# PORT POLICY, GOVERNANCE MODELS, AND THEIR INCENTIVES IN DEVELOPING COUNTRIES: A SYSTEMATIC REVIEW

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## Abstract

This study presents a systematic review of the scientific literature from 2019–2024 on port policy and governance models in developing countries, with a focus on South American nations. Through rigorous Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology, we analyzed 30 articles from indexed journals to examine port policies, governance structures, and incentive mechanisms. Results reveal significant heterogeneity in governance models, transitioning toward increased private participation and service-oriented approaches (Vélez Altamirano, 2021). A consistent finding across studies highlights specialized human capital as critical for successful policy implementation (Fuenzalida-O'Shee & Valenzuela-Klagges, 2019). Digital transformation emerges as essential yet unevenly developed, with notable gaps between leading and secondary ports. Environmental sustainability gains relevance, though economic incentives for clean technologies remain insufficient. The study concludes that effective port policies must transcend infrastructural approaches to embrace integral visions incorporating human capital development, innovation, sustainability, and digitalization. This review contributes significantly by providing a structured synthesis of current knowledge, identifying research gaps, and deriving implications for evidence-based policy formulation in developing countries.

**Keywords:** Port Policy, Port Governance, Maritime Logistics, Developing Countries, Systematic Review

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## 1. INTRODUCTION

Ports are critical infrastructures for the economic development and trade integration of nations, functioning as strategic interfaces between maritime and land transportation modes. Their efficient operation determines not only the competitiveness of a country's foreign trade, but also its capacity to effectively insert itself into global value chains (Martner-Peyrelongue, 2020a). In this context, port policies emerge as essential governmental instruments that establish regulatory frameworks, governance mechanisms, and incentives to optimize the performance of the national port system. The South American region mobilized approximately 45 million twenty-foot equivalent units (TEUs) in 2023, representing about 7% of world containerized maritime trade (Economic Commission for Latin America and the Caribbean [ECLAC], 2024). However, there are still important efficiency, connectivity, and infrastructure gaps that limit regional competitiveness. Recent studies indicate that logistics costs in Latin America and the Caribbean represent between 18% and 35% of the final value of products, significantly higher than the 8% recorded in Organisation for Economic Co-operation and Development (OECD) countries (Rocha & Ruta, 2022). Port policies, understood as the set of guidelines, norms, and governmental actions aimed at planning, development, operation, and regulation of ports and their environment (González-Cancelas et al., 2020), have undergone significant transformations in recent decades. The traditionally centralized and state-run model has evolved towards more complex governance schemes, where multiple public and private actors participate under various management modalities, such as concessions, public-private partnerships, and partial privatization of services. In South America, this evolution has followed heterogeneous trajectories. While countries such as Brazil and Colombia have advanced towards port authority models with greater autonomy and private participation (Vélez Altamirano, 2021), others maintain more centralized structures. Peru represents a particular case where port modernization has been promoted through concessions to international operators, generating significant advances in productivity and infrastructure. However, structural challenges related to land connectivity, trade facilitation, and articulation with comprehensive logistics chains persist (Fuenzalida-O'Shee & Valenzuela-Klagges, 2019). Despite the strategic importance of the port sector and its policies for regional economic development, the specialized scientific literature on port policies in South America presents significant fragmentation and knowledge gaps. There is no systematic and updated analysis that identifies common patterns, best practices, and shared challenges in port policy among South American countries. This gap limits the ability of decision makers to design and implement evidence-based policies that effectively respond to the needs of the sector. Against this backdrop, the present research aims to conduct a systematic review of the scientific literature on port policy and its incentives in South American countries during the period 2019–2024. Through this review, we seek to identify the main trends, governance models, policy instruments, incentive mechanisms, and shared challenges in South American port management. The results will contribute significantly to the field by providing a structured synthesis of existing knowledge, identifying research gaps, and offering guidance for the formulation of more effective port policies to boost the competitiveness and sustainability of the sector in the region.

