

# Illegal pesticide trade networks on the Brazil and Paraguay border: scenarios following the Latin American Integration Route (LAIR) construction

Redes de comercio ilegal de plaguicidas en la frontera de Brasil y Paraguay: escenarios tras la construcción de la Ruta de Integración Latinoamericana (LAIR)

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## Abstract

Agribusiness has unleashed new territorial dynamics on the Brazil and Paraguay border. Derived from Brazilian public policies influenced by geopolitical objectives, the spillover of agribusiness into Paraguayan territory has created productive, commercial, and logistical networks that have intensified the porosity of this border. In light of this, criminal groups have used these networks to carry out cross-border crimes. Among these illicit acts, the illegal flow of pesticides and agrochemical inputs stands out, since they use the road network to transport and distribute these products to the thriving agribusiness segment, despite the asymmetry between sanitary and legal parameters between Brazil and Paraguay. Through a qualitative analysis of quantitative data and interviews with agents responsible for security in the Brazilian Border Strip, we identified the characteristics of this cross-border illicit flow and built a scenario for the period after the construction of the RILA, which will make the river border of the state of Mato Grosso do Sul, Brazil, with the department of Alto Paraguay, Paraguay, between the cities of Porto Murtinho and Carmelo Peralta, more porous and therefore more vulnerable to these crimes.

Keywords: border; agribusiness; illicit pesticides and agrochemicals; Brazil; Paraguay.

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## Resumen

La agroindustria ha desencadenado nuevas dinámicas territoriales en la frontera entre Brasil y Paraguay. Derivado de políticas públicas brasileñas influidas por objetivos geopolíticos, el desborde del agroindustria en territorio paraguayo ha creado redes productivas, comerciales y logísticas que han intensificado la porosidad de esta frontera. Consecuentemente, los grupos criminales han utilizado estas redes para llevar a cabo delitos transfronterizos. Entre estos ilícitos se destaca el mercado ilegal de plaguicidas e insumos agroquímicos, que utiliza la red vial para transportar y distribuir estos productos al próspero segmento de la agroindustria, a pesar de la asimetría entre los parámetros sanitarios y legales en Brasil y Paraguay. A través de un análisis cualitativo de datos cuantitativos y entrevistas con agentes responsables de la seguridad en la Franja Fronteriza de Brasil, identificamos las características de este flujo ilícito transfronterizo y construimos un escenario para el período posterior a la construcción de la RILA, que hará frontera fluvial del estado de Mato Grosso do Sul, Brasil, con el departamento de Alto Paraguay, Paraguay, entre las ciudades de Porto Murtinho y Carmelo Peralta, más porosa y por lo tanto más vulnerable a estos delitos.

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Palabras clave: frontera; agroindustria; plaguicidas ilícitos; Brasil; Paraguay.

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## 1. Introduction

The trend of increasing grain production has provided, notably for Brazil and Paraguay, a prominent role in global food production networks. These countries are major producers and exporters of vegetable protein, which mainly supply consumer markets in Europe and the Pacific basin. Nevertheless, insofar as this production increases, the domestic demand for pesticides and agrochemical inputs also rises since the search for greater agricultural productivity determines the greater competitiveness of the crop. In this context, the concept of pesticides adopted is “compounds of chemical substances intended for the control, destruction or prevention of pathogenic agents that act on useful plants and animals and on people” (Brasil, 1989). The legal and efficient use of agrochemicals has been essential to increasing agricultural productivity on a global scale and, therefore, in areas that have large grain production, such as Brazil and Paraguay. Despite the need for technical procedures and prior approval from the National Health Surveillance Agency (ANVISA), the Brazilian Institute of the Environment and Renewable Natural Resources (IBAMA) and the Ministry of Agriculture, Livestock and Supply (MAPA), in the Brazilian context, as well as the Servicio Nacional de Calidad y Sanidad Vegetal y de Semillas (SENAVE), in Paraguay, part of the pesticides and agrochemical inputs used in the border region between these countries derives from a complex illegal cross-border network. According to North (1991), these institutions seek to restrict illegalities that affect agribusiness in order to promote greater competitiveness among producers.

Mainly supplied by importing companies headquartered in Paraguay, these products and inputs, in addition to being distributed domestically, enter the Brazilian territory through the binational border, where the twin cities of Bela Vista and Bella Vista Norte, Mundo Novo and Salto del Guairá, Coronel Sapucaia and Capitán Bado and Ponta Porã and Pedro Juan Caballero in Brazil and Paraguay, respectively, act as nodes in a network that involves actors responsible for the transportation, storage, counterfeiting and commercialization of these products. In addition to tax evasion, when they enter Brazil as a product of theft, their presence as an input in Brazilian territory violates national health and environmental laws since they are incompatible with cur-

rent technical standards and, therefore, represent potential threats to producers and consumers of animal and vegetable protein. The key objective is to analyze the potential of LAIR as a possible logistical route for markets of illegal pesticides and agrochemicals from Paraguay to Brazil. Thus, authorities responsible for public safety, notably the National Police of Paraguay (PNP) and the Federal Highway Police (PRF), the Federal Police (PF) and the Department of Border Operations of Mato Grosso do Sul (DOF-MS) in Brazil, have carried out operations in these cities and on the main highways in the border region, which have resulted in an increase in seizures of cargoes of pesticide and illegal agrochemical inputs.

