The role of the Paraná-Paraguay waterway in transnational cocaine trafficking: routes from the Southern Cone of South America to Europe

El papel de la hidrovía Paraná-Paraguay en el tráfico transnacional de cocaína: rutas desde el Cono Sur de Sudamérica hacia Europa

O papel da hidrovia Paraná-Paraguai no tráfico transnacional de cocaína: rotas do Cone Sul da América do Sul para a Europa

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Abstract

This article presents the findings of a qualitative study on the role of the Paraná-Paraguay waterway in the transnational trafficking of cocaine from South America to Europe. The aim is to explain why this fluvial corridor has become a strategic route for criminal organisations. The central hypothesis suggests that the interaction of geographical, logistical, and institutional factors —alongside the limited capacity of state control— enables criminal organisations to develop low-risk, high-profit operations. Based on in-depth interviews with key actors across five countries and documentary analysis, the study identifies three explanatory dimensions: a geography that hinders oversight and facilitates the movement of cocaine; the use of multimodal transport schemes; and a weakened surveillance system. The research reveals that the Paraná-Paraguay waterway functions as a duplex space, where legal and illegal flows overlap, and criminal organisations exploit institutional gaps to operate discreetly. The study concludes that this waterway has become a counterintuitive yet rationally chosen route due to its low risks, extensive connectivity, and limited state oversight. The article underscores the urgent need to strengthen interstate cooperation and to broaden the scope of security policies to include peripheral corridors such as the Paraná-Paraguay waterway, whose significance in the global cocaine trade continues to grow.

Keywords

Cocaine trafficking; organised crime; Paraná-Paraguay waterway; routes; transnational; Europe

Resumen

Este artículo presenta los resultados de un estudio cualitativo sobre el papel de la hidrovía Paraná-Paraguay en el tráfico transnacional de cocaína de Sudamérica a Europa. El objetivo es explicar por qué este corredor fluvial se ha convertido en una ruta estratégica para las organizaciones criminales. La hipótesis central sugiere que la interacción de factores geográficos, logísticos e institucionales -junto a la limitada capacidad de control estatal- permite a las organizaciones criminales desarrollar operaciones de bajo riesgo y alta rentabilidad. Basándose en entrevistas en profundidad con actores clave de cinco países y en el análisis documental, el estudio

identifica tres dimensiones explicativas: una geografía que dificulta la supervisión y facilita el movimiento de la cocaína; el uso de esquemas de transporte multimodal; y un sistema de vigilancia debilitado. La investigación revela que la hidrovía Paraná-Paraguay funciona como un espacio dúplex, donde los flujos legales e ilegales se superponen, y las organizaciones criminales aprovechan los vacíos institucionales para operar discretamente. El estudio concluye que esta hidrovía se ha convertido en una ruta contraintuitiva pero racionalmente elegida debido a sus bajos riesgos, amplia conectividad y limitada supervisión estatal. El artículo subraya la urgente necesidad de reforzar la cooperación interestatal y ampliar el alcance de las políticas de seguridad para incluir corredores periféricos como la hidrovía Paraná-Paraguay, cuya importancia en el tráfico mundial de cocaína sigue creciendo.

Palabras clave

Tráfico de cocaína; delincuencia organizada; hidrovía Paraná-Paraguay; rutas; transnacional; Europa

Resumo

Este artigo apresenta os resultados de um estudo qualitativo sobre o papel da hidrovia Paraná-Paraguai no tráfico transnacional de cocaína da América do Sul para a Europa. O objetivo é explicar por que esse corredor fluvial se tornou uma rota estratégica para as organizações criminosas. A hipótese central sugere que a interação de fatores geográficos, logísticos e institucionais — juntamente com a capacidade limitada de controle do Estado — permite que as organizações criminosas desenvolvam operações de baixo risco e alto lucro. Com base em entrevistas aprofundadas com os principais atores em cinco países e na análise de documentos, o estudo identifica três dimensões explicativas: uma geografia que dificulta o monitoramento e facilita o movimento da cocaína; o uso de esquemas de transporte multimodal; e um sistema de vigilância enfraquecido. A pesquisa revela que a hidrovia Paraná-Paraguai funciona como um espaço duplo, onde os fluxos legais e ilegais se sobrepõem, e as organizações criminosas aproveitam as brechas institucionais para operar discretamente. O estudo conclui que essa hidrovia se tornou uma rota contraintuitiva, mas racionalmente escolhida devido a seus baixos riscos, ampla conectividade e frágil fiscalização estatal. O artigo destaca a necessidade urgente de fortalecer a cooperação entre os Estados e ampliar o escopo das políticas de segurança para incluir corredores periféricos, como a hidrovia Paraná-Paraguai, cuja importância no tráfico global de cocaína continua a crescer.

Palavras-chave

Tráfico de cocaína; crime organizado; hidrovia Paraná-Paraguai; rotas; transnacional; Europa

Introduction

Over the past decade, the sustained increase in the production and transnational trafficking of cocaine at both regional and global levels (United Nations Office on Drugs and Crime [UNODC], 2024), along with the incorporation of new routes and concealment methodologies, has posed significant challenges to the efforts of authorities in producing, transit, and destination countries. South America plays a central role in this global chain, as it is home to the main coca-producing countries —Colombia, Peru, and Bolivia, in that order —and several nations that have become established transit hubs, such as Brazil and Ecuador (Global Initiative Against Transnational Organized Crime [GI-TOC], April 1, 2025). However, other countries including Argentina, Chile, Paraguay, and Uruguay represent territorial spaces that have been insufficiently analyzed, despite their growing relevance within the dynamics of drug trafficking.

Within this context, the Paraná-Paraguay waterway emerges as one of the cocaine export routes that requires greater attention from both academic research and government authorities, particularly when analyzed through the lens of what Sampó and Troncoso (2023) refer to as *counterintuitive routes*. This fluvial corridor connects Brazil, Bolivia, Paraguay, Argentina, and Uruguay, integrating regional economies while simultaneously creating logistical conditions that have been strategically exploited by criminal organizations for cocaine transportation. These operations occur both within intraregional circuits and through export flows to extra regional markets (mainly Europe), particularly via the ports of Buenos Aires and Montevideo.

