited.

In addition to an effective BWM Plan developed according to IMO guidelines, the master must complete the ballast water reporting form and forward it to the authorities, through local agents, no later than two hours after anchoring or berthing in the port of call. Compliance is closely monitored by Port State Control officers and penalties for breach of the regulation include hefty fines without prejudice to eventual civil claims and criminal sanctions[84].

6.7. Navigation hazards

In terms of risks to navigation, the most common types of nautical incidents in the Northern Arc region are groundings and collisions between oceangoing ships and smaller crafts (barges, riverboats and canoes) and fixed and floating objects (river buoys, jetties, fenders and piers).

In certain locations along the Madeira, Solimões and the Upper Amazon in general, the presence of unlit mining barges engaged in illegal river mining is a constant threat to commercial navigation in those waterways.

Basic navigation recommendations for the Amazon:

- Check with the local agents in advance the actual draft limitation and any other navigation restrictions along the access channels, port terminals and anchorage areas
- Follow the procedures and rules issued by the maritime authority at national and regional levels, as well as notice to mariners and navigational warnings
- Make sure the nautical charts are up-to-date, and navigation equipment is in good working condition before entering the Amazon
- Maintain a permanent watch on the VHF channel 16
- Beware of ballast water exchange restrictions applying in ecologically sensitive areas within the Amazon
- Keep a close visual lookout of small crafts (barges, riverboats and canoes) not visible to the navigation equipment on board

[84] NORMAM-20/DPC (2014) and Decree N° 6,514/2008 provides for fines from BRL 5,000 to BRL 50,000,000 for non-compliance

7. Safety & health

7.1. Safety and security

Law enforcement authorities[85] do not have enough workforce and equipment to prevent crimes in the thousands of miles of the Amazon waters. The tendency is for the police to deploy their limited resources in more densely populated areas, leaving remote rivers at the mercy of criminals, who are local and can rely on a formidable profusion of narrows, islands and straits to escape after an attack.

While incidents of attempted piracy and armed robbery on foreign vessels are likely underreported locally – to avoid delays and expenditure as a result of the official investigations and enquiries that follow – it is known that since last year there have been at least five cases of armed robbers who climbed aboard bulk carriers anchored off Macapá, in the North Bar, using a rope and hook or scaling the vessel's anchor chain to get on deck. The intruders attacked at night and eventually fled in speedboats as soon as they were detected, taking with them what they could steal from the vessels or without stealing anything. Fortunately, none of the crewmembers was injured in these incidents[86].

Regarding inland navigation, media reports of armed robbery and pilferage in the Amazon are plentiful. Criminals target cargo and passenger boats. Most sought-after items, besides the personal belongings of crews and passengers and the bunkers aboard, are fuel, household appliances and electronics. The river marauders, known in local parlance as "water rats", are ruthless people and ambush boats and fuel barges after dark in remote stretches of rivers where there is no telecommunication signal and law enforcement boats rarely venture.

Areas where the attacks are known to occur include but are not limited to the Madeira River; the stretch between Coari and Manaus and Manaus and Parintins; the Macapá anchorage; the South Bar of the Amazon; Belém and all around the Strait of Breves. Illegal fuel trade – to supply clandestine gold mining, drug trafficking and the black-market – and disputes between cross-border drug smugglers and river raiders constitute a significant cause of violent crime in the Amazon.

Basic safety recommendations for the Amazon:

- When transiting in risky areas, follow the Ship Security Plan, ISPS Code and IMO specific guidelines[87]
- Establish (and test) communication methods for outside and in-vessel support
- At anchor or alongside, keep the vessel's deck and outer side well lit
- Maintain portholes and accesses to the living quarters, engine room and bridge closed and locked
- When at anchor, keep the ladders raised, watch the anchor chain and monitor suspicious boats nearby
- When alongside, maintain a crewmember guarding the gangway and controlling access to the vessel and another watching the deck with attention to mooring ropes and the outer side
- Report any attempted or actual occurrence of pilferage, robbery or aggression to the local authorities

[85] The Brazilian Navy, through port and river captaincies, is responsible for the safety and control of waterway traffic while the Federal Police are in charge of the maritime policing, enforcement of the ISPS Code, and port and airport security. At state level, the Military Police and the Civil Police are responsible for law enforcement and crime investigation in the state rivers and islands of the Amazon

[86] Piracy and Armed Robbery Against Ships 2018 Annual Report, by the ICC International Maritime Bureau – IMB, Jan/2019; Piracy and Armed Robbery Against Ships First Quarter 2019, by the ICC IMB, Mar/2019 [retrieved 16/06/19]

[87] IMO Circular MSC.1/Circ.1334 dd. 23/06/2009: Guidance to shipowners and ship operators, shipmasters and crews on preventing and suppressing acts of piracy and armed robbery against ships

7.2. Stowaways

Stowaways incidents in the Northern Arc ports are infrequent. Disembark of foreign stowaways in the local ports is possible, but the process of identification and repatriation usually takes longer than in other more developed Brazilian ports[88].

7.3. Port health controls

Port health authority (ANVISA)[89] inspectors posted in the Northern Arc ports are strict. Inspections are carried out regularly in the main ports and anchorages, with emphasis on the validity of certificates, integrated vector management plan, HVAC system, ballast water records, sewage plant operation and the general hygienic-sanitary conditions prevailing on board[90].