## 2. Methodology

While the illegal pesticide market depends on the logistical structure and demand linked to the legal market, this article presents the following hypothesis: the construction of the Latin American Integration Route (LAIR), a bioceanic road corridor between Brazil, Paraguay, north of Argentina and the coast of Chile will create an alternative axis for this illegal market, due to the incipient security apparatus at the borders and the high road capillarity between this corridor and Mato Grosso do Sul (MS), one of Brazil's main grain-producing states. The key objective was to analyze the potential of LAIR as a possible logistical route for markets of illegal pesticides and agrochemicals from Paraguay to Brazil. As subordinate objectives, we intended to understand the functioning of the networks of this illegal market on the border between Brazil and Paraguay; and to identify the productive, logistical, and territorial aspects of MS state that favor the transformation of LAIR into an alternative logistical axis of these illegal activities. As part of the methodological resources, we carried out a qualitative analysis of quantitative data as well as open interviews with the commander of the Department of Border Operations of MS and with a special agent of the PF, both from Brazil, who work on the border between the two countries. Through data provided by government institutions in Brazil and Paraguay, as well as private companies related to the research, we sought to understand the functioning of the networks that constitute these illegal markets. We concluded that LAIR has a high potential to intensify the territorial fluidity of illicit activities.

## 3. Results

### 3.1. *The pesticide market on the border between Brazil and Paraguay*

The improvement of transportation and communication structures has provided the emergence of global production networks (GPN). Despite the increasing logistical fluidity resulting from these structures, each link in a GPN still depends on the territorialization of specific productive activities. Consequently, the nature and articulation of GPNs are profoundly influenced by the sociopolitical, institutional, and cultural context of the territories where they produce and reproduce (Dickens, 2009). Inasmuch as these networks become transnational, with productive links territorialized in border areas, as in the case of grain production in the Brazilian state of Mato Grosso do Sul (MS) and in Paraguay, these GPNs forge economic and geopolitical dynamics that not only promote regional development but also the emergence of transnational illicit networks.

The development of a cross-border illicit market presupposes the existence of economically viable supply and demand linkages between supplier and consumer. Furthermore, the availability of

physical networks is essential to boost the territorial fluidity of this illicit market, although this condition contradicts “the fundamental question in supply chain design and management as to how a chain can most effectively deliver quality and value to consumers” (King et al., 2010). In order to reduce operating costs and, therefore, provide products with competitive prices in relation to the legal market, criminal groups take advantage of logistical structures, such as roads and storage areas, similar to those used by companies that operate in accordance with current legislation.

As a large part of the Paraguayan agribusiness activity takes place in departments close to the border with Brazil, and being a product, in part, of the overflow of the advance of the Brazilian agricultural frontier (Huertas, 2007), criminal groups transport, store, and commercialize pesticides and agrochemicals inputs, originally intended for domestic agricultural activities, in the Brazilian territory. Regarding the concept of agribusiness, we understand it as “means the sum total of all operations involved in the manufacture and distribution of farm supplies; production operations on the farm; and the storage, processing, and distribution of farm commodities and items made from them” (Davis; Goldberg, 1957, p. 2).

On this topic, we point out that the concept of agribusiness presents a theoretical conflict between entrepreneurial agriculture and small agricultural producers in Brazil. A small farmer is part of the agribusiness system as well as a large corporate farm. Furthermore, the increase in agribusiness, notably the production of soybean, corn, wheat, and rice, which has occurred in South America, has triggered important territorial transformations, particularly in power relations, which, in turn, have altered geoeconomics and regional geopolitics. According to Luttwak (2001), geoeconomics is made up of capital for productive investment, development of products and services, search for new markets supported or subsidized by the State, among others. According to Huertas (2007), in the Brazil-Paraguay border region, the implementation and expansion of the agro-export model result from state policies that initially sought to expand the domestic supply of grains; and subsequently, to increase exports and attract international currency.