The limited academic engagement with the Paraná-Paraguay waterway can be partially explained by a broader omission within the field of transnational organized crime studies: the insufficient attention given to ports and maritime or fluvial routes associated with cocaine trafficking. Until recently, these topics were not considered priorities on the research agenda. However, the notable increase in seizures recorded after the COVID-19 pandemic has underscored the need to more closely examine the role these routes play in the global movement of cocaine.

Most existing studies have focused on entry ports located in Europe, North America, and Australia (Antonelli, 2021, 2024; Madsen, 2018; Roks et al., 2021; Sergi, 2021, 2022, 2023, 2024; Sergi et al., 2021; Sergi & Storti, 2020; Staring et al., 2023), and — to a lesser extent — on certain exit ports in Latin America (Jenss, 2020; Patriarca, 2022; Patriarca & Adorno, 2025; Pinho et al., 2023; Zaitch, 2001, 2002a, 2002b). This asymmetry has resulted in a significant knowledge gap regarding the connecting routes between Latin American points of departure and international markets, with only a few recent exceptions addressing this issue (Boekhout van Solinge, 2022; GI-TOC, April 1, 2025; Hernández-Roy et al., 2023; Sampó & Troncoso, 2023; Troncoso, 2025).

Within this analytical framework, the notion of counterintuitive routes constitutes a valuable conceptual tool for examining the adaptive logics of criminal organizations. These actors increasingly resort to multimodal trajectories —encompassing aerial, terrestrial, fluvial, and maritime segments— that, while not necessarily the most direct, rapid, cost-effective, or evident, strategically minimize exposure to state surveillance and enforcement mechanisms. Such dynamics effectively reconfigure the geography of cocaine trafficking circuits, shifting them toward less scrutinized yet operationally advantageous spaces (Sampó & Troncoso, 2023). The empirical plausibility of this rationale is corroborated by the UNODC's World Drug and Cocaine Reports (2023, 2024), which underscore how the most recent seizure patterns illustrate an expanding reliance on alternative routes designed to circumvent oversaturated control points.

The Paraná-Paraguay waterway has become a prominent example of this type of route. Existing academic literature indicates that, beyond its role in legal trade, this corridor is utilized by criminal organizations for cocaine transportation, taking advantage of its passage through production regions (Bolivia), storage zones, and export points (Cieza, 2021; Singh & Lasmar, 2025). Some studies identify it as part of the so-called *Southern Route*, a transnational network that combines fluvial, land, and air pathways to connect Andean production areas with international markets (Singh & Lasmar, 2024). Between 2010 and 2021, cocaine seizures associated with trafficking movements along the Paraná-Paraguay waterway increased fivefold (UNODC, 2023).

Within this operational logic, Bolivia and Paraguay —both landlocked countries— play strategic roles. Bolivia functions as a producer and consolidation hub, particularly along its eastern border (Bartolomé & Ventura-Barreiro, November 8, 2019; Moura, 2023), while Paraguay has emerged as a logistical and storage node for cocaine originating from Bolivia and Peru, facilitating the entry of shipments into the waterway (Alda Mejías, 2020; Martens, 2022). From the river ports of both countries, the drug is transported to major port terminals, from where it is shipped to Europe, Asia, and Africa (Lachi & Martens, 2025; Nicaso, 2023; Sampó, 2019; Sampó & Troncoso, 2023). This dynamic is further reinforced by factors such as institutional weakness, corruption, porous borders, and limited state oversight, which together create a conducive environment for the operations of

both regional and transnational criminal organizations (Devia-Garzón & Ortega-Avellaneda, 2018; Lien & Feltran, 2025).

This article aims to establish the role of the Paraná-Paraguay waterway as a *counterintuitive route* for the transnational trafficking of cocaine. The central research question guiding this study is: Why has the Paraná-Paraguay waterway become a strategic corridor for drug trafficking toward extra regional markets? The hypothesis underpinning the papers is that the convergence of specific geographical conditions, the diversification of cocaine trafficking strategies, and structural weaknesses in state control along the Paraná-Paraguay waterway facilitate the movement of large cocaine shipments by transnational criminal organizations operating across Brazil, Bolivia, Paraguay, Argentina, and Uruguay. The interaction of these factors enables criminal organizations to operate with low logistical costs and minimal risk, thereby transforming the Paraná-Paraguay waterway into a counterintuitive yet strategic route for cocaine exports, particularly to European markets.

In line with the research objective and question, the article is structured into five sections. The first offers a brief discussion defining the key concepts employed throughout the study. The second outlines the methodological framework, specifying the type of study, the qualitative approach adopted, and the data collection techniques —namely in-depth interviews and documentary analysis— as well as sampling strategy, ethical considerations, and the analytical procedure. Next, the results section presents the empirical findings, organized around three thematic axes: (1) geographical characteristics of the Paraná-Paraguay waterway; (2) methods employed by criminal organizations to move cocaine within and beyond the region; and (3) existing control mechanisms along the fluvial corridor and in the ports situated along it. The discussion section interprets these results in light of the academic literature, identifying implications, limitations, and potential avenues for future research. Finally, the conclusion section highlights that the Paraná-Paraguay waterway plays a significant role in transnational cocaine trafficking, and serves as an empirical example of counterintuitive routes.

A conceptual approach

Transnational cocaine trafficking represents one of the most dynamic and adaptive phenomena of contemporary organized crime (United States Mission to the United Nations, 2019). Far from being confined to a linear scheme of production in the Andean countries and consumption in Europe or North America, the business has become increasingly complex on multiple levels, incorporating new geographies, actors, and modalities. As supply expands and state controls intensify, criminal organizations devise ever more sophisticated strategies to minimize risks and maximize profits (Sergi, 2022; Zaitch, 2002a).