The structure of this paper is as follows. Section 2 reviews the relevant literature on port policy and governance models in developing countries. Section 3 presents the research methodology employed for this systematic review. Section 4 analyzes the results obtained from the literature analysis. Section 5 discusses the main findings and their implications. Section 6 concludes with a synthesis of key findings, limitations, and a future research agenda.

## 2. LITERATURE REVIEW

### 2.1. Theoretical foundations of port governance

The theoretical framework for understanding port policies and governance models has evolved significantly over the past decades, reflecting the transformation from traditional state-controlled ports toward more complex public-private arrangements. This section examines the key theoretical contributions and empirical evidence that inform contemporary port policy development in developing countries.

Port governance theory has been fundamentally shaped by the concept of the "landlord port" model, first conceptualized by Brooks and Cullinane (2006) and further developed by Notteboom et al. (2022). This model distinguishes between different levels of public and private involvement in port operations, ranging from fully public service ports to completely privatized facilities. Recent literature emphasizes that developing countries face unique challenges in implementing these governance models due to institutional constraints, limited financial resources, and complex political economies (Notteboom et al., 2022).

### 2.2. Port policy instruments and incentive mechanisms

Contemporary port policy literature identifies several categories of policy instruments available to governments. Regulatory instruments include licensing, safety standards, and environmental regulations. Economic instruments encompass taxation policies, subsidies, and concession arrangements. Information-based instruments involve transparency requirements and performance monitoring systems.

Recent research has highlighted the growing importance of sustainability-oriented policy instruments. Green port initiatives, systematically analyzed by Alamoush et al. (2021), have gained prominence in developing countries seeking to balance economic growth with environmental protection. However, implementation remains challenging due to limited financial resources and competing development priorities.

### 2.3. Digital transformation in port policies

The integration of digital technologies into port operations and policies has emerged as a critical area of scholarly attention. Port community systems (PCS) and digital platforms have been identified as key enablers of efficiency and competitiveness, with

recent World Bank research demonstrating significant potential for developing countries (Sahu et al., 2023). However, recent literature suggests that developing countries face significant digital divides in port development, with archipelago countries facing unique geographical challenges that require specialized digital maturity assessment models (Rusli et al., 2024).

Artificial intelligence and automation technologies are increasingly influencing port policy discussions. Recent systematic reviews by Belmoukari et al. (2023) demonstrated that smart port development requires comprehensive frameworks encompassing seven business domains, including operations, technology, and sustainability. The World Bank's comprehensive analysis of global PCS experiences provides valuable insights for developing countries seeking to implement digital transformation strategies (Ollivier et al., 2024).

### 2.4. Regional integration and port policies

The literature increasingly recognizes that port policies cannot be viewed in isolation but must be understood within broader regional integration processes. South American port development has been significantly influenced by regional trade agreements and infrastructure integration initiatives such as the Initiative for the Integration of Regional Infrastructure in South America (IIRSA) (Martner-Peyrelongue, 2022).

Recent research emphasizes the importance of corridor approaches to port development, where policies focus on entire logistics chains rather than individual port facilities. This perspective is particularly relevant for landlocked developing countries that depend on transit arrangements through neighboring ports, with recent United Nations Trade and Development (UNCTAD) initiatives in Peru demonstrating the practical application of United Nations (UN) Sustainable Development Goals (SDGs) in port management (UNCTAD, 2023).

## 3. RESEARCH METHODOLOGY

The present research was developed following the guidelines for systematic reviews established in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Page et al., 2021). Systematic reviews are secondary studies that seek to answer a research question through comprehensive searches of the available evidence and structured synthesis of the results found in such research (Fernandez Chinguel et al., 2019).

The review aimed to answer the following research question:

*RQ1: What are the importance, characteristics, and trends of port policies and their incentive mechanisms in South American countries according to the scientific literature for the period 2019–2024?*

### 3.1. Protocol and registration

A prior protocol was developed that defined the objectives, methods, and eligibility criteria of the review. This protocol was elaborated and agreed upon by the authors before starting the literature search, thus ensuring the transparency and reproducibility of the process.