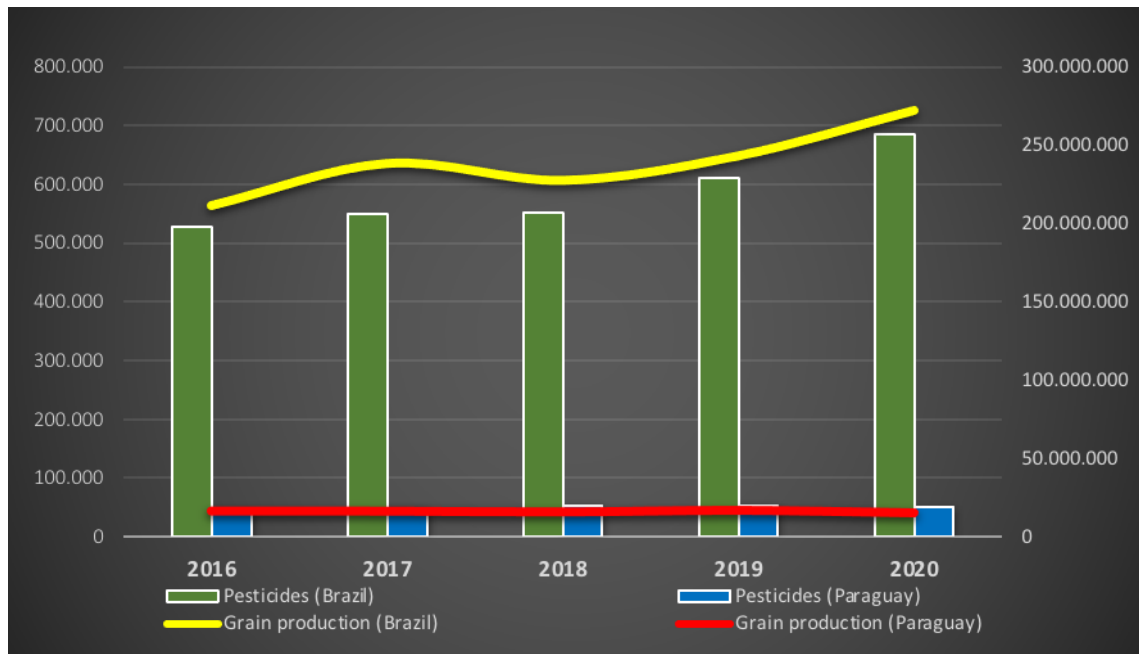
Geopolitics is the conceptual foundation of the State’s strategic objectives, based on knowledge of History, Geography and Politics (Mattos, 1990). Despite the conceptual differences, geoeconomics and geopolitics have objectives that sometimes overlap, since both interact with power relations that produce territory. In MS state, the genesis of agribusiness derives from the agricultural frontier expansion, as an occupation and development route of a region that is not very integrated with Brazil’s main urban and industrial centers. This was one of the geopolitical objectives established by the Brazilian governments during the civil-military dictatorship (1964-1985). Gradually, this agricultural frontier moved towards Paraguayan territory, with thousands of Brazilians migrating between the 1970s and 1990s, a process that was decisive in expanding the agribusiness model beyond Brazilian territorial limits. Consequently, the mismatch between state borders and ethnic borders, which are historically made explicit by the flows of Guarani indigenous people and, currently, by the circulation of rural producers and land, merchandise, and capital owners, is one of the main features of this region (Albuquerque, 2010).

In countries with a predominance of tropical climates, such as Brazil and Paraguay, the effects and damage caused by crop plagues tend to be more severe, since climatic conditions induce their development, due to the primacy of high average temperatures and higher relative humidity. In absolute numbers and in terms of volume, Brazil is the country that trades more pesticides and agrochemical inputs in the world. In 2020, 686 349 tons of pesticides were legally traded (Brasil,

2021), while in Paraguay, 50 895 tons were legally provided (Paraguay, 2020). In the last few decades, the herbicides glyphosate, 2,4-D and Atrazine, the fungicide Mancozeb, and the insecticide Acephate are the most legally consumed pesticides in Brazil and Paraguay (Estadão, 2021).

According to Graph 1, the growth in grain production is accompanied proportionally by the increase in the pesticide purchases, both in Brazil and in Paraguay.

Graph 1: Grain production and pesticide trade (in tons)



Source: adapted from Brazil (2021, 2022b).

In Brazil, the legal basis for this trade derives from the definition of pesticides set out in law 7,802/89. According to Article 2 of this legislation, pesticides and alike are: “a) *products and agents of physical, chemical, or biological processes, intended for use in the production sectors, the storage and processing of agricultural products, in pastures, in the protection of native or planted forests [...]*” (Brasil, 1989).

In Paraguay, law 123/91 establishes a more generic definition of agrochemicals: “*they are chemical products usable in agriculture*” (Paraguay, 1991). Law 3742/09, in turn, complements this legal device, to the degree that it also presents the standards for controlling the production, use, storage, and handling of phytosanitary products for agricultural use (Paraguay, 2009). Despite the existence of conceptual parallels and attempts to control trade, the legal frameworks of the two countries present important differences, with regard to the authorization of types and concentrations of agrochemicals. Since Paraguayan legislation is less restrictive, a large part of the agrochemicals sold domestically are not compatible with the standards imposed by Brazilian law, which results, for example, in the prohibition of entry and use of much of these chemical inputs in Brazil.

In Brazil, the legal framework that regulates pesticides determines that each product meets the technical requirements under different methods. Pesticide registration and trade are under the safeguard of law 7,802/89 and the regulatory decree 4,074/02. Furthermore, ANVISA, IBAMA, and MAPA have more than 100 federal norms and resolutions regarding the pesticide approval

process. In addition, the states publish distinct regulations on the subject. Based on the specific attributions of ANVISA, IBAMA, and MAPA, the following procedures are also carried out: “1- agronomic tests which consist of evaluating the efficiency of the product in controlling pests or weeds, after tests conducted in the field. This information is analyzed by MAPA; 2- toxicological and health risk tests which include the various laboratory studies to measure the toxic potential of the product to human health. Consequently, these tests are analyzed by ANVISA; 3- ecotoxicological tests and environmental risks which include assessments of possible environmental impacts caused by the product. IBAMA, responsible for this validation, evaluates the potential environmental danger of the pesticide and also the environmental risk assessment” (Martinez, 2022, p. 16).