In this scenario, an analysis confined to traditional routes and entry ports becomes insufficient. The scholarly literature has tended to focus predominantly on these destination points, thereby relegating to the background the strategic dimension of exit routes in South America, as well as the role of intermediate corridors such as those located in West Africa (Sampó, 2019). Recent studies underscore the need to conceptualize the transnational circulation of cocaine in a more comprehensive manner, emphasizing how criminal actors continuously reconfigure their mobility schemes in response to state control pressures and inter-organizational competition (Sampó & Troncoso, 2023; Troncoso, 2025). It is therefore essential to define four key concepts for understanding these emerging dynamics: counterintuitive routes, multimodality, non-traditional ports, and re-exportation.

Counterintuitive routes refer to trajectories that —at first sight— appear economically or geographically irrational when assessed through conventional cost-benefit parameters or from the perspective of state authorities. Instead of prioritizing the shortest distance or the most developed infrastructure, such routes favor longer, more expensive, slower, or more complex paths. The rationale underlying this choice lies in risk management: in these scenarios, greater logistical investment is justified by the reduction in the probability of interception within highly monitored areas (Sampó & Troncoso, 2023).

Counterintuitive routes reflect a criminal rationality that prioritizes the security of the shipment over immediate efficiency. By diversifying trajectories, criminal organizations reduce the likelihood of losing large volumes of cocaine in a single interdiction operation and simultaneously disorient law enforcement agencies, which tend to respond more slowly and take longer to adjust their operational frameworks to this new reality. Moreover, such routes displace trafficking flows toward peripheral spaces of control, where both media and police attention are comparatively weaker (Sergi, 2023).

The second central concept is multimodality, understood as the articulation of different modes of transportation —air, land, riverine, and maritime— within a single logistical chain. This strategy provides criminal organizations with high levels of flexibility, allowing them to adapt both to variations in the physical environment (droughts, insufficient dredging, climatic restrictions) and in the institutional environment (increased inspections at specific ports or highways, lower levels of permeability to corruption, among others) (Troncoso, 2025).

Multimodality serves several functions: (a) it reduces the exposure of shipments by fragmenting the trajectory into shorter and more diverse segments, thereby lowering the likelihood that a single interdiction operation will frustrate the entire enterprise; (b) it capitalizes on local, geographic, and institutional vulnerabilities; and (c) it guarantees operational continuity in highly volatile contexts, particularly those linked to abrupt environmental changes. In this sense, multimodality operates as an adaptive strategy that enhances the logistical resilience of criminal organizations, rendering the tasks of detection and state control significantly more difficult.

The use of non-traditional ports constitutes another critical choice for criminal organizations. Unlike the traditional cocaine-exporting ports —such as Cartagena Bay, Callao, Santos, or Guayaquil —non-traditional ports are located in countries that are neither producers of cocaine nor consolidated transit hubs, and that possess a certain reputation for institutional integrity and port efficiency. Precisely because of these characteristics, they are generally subject to less surveillance and arouse fewer suspicions in international customs controls (Sampó & Troncoso, 2023; Troncoso, 2025).

These ports become strategic nodes because: (a) they reduce the likelihood that shipments will be subjected to rigorous inspections, as they are not associated with traditional drug trafficking routes; (b) they allow for the diversification of geographic spaces, incorporating territories that had previously remained outside the map of the global cocaine commercialization chain; and (c) they connect with multimodality by receiving shipments through land, air, or riverine routes, thereby enabling logistical reassembly prior to the cocaine's transoceanic departure.

Finally, the concept of re-exportation explains how, through the use of non-traditional ports, criminal organizations manage to "launder" the provenance of cocaine. The mechanism consists of moving the drug from a producing or stockpiling country to a transit country with a strong commercial reputation, from which it is then dispatched to its final destination (Sampó & Troncoso, 2023).

This process offers several advantages: (a) it obscures the origin of the shipment, complicating traceability, since the registered exporting country is not identified as a cocaine-producing or transit state; (b) it benefits from regulatory frameworks such as free-trade zones or flexible customs regimes, which facilitate the concealment or mixing of illicit shipments with licit cargo; and (c) it exploits commercial legitimacy, as dispatching from a country considered reliable reduces the likelihood of the merchandise being detained at destination ports, given that it does not raise red flags. In this sense, re-exportation represents not only a logistical strategy but also a symbolic one, insofar as criminal organizations appropriate the international reputation of certain countries to conceal their illicit operations.

In sum, the concepts of counterintuitive routes, multimodality, non-traditional ports, and re-exportation may appear as separate tactics. However, in practice they are articulated as part of a broader criminal mobility system: counterintuitive routes are employed because they entail lower risks —even if they raise operational costs— by diverting shipments toward spaces that are generally overlooked by state authorities and subject to less surveillance. Within this framework, multimodality guarantees the continuity of shipments, enabling them to circumvent changes in the physical or institutional environment, and preventing disruptions in the cocaine supply chain. At the same time, the re-exportation of cocaine legitimizes the cargo by concealing its origin. Finally, the use of non-traditional exit ports reduces the likelihood of interdiction, insofar as destination port authorities assign little strategic importance to shipments originating from these geographic spaces. This assemblage enables criminal organizations to sustain their operability even in adverse contexts. Moreover, it demonstrates that these are not improvised structures but rather rational actors endowed with the capacity for logistical planning on a global scale (Sergi & Storti, 2020; Zaitch, 2002a).

Methodological notes

This article builds upon findings and conclusions from a previous research project conducted between 2020 and 2022, which focused on the evolution of criminal organizations in South America. During the course of that study, a significant gap was identified in the available information regarding the role of the Paraná-Paraguay waterway in transnational cocaine trafficking. This gap highlighted the need to open new lines of research to better understand regional criminal dynamics and ultimately led to the development of the present study.

This article examines the role of the Paraná-Paraguay waterway as a counterintuitive route for transnational cocaine trafficking. The research adopts a qualitative approach, deemed suitable for capturing the perceptions of key informants and for understanding complex and context-specific phenomena (Corbin & Strauss, 2008; Flick, 2022). The decision to focus on the Paraná-Paraguay waterway is based on three main reasons: (a) empirical observations gathered in previous studies; (b) growing concern in Argentina and Uruguay over the rise

in intraregional trafficking; and (c) a sustained increase in seizures linked to this route, particularly in Europe.