### 3.2. Eligibility criteria

The following inclusion criteria were defined:

- Scientific articles published in indexed journals.
- Publication period: From January 2019 to February 2024.
- Languages: Spanish, Portuguese, and English.
- Studies focusing on port policies in at least one South American country.
- Research that explicitly addressed port policies, regulations, governance, or incentives.

Exclusion criteria were:

- Conference proceedings, books, theses, technical reports, and gray literature.
- Studies focused exclusively on technical aspects of port engineering without addressing policy elements.
- Research focused on regions outside South America with no comparative analysis with South American countries.
- Opinion articles without an empirical or theoretical basis.

### 3.3. Alternative methodological approaches

Several alternative methodological approaches were considered for this research before selecting the systematic review methodology. A scoping review approach could have provided broader coverage of the literature, but would have offered less rigorous synthesis of findings. Bibliometric mapping using tools such as VOSviewer could have revealed citation patterns and research networks, but would not have provided the detailed content analysis required to answer our research questions. Meta-analysis was considered but deemed inappropriate due to the heterogeneous nature of the studies and the lack of quantitative data suitable for statistical synthesis.

The systematic review methodology was ultimately selected because it allows for comprehensive identification of relevant literature while maintaining rigorous quality assessment and structured synthesis procedures. This approach is particularly suitable for policy-oriented research where diverse methodological approaches and contexts need to be synthesized to inform evidence-based decision-making.

### 3.4. Sources of information

The literature search was conducted between December 2023 and February 2024 in the following databases and academic platforms:

- Scopus (Elsevier);
- Web of Science (Clarivate Analytics);
- Scielo (scientific electronic library online);
- Dialnet;
- Redalyc (network of scientific journals of Latin America and the Caribbean);
- Google Scholar;
- ProQuest.

This was complemented by a manual search of the bibliographic references of the selected articles to identify additional relevant studies (snowball technique).

### 3.5. Search strategy

A search strategy adapted to each database was used, but maintaining the key terms and general structure. In Spanish, the terms "port policy", "port

management", "port governance", "port incentives" were used, combined with "South America" or the name of specific countries such as "Brazil", "Chile", "Peru", "Colombia", "Argentina", etc. using Boolean operators (AND, OR). Equivalent terms were used in English and Portuguese.

The general search strategy was:

*COPY* ("port policy" *OR* "port governance" *OR* "port management" *OR* "port incentives" *OR* "port regulation") *AND* ("South America" *OR* "South America" *OR* "Argentina" *OR* "Brazil" *OR* "Chile" *OR* "Colombia" *OR* "Ecuador" *OR* "Peru" *OR* "Venezuela" *OR* "Uruguay" *OR* "Paraguay" *OR* "Bolivia" *OR* "Guyana" *OR* "Suriname")

For Google Scholar, given its limitations in complex searches, multiple searches were performed with simpler combinations of terms.

### 3.6. Selection of studies

The selection process was carried out in three phases:

1) Initial screening: Review of titles and abstracts to identify potentially eligible studies.

2) Eligibility assessment: Full-text analysis of the pre-selected articles applying the inclusion and exclusion criteria.

3) Final selection: Final determination of the studies to be included in the review.

Two investigators conducted this process independently. Discrepancies were resolved by discussion and consensus. In cases of persistent disagreement, a third investigator acted as arbiter for the final decision.

### 3.7. Data extraction process

A standardized form was designed to systematically extract the following information from each study:

- bibliometric data (authors, year, journal, country of origin);
- objectives of the study;
- methodology used;
- South American country or countries analyzed;
- specific aspects of port policy addressed;
- main findings;
- conclusions and recommendations.

### 3.8. Methodological quality assessment

The methodological quality of the selected studies was assessed using an adaptation of the Critical Appraisal Skills Programme (CASP) tool for systematic reviews. This assessment considered aspects such as clarity of objectives, methodological adequacy, analytical rigor, and relevance of the findings. No studies were excluded for low methodological quality, but this assessment was considered in the interpretation of results.