As a relevant global supplier of vegetable protein, Brazilian agriculture has increased the demand for pesticides. Thus, the existence of judicious and comprehensive procedural legislation for the liberalization and use of these products, combined with the growing demand of an expanding agricultural sector, are factors that stimulate the emergence of an illegal market. As a result, the smuggling and theft of pesticides and agrochemical inputs represent both a cause of huge foreign exchange evasions and a health threat to Brazilian society. According to Barros (2019), this illegal market imposes losses to the Brazilian treasury of approximately R\$ 20 billion every year (US\$ 4 billions). Still, according to this author, the illegal market of agricultural pesticides can be defined as “a set of crimes, where criminal groups act alone or jointly” (Barros, 2019, p. 8). Among the most common practices are theft, counterfeiting, deviation from the purpose of use, and smuggling, variants that intertwine, configuring the crime of using illegal products in crops.

According to Barros and Amadori (2021), the theft of pesticides is characterized by the action of criminal groups that irregularly get hold of these products that were made and distributed legally. Generally, these groups resort to violence, since they invade rural properties, cooperatives, commercial establishments and industries, as well as cargo transportation, in order to take possession of them. With regard to cargo theft, these groups identify the vehicles and the type of product being transported beforehand, thanks to networks of informants entrenched in the boarding areas of these cargoes. The approach usually occurs on stretches of highways with low vehicle flow, both in Brazil and Paraguay. Finally, the reintroduction of stolen cargo into the consumer market takes place through direct marketing or counterfeiting, which will depend on the infrastructure available to the criminal group.

Counterfeiting, in turn, is related to both cargo theft and smuggling. The counterfeiting involves the mixing of original products, usually derived from theft, with other agrochemical inputs, which are, recurrently, smuggled substances. In both cases, counterfeit products are not only ineffective in combating “pests” in the crop, but also pose health threats to producers and consumers, since they are not compatible with the standards established by current regulations. Counterfeiting agents build a “productive network” that provides all the logistical and operational needs of the illegal business, such as inputs, packaging, labels, chemical analysis, transportation, and even commercial invoices (Barros, 2019).

Lastly, smuggling is the clandestine entry of forbidden or controlled products into a country. In light of this, it is about “importing or exporting forbidden products or services” (Brasil, 2014). Pesticides or agrochemical inputs smuggling into Brazil involves the entry of substances prohibited by current law, as well as the entry of products with higher concentrations than those permitted by Brazilian health authorities, which entails risks of contamination because of improper use. Usually, the buyer knows about the illegality of the smuggled product, which is not often the case

with a counterfeit one. For commercialization, criminal groups make use of shell companies and, in some cases, legal investment that, with sale and distribution logistics, introduce illicit goods into the market, amid legal products (Barros and Amadori, 2021). Dorfman and Rekowski (2011, p. 02) point out that “*smuggling, in its geographical aspects, adapts its flows and fixed points to market demands, available technologies and the criminalization and/or valuation of certain objects by different agents*”. Consequently, in a setting of increasing regional agricultural production, growth of pesticide trade is not surprising.

According to the State Agency for Animal and Vegetal Sanitary Defense of MS, which is responsible for the execution, control, and inspection of activities related to pesticides, inputs, and the like, there are 338 companies able to commercialize, store, transport, apply, and collect packaging of pesticides in MS (Mato Grosso do Sul, 2019). Since they must be close to areas with greater demand, these companies, in terms of their acquisition and distribution logistics, handling and access to customers, are easily mimicked by criminal groups. Thus, the territorialization of the illegal pesticide market in MS takes place through cross-border networks between Brazil, and Paraguay that, in part, overlap with the network established by the current legal market in Brazil.

### 3.2. *The porosity of the border between Brazil and Paraguay*

Based on Moraczewska’s transnational paradigm, the border is understood as a porous line, where the State tries to contain or stimulate certain flows (Moraczewska, 2010). The border represents, therefore, a link that can be used as an instrument of integration or containment, according to the political and strategic conditions of the countries involved. In order to expand and diversify their trade agendas, South American countries have encouraged, either through regional agreements or through the construction of physical infrastructure networks, greater territorial border fluidity, that takes place in entangled illegal cross-border networks.

The Arco Central region, the Border Strip between Brazil and Paraguay is considered strategic for national security, since it is a link between the Amazon Basin, the Plata Basin, and the Paraguayan Chaco (Brasil, 2005). By prioritizing the national territory integration, post-World War II Brazilian geopolitical thought prioritized the implementation of infrastructure networks that would connect the agricultural frontier in the Midwest region to the main Brazilian urban and industrial centers, as part of a stimulus for border integration with Paraguay and Bolivia, which would constitute a “continental welding area” (Couto e Silva, 1981; p. 164). The increase in international demand for soy has caused a sharp rise in property prices in the state of Mato Grosso do Sul, which has encouraged Brazilian farmers to buy rural properties in other Brazilian states and in Paraguay (Escher and Wilkinson, 2018). Consequently, the areas of the current state of MS, Mato Grosso (MT) and Rondônia (RO) have become key to both national and South American integration, which has led Brazil, more recently, to build road and rail networks to streamline connections between the center-south of the country and the northern region, as well as with Paraguay and Bolivia.