The research was conducted using a combination of primary and secondary sources. First, a thorough documentary review was carried out, covering academic literature, official statements, and press reports in Spanish, Portuguese, and English. These documents were primarily gathered through searches in Google and Google Scholar, conducted using keywords such as *Paraná-Paraguay waterway*, *drug trafficking*, *cocaine*, *ports*, and *control*, among others. The information was systematized in a thematic database and organized through bibliographic records.

In parallel, in-depth interviews were conducted with twenty key informants from Argentina, Bolivia, Brazil, Paraguay, and Uruguay. The sample included four members of the security forces, two customs officials, three government ministry officials, three members of the judiciary, four academics, three foreign trade specialists, and a former government agency official. Participants were selected through purposive sampling using the snowball method. To ensure confidentiality, each informant was assigned a unique reference code. The in-depth interviews were conducted in 2025 (see Table 1). The purpose of these interviews was to assess the significance of the Paraná-Paraguay waterway in transnational cocaine trafficking and to address questions that had emerged during the previous research (2020-2022), as well as those arising from the literature review.

Table 1. | In-depth interviews by area and country

Areas/Countries	Argentina	Bolivia	Brazil	Paraguay	Uruguay
Security Forces	1		1	1	1
Customs Officials	1				1
Government Ministry Officials	1		1		1
Members of the Judiciary			1	1	1
Academics	1	1		1	1
Foreing Trade Specialists	2			1	
Former Government Agency Officials		1			

The analysis of the information was carried out through a qualitative content analysis approach, aimed at systematically identifying and organizing the meanings, patterns, and relationships present in the textual data. This approach was deemed appropriate given that the objective of the research was to understand complex and contextually situated processes rather than to measure predetermined variables.

The procedure was carried out in three complementary phases. In the first phase, an initial coding of the materials was conducted, identifying relevant expressions and segments that were subsequently transformed into analytical codes. This stage was guided by an inductive criterion, which allowed the categories to emerge from the data themselves rather than from *a priori* imposed frameworks.

In the second phase, the codes were grouped into thematic categories that represented central dimensions of the phenomenon under study: (a) the geography of the fluvial corridor; (b) methodologies of cocaine movement; and (c) mechanisms of state control. These categories were constructed through an iterative process of constant comparison, reviewing and regrouping the material to ensure that each category consistently and distinctly reflected the dynamics under analysis. Finally, in the third phase, an analytical refinement of the categories was carried out through triangulation with the specialized literature and the research objectives. This procedure ensured both the internal coherence of each category and their interpretive validity in relation to the research questions.

In order to provide greater transparency and coherence to the qualitative analysis process, the categories identified through inductive coding were systematized in a table that integrates their definitions and main empirical indicators (see Table 2). This methodological strategy illustrates how the transition from the initial codes to broader analytical dimensions was operationalized, ensuring traceability between the empirical data and the interpretations. Furthermore, the exercise of organizing the categories into a table seeks to strengthen the validity of the analysis by articulating the inductive construction with the specialized literature, thus preventing the categories from being perceived as mere descriptions and underscoring their analytical character.

Table 2. | Description of analytical categories

Category	Definition	Empirical Indicators
Geography of the fluvial corridor	Spatial configuration of the Paraná-Paraguay waterway, which facilitates both licit and illicit circulation, characterized by heterogeneous depths, multiple branches, and limited state presence.	• Extension of 3400 km with uneven depths • Branches (islands, wetlands, secondary tributaries) • Meandering course of the river • Limited state coverage in rural and riverside areas • Existence of minor ports (formal and informal)
Methodologies of cocaine movement	Logistical strategies employed by criminal organizations to move cocaine from storage areas to extra regional export ports.	• Use of barges, tugboats, barge convoys, and bulk carriers • Container contamination (blind hook, falsified seals, refrigerated containers) • Clandestine air routes and irregular or dual-use airstrips • Land transport through secondary and/or irregular crossings • Contamination in the river (transshipment, offloading zones or waiting zones) or on the high seas
Mechanisms of state control	Set of institutional and technological mechanisms aimed at monitoring the waterway, characterized by weakness, fragmentation, and susceptibility to corruption.	• Low coverage of scanners and limited technical effectiveness • Free trade zones with minimal oversight • Private ports without effective inspection • Inter-institutional lack of coordination among security forces, customs, and judiciary • Corruption among public or private employees

The inclusion of this methodological table serves two purposes. First, it highlights the logic of the analytical construction employed, showing that the categories were not selected arbitrarily but rather emerged from the dialogue between the data, the information provided by interviewees, and the theoretical framework. Second, it offers the reader a synthetic tool for understanding how the empirical findings were articulated around central dimensions of the phenomenon under study: the geographical configuration of the waterway, the logistical strategies of criminal organizations, and the structural limitations of state control. In this sense, the table does not replace the detailed description presented in the results section; instead, it complements it by providing greater clarity to the interpretive logic and methodological consistency of the study.

Results

Vulnerable geography

The Paraná-Paraguay waterway is a large-scale fluvial system that connects the territories of Argentina, Bolivia, Brazil, Paraguay, and Uruguay. Its course intersects with other regional river basins and extends through multiple lateral branches, forming a transnational corridor linked to the Atlantic Ocean. This geographical configuration provides the waterway with a dual function, as consistently noted by key informants.

On the one hand, it facilitates the movement of legal goods and strengthens trade ties between landlocked countries such as Bolivia and Paraguay and major port hubs such as Buenos Aires, Rosario, Montevideo, and Nueva Palmira (which is located on the Uruguay River). On the other hand, the same territorial structure enables the flow of illicit goods —particularly cocaine— by taking advantage of the corridor's vast extension, difficult access, limited state presence, and low levels of oversight (Personal communications: I-05, I-08, I-09, I-12, I-13).