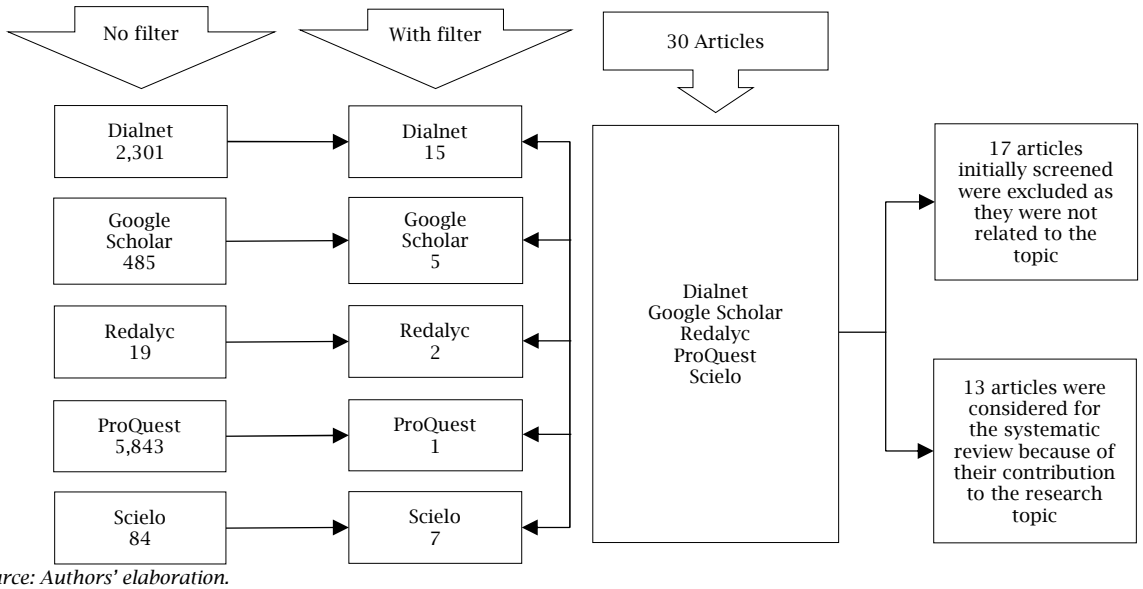
### 3.9. Summary of results

A narrative synthesis of the findings was made, organizing the information according to the thematic dimensions emerging from the analysis. In addition, summary tables were prepared to systematically present the main characteristics and contributions of each study. Analytical categories were established to classify the different aspects of port policies identified.

### 3.10. Bibliometric analysis

A descriptive bibliometric analysis was carried out to identify publication patterns by year, country, scientific journal, and methodological approach. This analysis made it possible to complement the qualitative synthesis with a quantitative characterization of the scientific production on the subject.

**Figure 1.** Flow chart of the inclusion and exclusion criteria used for the systematic review.




*Source: Authors' elaboration.*

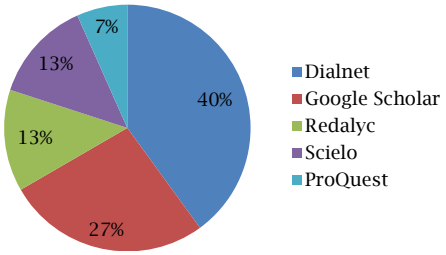
Figure 1 illustrates the complete process of study selection, from initial identification to final inclusion, specifying the number of articles at each stage and the reasons for exclusion.

## 4. RESULTS

The results of the research are presented below. The bibliographic analysis was carried out through the academic network, that is, using virtual resources, but on reliable pages for scientific searches. The following search engines were used: Dialnet, Google Scholar, Redalyc, ProQuest, and Scielo, in that order. The articles are current, no less than five years old; on the other hand, important articles in Spanish were found. The terms for this search were "Port policy" and "Port policy in South America", yielding results very similar to the research problem. Figure 1 shows the information search process. At the beginning, by entering the search terms without any filter, results were shown with numerous articles: Dialnet — 2301, Google Scholar — 485, Redalyc — 19, ProQuest — 5843, Scielo — 84. Applying filters of language (Spanish), age not less than five years, specifying that they are only articles from scientific journals, a smaller number of articles were obtained. It is also worth mentioning the personal choice, discarding articles that are not related to the application of the topic in port policy. So, the search is as follows: Dialnet — 15, Google Scholar — 5, Redalyc — 2, ProQuest — 1, and Scielo — 7.