Gradually, on the Brazil-Paraguay border, twin cities have developed a “*typical border geographic environment, which is identifiable only on the local/regional scale of cross-border interactions*” (Brasil, 2005; p. 146). These urban population centers, which may have a land or river border, are furthered by highway and bridge infrastructures and have the potential for economic and cultural integration. Nonetheless, they can also unleash border problems, such as drug trafficking and smuggling, which have deleterious effects on regional socioeconomic development. In MS, there

are six twin cities on the border with Paraguay: Bela Vista and Bella Vista, Mundo Novo and Salto del Guairá, Paranhos and Ypejhú, Ponta Porã and Pedro Juan Caballero, Coronel Sapucaia and Capitán Bado and Ponto Murinho and Carmelo Peralta (Brasil, 2019).

This intense territorial fluidity that derives from this cross-border urban integration, notably that located on land borders, undermine the defense and public security actions of state institutions and benefit the activities of criminal organizations. Arroyo (2014) understands territorial fluidity as the faculty of national territories to allow an acceleration of flows that contribute to their structuring considering the materiality of the geographical objects built to guarantee movement. On the Brazil-Paraguay border, the acceleration is due to the roads that connect the twin cities to each other and the highways that connect them to large Brazilian urban centers mentioned above, which also favor the occurrence of cross-border crimes. In that regard, the criminal groups that operate in this region, as social actors produce relationships, also of power, that overlap with State objectives. These actors “[...] produce territory from a given reality, which is abstract space. Therefore, territory is produced when all kinds of power relations are manifested, which translated in meshes, networks and centralities” (Raffestin, 1993, p. 7-8).

By appropriating a space, concretely or abstractly, an agent territorializes it. In this process of territorialization, drug trafficking is the most persistent crime. In recent years, the greatest number of police actions aimed at destroying marijuana plantations have taken place in the departments close to the border with Brazil. According to Secco (2021), approximately 80% of the marijuana produced in Paraguay, which is the world's largest producer, is for the Brazilian consumer market. It crosses to Brazilian territory mainly through the dry border between the twin cities of Bella Vista-Bela Vista and Ponta Porã-Pedro Juan Caballero. The passing through the natural border, the Paraguay River is used only when police operations take place on the dry border, transforming the cities of Porto Murinho-Carmelo Peralta into a secondary route. Cocaine trafficking mainly uses the territory of Paraguay and Brazil as a transit route. Cocaine produced in Bolivia and Peru is transported to the Brazil-Paraguay border, by air and land, mainly to Bella Vista and Pedro Juan Caballero; later, it goes to the ports of Santos and Paranaguá, to be shipped to Europe and Africa. Brazilian criminal organizations, such as *the Primeiro Comando da Capital* (the PCC group) and *the Comando Vermelho*, use socioeconomically vulnerable people to transport and secure these shipments. These organizations are also responsible for the international trafficking of weapons and ammunition (Secco, 2021).

Alongside these crimes, seizures of pesticides and illegal chemical inputs from Paraguay have increased in recent years. Between 2020 and 2021, the PRF, Federal Highway Police seized approximately 307 tons of pesticides or illegal agrochemical inputs on Brazilian highways. In MS state, approximately 17 tons (PRF, 2022). Furthermore, the Department of Border Operations of Mato Grosso do Sul recorded 15 tons in the MS Border Strip (IDESF, 2022). Regarding pesticides and agrochemical inputs, MS is the third state in the national ranking of apprehensions. Within the scope of these actions, the Brazilian BR-163 north-south route is identified as a logistical axis of the illegal pesticide market, since it connects cities with high production of grains and sugarcane. The BR-262 road, which crosses a region that is experiencing a significant expansion of agribusiness in MS, between the cities of Campo Grande and Porto Murinho, is another of these logistical axes, since it can facilitate the distribution of these illegal products to a larger population.

In order to analyze the illegal entry of smuggled pesticides into Brazil, it is important to understand the importation process of these products. As RPGs become longer and longer, their sup-



pliers become more heterogeneous and physically distant. In 2020, in Paraguay, SENAVE recorded an increase in legal imports of pesticides and chemical inputs. In 2017, the total imported was 52,000 tons, while in 2020, it was 58,000 tons. The suppliers of these products are companies located in China, Argentina, and India. Notwithstanding the legal importation, Paraguayan health standards are not compatible with those applied by ANVISA in Brazilian territory. For example, resolution 564/19 released the registration of products based on Emamectin Benzoate in any concentration (Paraguay, 2019). Until then, Paraguay allowed the importation and registration of this active principle at a maximum concentration of 10 %, which was twice the concentration allowed in Brazil (Barros and Amadori, 2021). This asymmetry between health standards strengthens the importance of apprehensions on the Brazil-Paraguay border.