The Paraná-Paraguay waterway spans over 3400 kilometers in total, but it is not homogeneous (Ministerio de Economía de Argentina, n. d.)[1]. The waterway's connectivity is characterized by significant disparities,

1 See different maps related to the Paraná-Paraguay waterway at: https://magyp.gob.ar/sitio/areas/ss_mercados_agropecuarios/infraestructura/_archivos/000071_Hidrov%C3%ADa%20Paraguay-Paran%C3%A1%20(HPP).pdf

largely determined by the river's draft —the minimum depth required for the safe navigation of vessels. This variability segments the waterway into sections with differing operational capacities (see Map 1).

Map 1. | Paraná-Paraguay waterway

Source: Ministerio de Economía de Argentina (n. d.)

As a result of this variability in depth, the Paraná-Paraguay waterway is divided into four distinct sections (Gobierno de Santa Fe, n. d.), which directly impacts its navigability and the uses that both legal and illegal actors can make of each segment. The first section, between Puerto Cáceres and Corumbá (Brazil), crosses the Pantanal ecosystem and faces serious operational constraints due to shallow depths and environmental regulations; however, its limited oversight makes it conducive to illicit activities. Both this section and the following two have depths of up to 10 feet (approximately 3 meters). The second section, located primarily in Paraguayan territory with connections to Bolivia, has an unstable draft that hinders navigation but also provides opportunities for criminal organizations in a context of weak state presence.

The third section, between La Confluencia and Santa Fe (Argentina), is more stable thanks to the investment that allows the movement of high-tonnage barges, although small variations in depth affect logistical efficiency. Finally, the lower section —from Santa Fe to Nueva Palmira (Uruguay), and the Atlantic— concentrates the region's most advanced port infrastructure and serves as the main export hub. Between Santa Fe and San Lorenzo, the draft is typically 25 feet, while from San Lorenzo onward, the guaranteed depth (maintained through constant dredging) ranges between 32 and 34 feet, allowing for the navigation of ocean-going vessels.

According to some specialists, ensuring navigability, especially in sections with naturally shallow depths, requires dredging operations, a technical intervention that involves removing sediment from the riverbed to maintain a constant depth (Personal communications: I-03, I-5, I-17). However, the execution of such works depends on political decisions, technical capabilities, and the availability of state (or private) resources, which introduces asymmetries in the management of the corridor.

The lack of regional coordination and the uneven distribution of dredging-related costs create logistical bottlenecks and expose the waterway to frequent disruptions, particularly in the upper sections such as those in Brazil, Bolivia, or the upper Paraguay River. In these areas, budgetary constraints and the absence of sustained investment have hindered the development of key port infrastructure. Even projects like Puerto Busch in Bolivia have been sidelined due to the high investment required to maintain permanent dredging (Personal communication, I-06).

These gaps not only affect licit trade, but also reconfigure drug trafficking dynamics, shifting storage and shipment points toward areas more accessible to criminal organizations, particularly during periods of reduced navigational depth. As a result, part of the shipments is redirected to ports in the lower stretch of the waterway, especially those located in the San Lorenzo area and Nueva Palmira (situated on the Uruguay River).

The vulnerabilities that characterize this waterway are among the main attributes that explain its appeal to criminal organizations. Along its margins lie territories fragmented by secondary tributaries, wetlands, river islands, and private properties, where state authorities have limited capacity for control and governance. This diffuse geography facilitates covert circulation and enables the use of poorly monitored alternative routes. As several key informants point out, the river's branches not only connect with smaller ports —many of them riverine, whether formal or informal, public or private— but also allow traffickers to bypass traditional routes that are subject to tighter controls.

Dense vegetation, secondary roads, vast rural areas, and weak institutional presence reinforce this condition,

making the environment ideal for transshipment, storage, and protection of cocaine. In this context, numerous rural areas with direct access to the river function as sites for stockpiling, cargo consolidation, and even loading. In such areas, criminal organizations can carry out their operations under the radar of state institutions, granting them a significant advantage (Personal communications: I-05, I-01, I-03, I-07, I-18).

Methods used to move cocaine

Cocaine trafficking along the Paraná-Paraguay waterway illustrates the remarkable adaptive capacity of criminal organizations. Variations in the river's draft often force those moving cocaine to adopt multiple modes of transportation within the same smuggling operation. In this way, the integration of land, air, fluvial, and maritime transport enables the movement of cocaine both within and beyond the region. The use of different methods across various territories depends not only on the geographic and infrastructural conditions of each section of the fluvial corridor, but also on the levels of state control and the logistical opportunities identified by criminal organizations.

As key informants consistently emphasize, this multimodal articulation is far from an improvised strategy; rather, it reflects meticulous planning by criminal networks. These organizations take advantage of the waterway's vast reach and connectivity to maximize the efficiency of their shipments, minimize points of exposure to control, and ensure the continuity of the logistical chain from production and storage centers to cocaine export ports bound for international destinations (Personal communications: I-09, I-11, I-12, I-13, I-14).

In the upper sections of the waterway —particularly in areas of Brazil, eastern Bolivia, and the upper Paraguay River— limitations in draft and port infrastructure hinder fluvial transit during certain times of the year, especially in the dry season. In fact, between October and November 2024, navigation was disrupted several times due to insufficient draft in the river. The ports of Asunción and Villeta (Paraguay) recorded historic lows, as the river experienced a sharp drop in water level, reaching record depths of minus 1.61 meters and minus 1.21 meters, respectively (Dirección de meteorología e hidrografía, , n. d.).

In such conditions, criminal organizations are forced to alter their *modus operandi*. As a result, they resort to land and air transport to move cocaine to a port that allows for extra regional exports. According to various testimonies, cocaine may leave from Peru, Bolivia, or even Paraguay by air or overland to reach ports in Argentina and Uruguay (the area of San Lorenzo, Rosario, Nueva Palmira, Buenos Aires, and Montevideo, as well as other, often private, smaller ports) where navigability is guaranteed (Personal communications: I-04, I-10, I-15, I-20).