For this study, an attempt was made to collect articles from different academic search engines, in order to obtain different results, although it is noteworthy that, as shown in Figure 2, the presence of articles related to the topic is more abundant in the academic search engine "Dialnet", being interesting when we observe that most of the articles, as shown in Figure 1, are from the search engine "ProQuest". It should be noted that, as mentioned earlier, the searches through the filter discarded many results, in addition to the personal selection, highlighting that, although the search terms were precise, results with little relation to the research topic were found. On the other hand, in "Dialnet", articles similar to the research topic were shown, giving the possibility of taking several interesting articles.

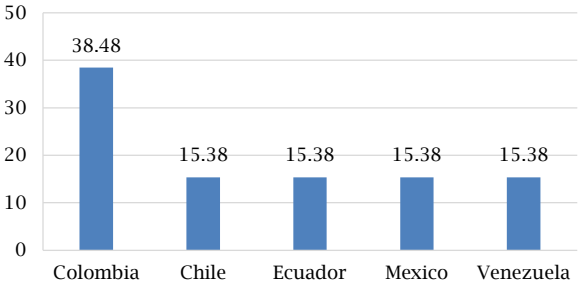
**Figure 2.** Percentage distribution of articles according to the academic search engine




*Source: Authors' elaboration.*

On the other hand, the origin of the research has been reviewed in order to make a comparative study of the countries that have studied this problem. Colombia stands out in this opportunity, with 38.48% being Colombian articles.

**Figure 3.** Percentage distribution of articles by country




*Source: Authors' elaboration.*

Some articles consulted in the review provide more general results. For example, in Boyano-Fram and Mestra-Sierra (2023), seaports in terms of infrastructure, connectivity, and governance are prepared for the movement of goods, but they do not depend on them either to curb mobility or to increase it, which is what everyone wants.

Among all this, the following table (Table 1) shows the most important contributions of each research to solve the question posed about the importance of port policy and its incentives in South American countries.

**Table 1.** Articles by the author and contributions (Part 1)

| *No.* | *Authors* | *Contribution to the study* |
|---|---|---|
| 1 | Guerrero Molina et al. (2022) | Caribbean ports plan to improve their performance in terms of the volume of cargo moved for transit, import, and export; in general, they intend to develop logistics and technological infrastructures that reflect high levels of competitiveness in relation to distances and costs that will attract companies and shipping companies. |
| 2 | Schweitzer et al. (2020) | It is evident that, within the framework of this tension between the needs of urban growth and the needs of territorial expansion of port activities (new activities within the enclosures), the incompatibility of land uses on an urban scale, the existence of environmental risks for the population settled in the vicinity of the port enclosures and other damages generated by the lack of foresight in the transport infrastructures that cross urban fabrics are evident. |
| 3 | González Laxe et al. (2019) | It concludes that important changes can be detected in the structure of transatlantic maritime cargo traffic, and therefore of international merchandise trade, in the sense that there has been a shift in the centers of port demand. |
| 4 | Fuenzalida-O'Shee and Valenzuela-Klagges (2019) | It proposes to promote integrative research and innovation; that universities and private institutions work together in the construction of knowledge directly related to production and its diversification and added value; to stimulate private investment in research and development (R&D), given that public investment in science and technology alone in Latin American countries will not reverse this reality; and to have information available to guide decision-making, research lines and professionalization in the management of scientific and technological institutions. |