ANVISA stations in the ports of Itaqui, Belém, Vila do Conde/Barcarena, Santana and Manaus issue ship sanitation certificates (SSC) in conformity with the International Health Regulations (IHR 2005) of the International Health Organisation (WHO) and the charges for these services are payable through the banking system, without any direct payment to the health inspectors.

Sanitary inspections (for free pratique and SSCs) must be scheduled in advance through local agents and are performed only on weekdays during business hours.

7.4. Mosquito-borne diseases

Brazil is currently experiencing several outbreaks of mosquito-borne infectious diseases that may be of significance to maritime shipping.

Figure 27: Yellow fever vaccine (left-yellow area) and malaria recommendations (right-red area) for Brazil. Source: CDC

Malaria is an infectious disease transmitted by the bite of infected female Anopheles mosquitoes and is endemic in the Amazon Basin. Three of the five known types of parasites occur in Brazil (*Plasmodium vivax*, *P. malarie* and the deadliest *P. falciparum*), the *P. vivax* being the most prevalent in the Amazon, where the incidence and mortality rate of malaria (in jungle and mining areas) is much higher than in other regions of the country. [Figure 27]

[88]Detailed information on stowaways in Brazil can be found at: https://proinde.com.br/manuals/stowaways-in-brazil-practical-guidance-and-statistical-review/

[89] The *Agência Nacional de Vigilância Sanitária* - ANVISA (National Health Surveillance Agency) is the regulatory body of the Ministry of Health responsible for the sanitary and epidemiologic surveillance, vectors and health controls of ships and port facilities. It is also the National IHR Focal Point under the IHR 2005

[90] Detailed information on sanitary inspections and port health controls in Brazil can be found at: https://proinde.com.br/manuals/shipboard-sanitary-inspections-in-brazil-practical-guidance/

Sylvatic **yellow fever** virus, transmitted to monkeys by forest dwelling mosquitoes *Haemagogus* and *Sabethes* and circulated in urban areas through the *Aedes Aegypti*, is widespread in the Northern Arc states with peaks of human cases during the wet season in the Amazon that coincides with a more significant concentration of unvaccinated people visiting the region.

Brazil is experiencing an outbreak of yellow fever, with the greatest risks in the states of São Paulo, Rio de Janeiro, Paraná and Santa Catarina and has adopted the single-dose vaccination scheme recommended by the WHO[91]. Currently, Brazil does not require vaccination against yellow fever for entry into the country, though the Ministry of Health and the WHO recommend the vaccination of those visiting affected areas, which includes the entire Northern Arc region[92]. ANVISA vaccinates travellers for free and issues them with the international vaccination certificate in the WHO standard, which is valid for the lifetime of the vaccinee. [Figure 27]

Apart from yellow fever, other flaviviruses also spread by the bite of the female *Aedes* mosquitoes, mostly the *Ae. Aegypti*, that are common in Brazil and occur through the Northern Arc are **dengue**, **chikungunya** and **Zika**. There is no vaccine commercially available to prevent these diseases, and the only recommendation is mosquito avoidance[93].

Basic health recommendations for the Amazon:

- Maintain efficient and well-documented plans and records for ballast water exchanges, sewage system, HAVC system and integrated vector management ready for inspection by ANVISA
- Vaccinate against yellow fever, unless contraindicated by a physician
- Try to stay indoors in a screened or air-conditioned room
- Sleep under permethrin-treated bed nets if not in an air-conditioned room
- Wear long-sleeved shirts and trousers, ideally light-coloured and permethrin-treated
- Use approved insect repellent on exposed skin and clothing as directed by the manufacturer

[91] WHO yellow fever vaccination requirements and recommendations, malaria situation, and other vaccination requirements can be found at: https://www.who.int/ith/ITH_country_list.pdf?ua=1

[92] List of cities where vaccination against yellow fever is recommended: http://portalarquivos2.saude.gov.br/images/listavacinacaofa.pdf

[93] Detailed information on mosquito-borne diseases in Brazil can be found at: https://proinde.com.br/manuals/mosquito-borne-diseases-in-brazil-practical-guidance/

8. Conclusion

Brazilian production and exports of soya bean and corn are projected to continue growing over the coming years, particularly the grain powerhouse state of Mato Grosso and other producing areas in the Central-West, North and Matopiba regions. In anticipation of even larger grain crops and more intense use of inland waterways, the government is streamlining regulations and procedures to facilitate foreign trade processes and is investing in basic transport infrastructure, including improvements to major roads linking the grain fields of central Brazil to the waterways of the Amazon. The 2019/2020 Harvest Plan foresees spending in the order of US$ 58 billion in crop financing, with a focus on expanding grain storage capacity.

Government measures associated with substantial long-term investments by the private sector, which include greenfield projects for key railways and cargo handling facilities, contribute to the continued expansion and development of northern Brazil, which is increasingly becoming a cleaner and financially attractive logistical alternative for exporters who are now shipping their mineral and agricultural products through the Northern Arc ports, which are closer to the import markets in Europe, the Middle East, North America and Asia through Panama.

Due to its geographical diversity and ecological sensitivity, it will take some time for the ports of the *Arco Norte* to be exploited to their full potential with environmental responsibility in order to increase Brazil's trade and export capacity and contribute to the socioeconomic development and wealth of the North and Northeast regions.

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