When the route is aerial, small aircraft operate from clandestine airstrips or dual-use (civil-agricultural) runways. As key informants highlight, this strategy is facilitated by gaps in radar systems (Personal communications: I-13, I-14, I-16). Aerial routes have generally become a key link in the multimodal trafficking scheme due to their speed, limited oversight, and ability to evade detection through low-altitude flights or visual navigation routes. When the route is terrestrial, there are numerous options for moving cocaine from Bolivia, Paraguay, or Brazil via irregular border crossings and secondary roads to departure ports.

A clear example of a multimodal method is the 2022 "Operativo A Ultranza Py", in which more than 17 tons of cocaine were seized. The drugs entered Paraguay by aircraft from Bolivia, were then transported overland, and finally loaded into containers at the port of Villeta for shipment to Europe (Antwerp, Rotterdam) and Asia (Singapore) (Ministerio Público de la República de Paraguay, 2024). Other examples of multimodal methods include:

1. The "Conexión Atlántico Norte" operation (2021), in which over 16 tons of cocaine were seized hidden in paint cans. The cocaine was flown from Bolivia to Paraguay in small aircraft, where it was stockpiled and then transported overland to the port of Villeta. From there, it traveled along the waterway to Argentina and was exported by ship —after being transferred from barges— through the port of Buenos Aires to Hamburg (Germany) (Personal communication: I-04); and

2. The seizure of 385 kilograms of cocaine in the Bahía Negra area (Paraguayan Chaco) in 2020. According to authorities, the drugs had been loaded near the Bolivia-Brazil border and were to be transported by aircraft, which had already landed in the raided area and was merely awaiting refueling when it was discovered (SENAD, 2020).

In the lower section of the waterway, where major ports are located, trafficking methods become even more complex. The use of bulk cargo ships to transport large quantities of high-purity cocaine has been recently confirmed. One example is the seizure of 460 kilograms of high-purity cocaine at the port of San Lorenzo in early May 2025. The cocaine was hidden in suspicious packages inside one of the ship's refrigerated chambers and in the vessel's locker rooms (Gobierno de Argentina, 2025).

A different case is the seizure of 1500 kilograms of cocaine at the port of Montevideo (in 2023), destined for Europe. The shipment was intended for the vessel *Grande Nigeria*, and authorities found 32 plastic tubs and four metal tanks during inspection of a truck belonging to a family employed at the port (Dirección Nacional de Aduanas Urguay, 2023). In this case, the traffickers sought to exploit the ship's resupply procedures as a means to conceal the drugs.

In addition to the aforementioned cases, some key informants suggest the direct contamination of bulk carrier cargo. The loading system of bulk carriers —where elevators transfer grains from storage directly into the vessel, where they are stored loose in a kind of "bathtub"— creates opportunities for new forms of contamination (Personal communications: I-02, I-03, I-04, I-17, I-18, I-20).

According to customs officials, there are strong indications that the cargo is contaminated directly, since footprints are sometimes found on top of the load, or the grains do not form the characteristic "peak" that should result from the loading process. These vessels have a significant advantage over container ships: they are charter vessels, meaning they can follow any route and are not dependent on the pre-established itineraries of shipping companies (Personal communications: I-04, I-20). This enables criminal organizations not only to move their shipments in a less conspicuous manner, but also to decide directly where to send them —without intermediate stops— according to the markets they seek to supply.

One of the predominant methodologies in this geographical area is container contamination in various forms. In recent times, offshore vessel contamination has been confirmed: this involves the transfer of cocaine from smaller boats to merchant vessels anchored in waiting zones, offloading zones or in international waters. According to key informants, the concealment methods used for trafficking in containers have reached a high level of sophistication. Techniques include the "rip-on/rip-off" method (introducing drugs without the sender's knowledge), the use of fake seals, the insertion of hidden compartments in refrigerated containers (reefers), or concealment within bulk cargo, as demonstrated in previous cases (Personal communications: I-02, I-15, I-16, I-19). Concealment has also been detected in machinery, liquid tanks, and internal structures of ships.

In the case of trafficking from Uruguay —whether through Nueva Palmira, Montevideo, or private ports— the predominant method combines the use of aerial routes with land routes and/or riverbank storage sites located along the Uruguay River (Personal communication: I-01). In contrast, in Argentina, both land routes and combinations of air and land routes are used to reach the main departure ports located in the final stretch of the Paraná-Paraguay waterway: the San Lorenzo and Rosario area, where bulk cargo ships are primarily used, and the port of Buenos Aires, which handles container shipping.

Criminal organizations operate with a business-like logic. As some key informants have noted, these groups combine expert knowledge in customs and maritime law with an integrated regional logistics network. This includes control over the entire payment chain —marked by the growing use of cryptocurrencies— and a tactical capacity to adapt to new control measures. For instance, when faced with increased scanning at certain ports, they redirect shipments through alternative routes, such as fluvial crossings from Argentina or offshore contamination (Personal communications: I-10, I-11, I-17, I-20).

State control and surveillance

The functioning of the Paraná-Paraguay waterway has been exploited by criminal organizations, which use it as a logistical hub for the transnational trafficking of cocaine. This appropriation is largely made possible by the numerous weaknesses in the control and surveillance systems across the geographical areas surrounding the fluvial corridor. Far from being isolated or sporadic failures, the testimonies collected through interviews with authorities from Argentina, Bolivia, Brazil, Paraguay, and Uruguay reveal a structural set of problems that exceed the capacity of states to effectively prevent, intercept, or even monitor the various cocaine flows associated with this navigable route.

One of the main weaknesses identified is the limited coverage of container scanning at the region's primary departure ports. However, cargo scanning does not necessarily guarantee the detection of concealed cocaine (Personal communications: I-04, I-07, I-20). This was clearly demonstrated in the case of contaminated sugar shipped from Asunción (Paraguay) to the port of Antwerp (Netherlands), where four tons of cocaine were seized (SENAD, 2024). As key informants explain, the limited technological capacity of the scanners used in the region allows large volumes of goods to pass through the port system without effective control, thereby facilitating their exploitation by criminal organizations (Personal communications: I-02, I-08, I-12, I-19).