**Table 1.** Articles by the author and contributions (Part 2)

| *No.* | *Authors* | *Contribution to the study* |
|---|---|---|
| 5 | Delfín-Ortega and Lucas Avilés (2022) | It recommends that they should be directed to generate an improvement in the technological progress of the ports of North America, so it is recommended a greater investment in research and development in this sector, in addition to a complete adaptation to new digital technologies and telecommunications systems, promoting the full use of all users, shipping operators and all other actors involved in the port sector of these countries. |
| 6 | Neumann Novack (2019) | It affirms that the urban restructuring considered for the central areas of the cities studied indicates alternatives that contribute to the diffusion of neoliberal policies in South American port cities. It can be concluded that the restructuring developed by public policies, finally, is linked to agreements and/or private projects that promote the reproduction of neoliberal policies in the city. In the case of Rosario, there is a neoliberal reproduction linked to the recovery and creation of public spaces that generate the expansion of the real estate market. Meanwhile, in Valparaíso, there is a change from traditional commerce to Chinese and informal commerce that expresses other reflections and forms of neoliberalism diffusion in the city. |
| 7 | Boyano-Fram and Mestra-Sierra (2023) | In terms of infrastructure, connectivity, and governance, seaports are prepared for the movement of goods, but they are not responsible for slowing down mobility, nor for increasing it, which is what everyone wants. |
| 8 | Zambrano-Noboa et al. (2019) | A minimum percentage of the surveyed population is of the opinion that compliance with port regulations is excellent. However, in order to ensure maritime safety in the ports, it is necessary that there is excellent compliance with the port services regulations in Ecuador by all those involved. On the other hand, there are operators who do not perform the work in the port areas according to the regulations; the reasons are probably due to a lack of knowledge of the regulations, the length of the regulatory material, or a lack of access to it. |
| 9 | González-Cancelas et al. (2020) | The diagnosis shows the current situation to be able to address planning, where the use of a business observation tool analysis shows that currently the Spanish ports are in a medium-low position of digitization, and continue to update and innovate, to become increasingly competitive in the market. Despite this, there is still a long way to go in digitization, such as making an immediate conversion to digital, intelligent, and green ports, which optimize existing infrastructures with added capacity thanks to intelligent space management. For this, it is necessary to integrate technologies such as the cloud, Big Data, or sensorization, as mentioned above. |
| 10 | Quintero Ramos et al. (2021) | It highlights how important it is, in a prospective manner, to present new research that is specified in these recommended actions or strategies, which can be linked to other ports in order to achieve better data with valuable information, which, through scientific research, provides solutions to the problems that exist within the activity of international trade in the maritime terminals, with the purpose of improving the productive apparatus of the country. |
| 11 | Martner-Peyrelongue (2020b) | Connectivity is a key element for improving the competitive position of ports and is a *sine qua non* condition for the formation and consolidation of multimodal networks linked to hub ports. Indeed, ports of this type need to concentrate cargo by expanding and diversifying their *hinterland*, and this is possible through a smooth modal and logistical articulation that allows the continuous flow of supply of globalized production-circulation chains. |
| 12 | Pereira and Gavilán Díaz (2021) | Most port communities still face problems related to the current digital transformation of the sector, such as low information technology (IT) penetration, especially in the inland parts of the logistics chain (far from the ports); a fragmented industry, with many screens of different systems; unnecessary number of communication channels; difficulty in detecting possible errors in information; intensive use of manual transactions; excessive re-entry of data; and unnecessary and wasted truck movements. |
| 13 | Vélez Altamirano (2021) | The research affirms that both Brazil and Colombia have achieved an implementation and evaluation of maritime policies, which have generated a governance framework in which the coordinated work of governmental entities is promoted, thus creating the basis for public management that contributes to the maritime development of the countries. |

*Source: Authors' elaboration.*

The 13 studies analyzed corroborate the importance of specialized training in port management to ensure the successful implementation of innovative port policies in South American ports. Port professionals need to acquire skills in areas such as logistics process optimization, port infrastructure management, environmental sustainability, and investment attraction. By training port professionals, it is possible to ensure that the policies implemented are effective and contribute to improving the competitiveness of the region's ports.

## 5. DISCUSSION

This systematic review has identified common patterns, trends, and challenges in South American port policies during the 2019–2024 period. The most relevant findings are discussed below according to the main thematic dimensions emerging from the analysis.