Emamectin Benzoate is recognized in the agricultural environment and among public security institutions as one of the most smuggled agrochemical inputs in Brazil (Campo Grande News, 2022). It is generally transported illegally across the borders between Brazil and Paraguay, as only one company has a sanitary authorization to produce and market pesticides based on 5 % Emamectin Benzoate in Brazil. It is a controlled active principle, indicated for use in soybean, corn, bean, and cotton crops. The use in improper proportions generates increasing resistance to “plagues”, and presents human and environmental risks (EMBRAPA, 2022).

The illegal entry of Emamectin Benzoate into Brazil, via Paraguay, takes place both by theft and mainly by smuggling, due to the significant discrepancies in permitted concentrations between Paraguayan and Brazilian legislation. Table 1 shows that, after the approval of resolution 564/19 in Paraguay, companies imported agrochemical inputs with Emamectin Benzoate at a concentration greater than 5 %, totalizing more than 111 tons. Part of this cargo has been smuggled to Brazil.

Table 1: Importation of Emamectin Benzoate by Paraguay [2019-20]

Year	Concentration	Total (tons)
2019	25 %	8
	30 %	4.5
	95 %	14.5
2020	30 %	73.6
	40 %	4
	95 %	7

Source: adapted from Barros and Amadori (2021)

According to SENAVE (2020), cases of misuse or falsification of pesticides in Paraguay occur mainly in the region of Asunción, the national capital, and in areas close to the border with Brazil, which are the largest grain producers in the country. Since there is an extensive dry border in this region, access to Brazilian territory, mainly through urban areas of twin cities, is more fluid.

Table 2: Seizures of pesticides and agrochemical inputs in MS (tons)

YEAR	PRF	DOF-MS
2019	20.5	1.03
2020	17.9	5.91
2021	14.0	10.97

Source: adapted from PRF (2022) and Barros and Amadori (2021)

Data from seizures carried out by Brazilian public security institutions demonstrate the magnitude of the illegal pesticide market. In 2020, certified companies sold 44,603 tons of pesticides in MS state (Brasil, 2022c). Consequently, the total seized represents approximately 0.06 % of the overall sold in the state. Although apparently small, this amount can cause harmful effects on a large scale. Based on the Pearson Correlation Index, which establishes parameters between pesticide consumption and planted area, between 2001 and 2019, MS state used 0.011 tons of pesticides per hectare (Mato Grosso do Sul, 2022a). Consequently, the total amount of illegal pesticides seized in 2021 would be sufficient for at least 6391 hectares. However, according to Vittorazzi (2022), the amount of pesticides and illegal agrochemical inputs used could be much higher: it would supply up to 25 % of MS state's planted area. In the first half of 2022, the total number of seizures carried out by the DOF-MS reached 40.8 tons (data obtained in field research, 2022), while the PRF recorded a seized amount of 50.9 tons (BRASIL, 2022c). Approximately 43 % of these seizures took place in the city of Maracaju, Brazil. Located in the center-south of MS, this city, along with Dourados and Ponta Porã, is one of the largest regional grain production centers. In the city of Ponta Porã, on the border with Paraguay, 37 % of seizures took place; and 6.1 % of the total number of apprehensions occurred in the city of Dourados (Silva, 2022). These cities have something in common: they are located on the land Brazil-Paraguay border.

According to Colonel Wagner da Silva, director of DOF-MS, the increase in pesticide and input seizures on the border between MS and Paraguay has two main sets of causes. The first is the large profit margin, the easiness to sale and relatively low penalty compared to other smuggling crimes. The high profitability makes up for the risks of losing smuggled cargo. This is reinforced by the great demand coming from the MS agricultural activity. These favorable aspects tend to encourage the intensification of cross-border illicit flows related to the agrochemical market. The second set is related to the increase in police operations and better equipment in border security. Seizures of illegal pesticides inexorably depend on, for example, technical reports attesting to the irregular chemical characteristics of the cargo (Silva, 2022).

The intensification of operations and seizures on the MS land border with Paraguay has increased criminal groups' losses, notably those that are part of the illegal pesticide market. According to Gilmo França, a PF special agent, "*the imposition of material or pecuniary losses is the main police instrument to combat cross-border crimes, especially in a region as vulnerable to these crimes as the border between Brazil and Paraguay*" (França, 2021). In short, substantial profit margins and growing demand coming from Brazilian agribusiness encourage cross-border criminal groups both to face greater risks of apprehending illegal agrochemicals and to seek alternative routes to transport these products into Brazilian territory. Thus, the increase seizures is the result of a larger number of operations and investments in public safety.