On the other hand, it is important to highlight the tension that arises between trade and security (Nøkleberg, 2023; Patriarca & Lopes, 2023). In contexts dominated by commercial logic, time is of the essence, and controls introduce delays that significantly reduce the profitability of exported goods. As a result, reinforcing controls becomes costly for states, as it is often perceived as a "waste of time."

Added to this is the existence of free trade zones —areas with special regulations that allow Bolivia and Paraguay to transfer their goods from barges to ocean-going vessels— which function as blind spots for state control. These zones operate with little to no customs oversight, effectively preventing port authorities from inspecting "in transit" cargo unless explicit orders are issued (Personal communications: I-05, I-07).

Another important element to highlight is the lack of oversight and control in private ports located along the riverbanks in both Argentina and Uruguay. As key informants point out, there are numerous private properties and areas with their own ports. These docks operate under protocols that merely require notifying authorities of a vessel's arrival or departure, without the physical presence of inspectors or any cargo inspection. This absence of direct control makes these ports highly vulnerable points from which goods can be moved without institutional record (Personal communications: I-01, I-15, I-16, I-20).

In parallel, interviewees expressed concern over the limited inter-institutional coordination among the various agencies responsible for security and control. For example, they emphasized the structural obstacles that delay collaboration between the Armed Forces, Security Forces, police, customs authorities, and the judicial system, largely due to a fragmented institutional culture. This lack of coordination hampers intelligence sharing, the execution of joint operations, and the deployment of integrated responses to transnational threats such as drug trafficking (Personal communications: I-08, I-13, I-11). Additionally, the interviews revealed that for countries such as Brazil, cocaine trafficking through the Paraná-Paraguay waterway is not considered an agenda priority, as their efforts are concentrated on other geographical areas (Personal communication, I-14).

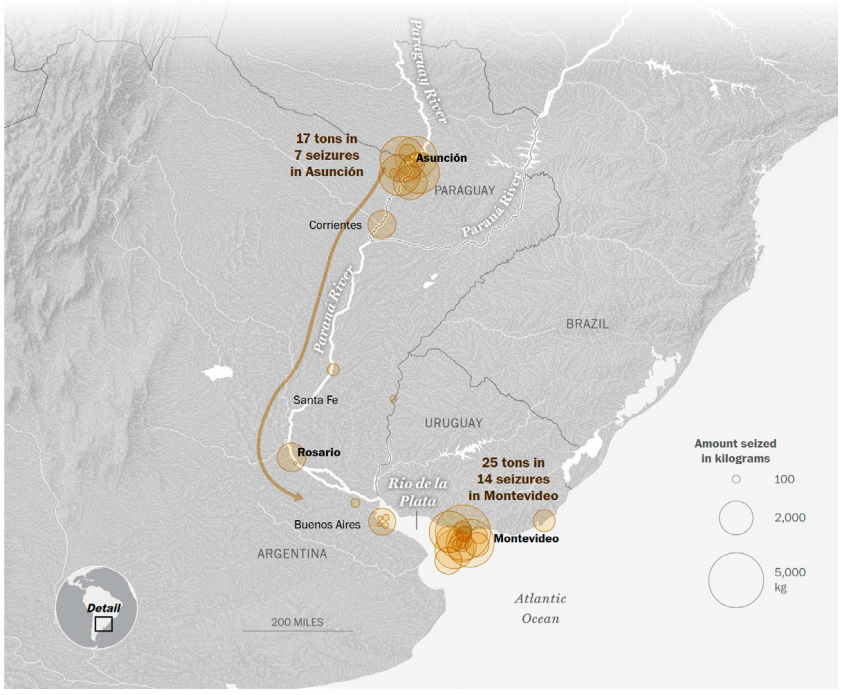
Discussion

The empirical findings of this study demonstrate that the use of the Paraná-Paraguay waterway for transnational cocaine trafficking reflects rational and adaptive logistical planning, consistent with the concept of counterintuitive routes (Sampó & Troncoso, 2023). These routes offer strategic advantages in terms of operational security, low levels of enforcement, and reduced exposure to controls. The evidence collected shows how criminal organizations reconfigure transnational cocaine trafficking circuits toward areas on the periphery of state control, such as the Paraná-Paraguay waterway, transforming them into corridors leading to extra regional markets. Moreover, the cases presented illustrate how criminal organizations resort to different methods for moving cocaine depending on the territorial conditions surrounding the waterway. Multimodality appears to characterize the movement of cocaine from this geographical space to other regions, with a particular emphasis on Europe.

This shift toward less obvious routes reflects an adaptive rationality in response to securitization processes. As Sergi (2024) observes, improvements in surveillance and control systems at traditional ports and corridors do not eliminate drug trafficking; rather, they displace it geographically, pushing criminal organizations to explore alternative routes where enforcement capacities are limited or nonexistent. This creates what is known as a displacement effect. Within this context, the Paraná-Paraguay waterway emerges as a space largely overlooked by international control systems, yet strategically positioned for criminal organizations seeking low-profile routes. This utilization can be observed in the seizures linked to the Paraná-Paraguay waterway (2018-2024; see Map 2), which exceed 45 tons of cocaine and are concentrated primarily in Asunción (Paraguay) and Montevideo (Uruguay), although they also include Rosario and Buenos Aires (Argentina) (Schmidt et al., December 8, 2024).

This study confirms that this use is not improvised. As several authors have argued (Roks et al., 2021; Sergi, 2022; Sergi & Storti, 2020; Staring et al., 2023; Zaitch, 2001, 2002a, 2022b), criminal organizations —far from operating in a disorganized manner— make rational decisions under conditions of risk, evaluating logistical opportunities, levels of exposure, and operational costs. These decisions may involve using longer or more complex routes, such as the Paraná-Paraguay waterway, as long as they offer greater security against detection or interception of shipments.

Map 2. | Cocaine seizures along the waterway Paraná-Paraguay (2018-2024)



Source: Schmidt et al. (December 28, 2024).

Regarding the factors that explain this functionality, the framework of endogenous and exogenous factors proposed by Antonelli (2024) helps to break down the capacity of criminal organizations to adapt to changing operational contexts. Endogenously, these networks demonstrate expert knowledge, material resources, and mastery of logistical technologies that allow them to operate across different segments using barges, transshipments, and the contamination of both bulk cargo vessels and containers in fluvial and maritime ports. Exogenously, the lack of interstate cooperation, weak enforcement, limited control capabilities, regulatory permissiveness in free trade zones, and the existence of private ports without effective inspection reinforce the operational advantages of this route.

The testimonies collected also reveal that this route is structured through a multimodal logic, combining land, air, fluvial, and maritime segments depending on available infrastructure, seasonal variations, and levels of control. This logistical flexibility —also identified by Moura (2023), Lachi and Martens (2025), and Singh and Lasmar (2024)— ensures the continuity of shipments even when critical segments are disrupted due to lack of dredging or drastic changes in river depth. The ability to plan and reconfigure routes in real time reinforces the deliberate nature of this choice. Thus, an operational scheme emerges that responds to structural conditions.

From an institutional perspective, the study identifies a series of structural vulnerabilities that help explain why this route is attractive to criminal organizations. The lack of coordination among agencies, limited scanner coverage, absence of oversight in free trade zones, and lack of control in private ports allow large volumes of goods to circulate without effective monitoring. These conditions reflect what some authors conceptualize as "duplex spaces": logistical environments where legal and illegal activities coexist without clear boundaries, and where state control is episodic, informal, or easily circumvented (Antonelli, 2021; Sergi, 2023; Sergi et al., 2021).

In this context, the waterway must be understood as a complex geographical space, not merely as a transit route. This space, which beyond the river itself, is extremely difficult to control and monitor due to both its geographical characteristics and the presence of multiple state actors who must cooperate to facilitate trade while preventing the movement of illicit goods. As a result, criminal organizations take advantage of both these vulnerabilities and the opportunities afforded by the geography and port infrastructure.

In this regard, the large number of small and private ports increases the challenges of control, as these facilities appear to be increasingly exploited by criminal actors. In addition to the traditional use of containers (with various contamination methods), the use of bulk cargo vessels departing from secondary ports must also be considered —these vessels' loading formats make cocaine detection virtually impossible. Finally, the use of different types of vessels, in which the drugs are concealed with the complicity of some crew members, should not be overlooked.

The implications of this study are significant for both academic knowledge production and the design and implementation of public policy. On a theoretical level, the analysis contributes to consolidating the notion of counterintuitive routes through empirical evidence that brings together dimensions such as the operational spatiality of drug trafficking, the risk management strategies employed by criminal organizations, and the limitations of state control over fluvial corridors. On a practical level, the findings challenge the effectiveness of traditional approaches focused on intervening in criminal "hotspots" and suggest the need to redirect security strategies toward peripheral logistical spaces, which are marked by limited institutional presence and high criminal functionality.

This study faces a few limitations. On the one hand, there is a lack of organized and accessible statistical data, and a marked asymmetry between certain countries along the fluvial corridor becomes evident. On the other hand, some countries showed resistance to sharing information despite formal requests. Nevertheless, the combination of in-depth interviews and documentary analysis made it possible to construct a consistent diagnosis of how this route functions and why it is strategically useful for transnational cocaine trafficking.

Building on these limitations and the findings obtained, new questions arise that open avenues for future research. In particular, it is necessary to expand the analysis to other counterintuitive corridors in South America, in order to explore more deeply the cocaine trade from landlocked countries —such as Bolivia and Paraguay— and to understand how these geographies shape the logistical design of drug trafficking. Additionally, it becomes a priority to investigate the activity of ports located along the stretch between San Lorenzo and Nueva Palmira (Uruguay River), as they appear to concentrate the highest levels of illicit activity due to the river's depth and the existing port infrastructure.

Conclusions

Based on the empirical examples presented, along with the geographical vulnerabilities and weaknesses in state control and surveillance, it is possible to establish that the Paraná-Paraguay waterway plays a significant role for transnational criminal organizations. These organizations demonstrate high levels of adaptability and operate as rational entities that assess the risks of their operations before executing them.

The Paraná-Paraguay waterway has received little attention —not only from the countries involved in it, but also from European entry ports for cocaine. Only recently has there been growing interest in cargo movement along this fluvial route, particularly shipments originating from Bolivia and Paraguay. This interest stems from the fact that Bolivia is a producer of coca leaf, and that Paraguay has, in recent years, become a key site for the storage and redistribution of cocaine within the region.

The Paraná-Paraguay waterway appears as a counterintuitive route in the eyes of authorities, as it involves moving away from major maritime ports and relies on multimodality as the prevailing system. The combination of methods used to transport cocaine makes the detection of contaminated shipments even more difficult, since air and land routes can be modified according to geographic and state control conditions. In this regard, it is important to emphasize that control limitations are structural.

The geographical space encompassed by the waterway presents particular challenges for state surveillance. Moreover, even when scanners are used, their deployment does not guarantee the detection of illicit cargo. In other words, while political will is necessary to improve the chances of intercepting cocaine shipments, it appears insufficient to stop this phenomenon. As long as demand for the drug continues to grow, criminal organizations will continue to find efficient ways to move it toward consumer markets.

Strengthening the existing mechanisms of cooperation among the countries that are part of the Paraná-Paraguay waterway is, without doubt, the variable that can make the difference in identifying both contaminated shipments and the actors involved in the movement of illegal goods. The inclusion of transnational cocaine trafficking through the Paraná-Paraguay waterway on the discussion agenda of the five countries that share this fluvial corridor is indispensable for advancing more effective mechanisms of control over the movement of these illicit cargos.

In this regard, focusing on those private actors who —whether through co-optation or coercion— choose to facilitate the operations of criminal organizations must be a priority. The tension between trade and security is ever-present and must be addressed by seeking a balance that tips the scale in favor of security, within a world increasingly governed by the timing imposed by global trade flows.

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Conflict of interests

There was no conflict of interest among the authors of this academic research. We declare that we have no financial or personal relationship that could influence the interpretation and publication of the results obtained. Likewise, we assure compliance with ethical standards and scientific integrity at all times, in accordance with the guidelines established by the academic community and those stipulated by this journal.

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