## 4. Discussion

### 4.1. Will the LAIR be an instrument of territorial fluidity for illegal agrochemicals?

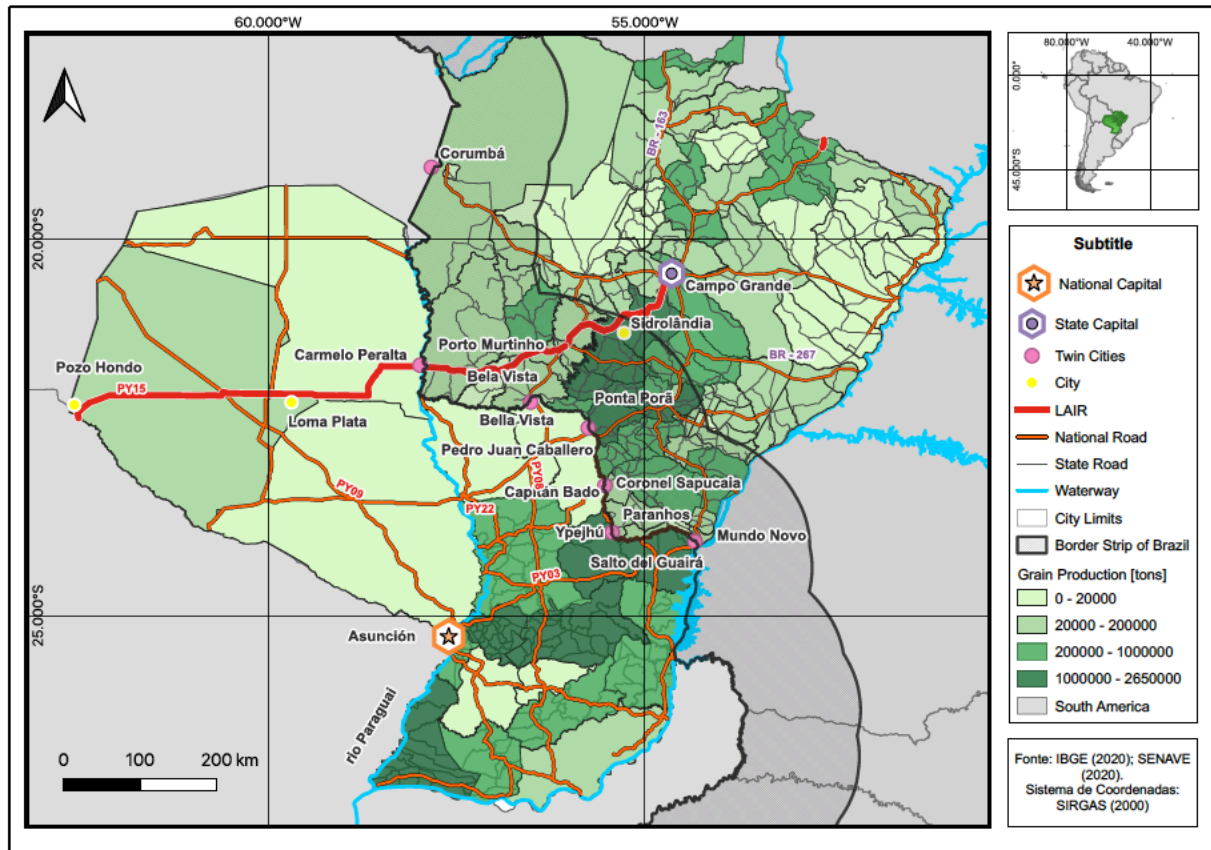
Border integration between Brazil and Paraguay is a broader process that will increase territorial fluidity between twin cities. Within the scope of strategic physical networks, despite the decline of the Union of South American Nations, which had a structure designed to plan and promote the sub-regional infrastructural integration, the Brazilian and Paraguayan authorities have developed a broad integration agenda. In addition to the Integration Bridge, which will be the second

road connection between the cities of Foz do Iguaçu, in the state of Paraná, Brazil, and Presidente Franco, in the department of Alto Paraná, Paraguay, the International Bridge between Porto Murtinho, MS, and Carmelo Peralta, Alto Paraguay, Paraguay, is also under construction (Vilela, 2022). This link between Porto Murtinho and Carmelo Peralta is part of LAIR, a bioceanic road corridor that will provide greater logistical fluidity between Brazil, Paraguay, northern Argentina and Chile, and intends to stimulate socioeconomic development, for example, in the Border Strip of Brazil, in MS (Bitencourt, 2021).

Space appropriation by illegal smuggling pesticide groups reorganizes the territory by implementing of new cuts and connections (Raffestin, 1993, p. 143-144). Within the scope of LAIR, a redefinition of territory emerges that stems from the territorial structure of the State and of networks, circuits and flows, also called territory vertebrae (Vallaux, 1914), which interconnect central regions and nodal points of it to the peripheral and border regions and points. Illegal market flows take advantage of this structure, as they redefine it with new functions, in this case, the transit of illicit that supply an overlapping territorial network that emerges from this superimposed fluidity. Thereby, territory surfaces as an arena of conflicts between circuits of legality and illegality in certain areas. In this way, the territorial capillarity available by LAIR, together with the significant availability of secondary roads, present logistical potential to streamline commercial links between pesticides and illegal agrochemical inputs suppliers and consumers, both within the MS and in other regions from Brazil. Thus, a new territorial configuration is produced, composed of overlapping networks of illegal and illegal activities, which are articulated with the supply and demand of agribusiness agrochemicals.

The International Bridge over the Paraguay River, between the cities of Porto Murtinho and Carmelo Peralta, which is under construction, is a fundamental logistical link to connect the northern region of Paraguay, the Gran Chaco, to the west of MS, the Pantanal. Both in Paraguayan territory, in the Departments of Boquerón and Alto Paraguay, and in Brazil, in the extreme southwest of MS, there are flat areas covered with grasses, with low population density, predominance of livestock activities and significant road distances between small and medium-sized urban centers. These characteristics make it difficult to carry out police operations to combat cross-border crimes, since they hamper, for example, the surprise factor of operations. Despite the favorable conditions for criminal organizations to operate, *“the latitudinal route of the Paraguay River, which determines the international boundaries between Brazil and Paraguay, partially blocks transnational illicit flows”* (Reis, 2022). In addition to the river surveillance carried out by the Brazilian Navy, the high costs of crossing Porto Murtinho to Carmelo Peralta by ferry, vary between R\$ 300 and R\$ 1200 (data obtained in field research, 2022). The ferry's loading and unloading operations, in turn, are more susceptible to police approaches, which tend to keep transporters of illicit products away from this logistical alternative.

Figure 1: Road network and grain production in MS, Brazil, and Paraguay [2021]



Source: own elaboration; data from IBGE (2020) and SENAVE (2020).

During the construction of LAIR, the city of Porto Murtinho has received public investments aimed at improving security and border control. In addition to the implementation of a PRF post and the expansion of the Brazilian Federal Treasury unit in Porto Murtinho, the city is now covered by the Integrated Border Monitoring System (SISFRON) (data obtained in field research, 2022). SISFRON is a sensing and decision support system for strategic operations, based on integrated actions, whose purpose is to strengthen the presence and monitoring conditions and State actions in the Brazilian Border Strip, which enhances the effectiveness of the defense and security institutions in this area (Brasil, 2022d). Despite the strategic importance of these investments, the regional and international flows resulting from the construction of a bioceanic road corridor enhance the porous nature of the Brazil and Paraguay border.

Against this background, Chilean ports emerge as potential import and storing centers for agrochemicals and chemical inputs from Asian suppliers. Currently, Asunción International Airport is one of the main vectors for importing pesticides and agrochemicals sold in the country. According to Barros and Amadori (2021), approximately 12 tons of Emamectin Benzoate were seized by the Paraguayan police at the airport facilities between 2014 and 2017. Thus, for Colonel Wagner of the DOF-MS, *“the conclusion of LAIR could be a new road vector that will transport illicit products, including pesticides and chemical inputs”* (Silva, 2022).

Between the cities of Porto Murtinho and Campo Grande, the longitudinal route of LAIR passes through important areas of grain cultivation, notably soybean and corn, which are potential consumers of illegal pesticides and agrochemicals, as shown in Figure 1. In the city of Campo

Grande, LAIR connects with the BR-163 highway, which is an integration vertebra for the western territorial portion of Brazil. Implemented during the 1960s, the BR-163 highway initially sought to provide territorial fluidity to the agricultural frontier, which had been planned by the federal government to attract migrants and integrate the western portion of Brazilian territory into the larger Brazilian urban centers. Currently, this highway represents a strategic logistical axis for grain flow produced in MS, which also qualifies it as an essential route for the transportation and distribution of illegal pesticides. According to Barros and Amadori (2021), between 2018 and 2021, BR-163 highway had the largest number of pesticide seizures in Brazil: 54.8 tons. Consequently, LAIR will provide greater geographic capillarity for the transportation and distribution of illegal pesticides and agrochemical inputs, making this market even more profitable.

## 5. Conclusion

Agribusiness is an essential socioeconomic sector in the border between Brazil and Paraguay. Derived from Brazilian public policies and determined by geopolitical purposes, the border overflow of agribusiness into Paraguayan territory has caused the emergence of new regional territorial dynamics. As an instrument of South American integration of physical infrastructure networks, the LAIR has triggered relevant territorial transformations in the extreme west of the MS state, on the border with Paraguay: in parallel with commercial and productive gains, cross-border illicit flows increase in intensity and scope.

The illegal market, which has Asuncion, the Paraguayan capital, as the main import center, can use LAIR route to transport and distribute pesticides and agrochemical inputs in Brazil. Despite recent investments in surveillance and protection on the Brazil - Paraguay border, the river section of it does not have the security mechanisms that exist on the land border. In this regard, the completion of the international bridge between Porto Murtinho and Carmelo Peralta can encourage the flow of these illicit products, given the road capillarity between regions of great agribusiness production as in MS state.

The lack of public health and safety policies for the river border of MS favor the territorialization of cross-border networks of illicit activities, which, therefore, have the potential to cause prejudicial effects, both in the pesticides and agrochemical inputs of legal markets as in consumers and local food security production. In this context, the construction of the RILA represents a double-edged sword: it can promote both socioeconomic development in a poor region and logistical accessibility for cross-border criminal organizations, notably those operating in the illegal agrochemicals market. Despite the existence of a vast legal framework and public policies that aim to provide the Border Strip with security and regional development, the inefficiency of these initiatives is still a challenge for Brazilian and Paraguayan authorities.

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### Conflict of interest

The authors of this work declare that there is no conflict of interest of any kind.