### 5.1. Port governance models and their evolution in South America

The results reveal a marked heterogeneity in the port governance models adopted by South American countries, although with a shared trend towards schemes that incorporate greater private participation. As Vélez Altamirano (2021) points out, Brazil and Colombia have made significant progress in the implementation and evaluation of maritime policies that promote governance frameworks with coordinated work among government entities. This finding coincides with the global trend of transition from the traditional "service port" model to "landlord" or mixed models where the State maintains ownership of the basic infrastructure while services are operated by private entities under different contractual schemes (González-Cancelas et al., 2020).

However, our analysis identifies that this evolution has not been uniform in the region.

Countries such as Chile and Brazil have moved more decisively towards port authority models with greater autonomy, while others maintain more centralized structures with less differentiation between regulatory and operational functions. This disparity creates challenges for the harmonization of policies at the regional level and for the implementation of efficient transnational logistics corridors, as suggested by Martner-Peyrelongue's (2020a) findings on the importance of intermodal connectivity. Recent studies by Andersen et al. (2023) suggest that developing countries face unique challenges in implementing governance model transitions due to institutional constraints and political complexities, particularly in African contexts where public sectors are highly politicized and susceptible to influence from powerful multinationals.

## 5.2. Specialized training and knowledge management as strategic axes

A cross-cutting and consistent finding in the studies analyzed is the critical need for specialized and continuous training for professionals in the South American port sector. This need encompasses multiple dimensions: from technical competencies in logistics and operations to infrastructure management skills, environmental sustainability, and investment attraction. Evidence suggests that human capacity gaps constitute one of the main bottlenecks for the effective implementation of innovative port policies in the region.

Fuenzalida-O'Shee and Valenzuela-Klagges (2019) propose an integrative approach where universities and private institutions collaborate in the construction of applied knowledge directly related to production, diversification, and the generation of added value. This finding is particularly relevant when contrasted with experiences of successful port-logistics clusters in other regions, such as Rotterdam or Singapore, where the close linkage between academia, industry, and government has been fundamental for innovation and competitiveness (González Laxe et al., 2019). Recent research on African ports demonstrates that systematic capacity-building programs are essential for successful port development, though implementation remains challenging due to limited resources and institutional barriers (Sub-Saharan Africa Transport Policy Program [SSATP], 2024).

In this context, it is significant that the ports of the Colombian Caribbean, according to Guerrero Molina et al. (2022), are planning improvements in logistics and technological infrastructure aimed at increasing their competitiveness in terms of distances and costs. However, this infrastructural development will hardly reach its potential without a corresponding investment in specialized human capital. Our findings suggest that South American port policy should explicitly integrate knowledge management and skills development strategies as central, not peripheral, components.

## 5.3. Digitalization and technological integration challenges

Digital transformation emerges as another priority challenge for South American port policies. Pereira and Gavilán Díaz (2021) evidence that port communities in the region still face significant obstacles related to digitization, including limited penetration of ITs, fragmentation of systems, multiplicity of communication channels, and redundant manual processes. These findings contrast with advances in global benchmark ports, where the implementation of PCS, blockchain, and the Internet of Things (IoT) solutions is revolutionizing operational efficiency.

González-Cancelas et al. (2020) point out that Spanish ports -referent for many South American port systems- are at a medium-low level of digitization despite continuous upgrades. The situation in South America is even more challenging, with marked asymmetries between major and minor ports, and between countries with different levels of digital development. Our analysis suggests that regional port policies are gradually incorporating digital transformation objectives, but often lack a clear roadmap, adequate funding, and impact assessment mechanisms. Recent studies by Rusli et al. (2024) highlight that successful digital transformation in developing country ports requires comprehensive maturity assessment models that consider the unique geographical challenges faced by archipelago countries, with Indonesian ports showing significant gaps in technology adoption and system integration. Furthermore, research on African ports indicates that digital maturity is highly asymmetrical, with some ports achieving high digitalization levels but lower than expected productivity, suggesting that other factors, such as working conditions and equipment availability, may affect performance (Almeida & Okon, 2025).

This finding becomes even more relevant in light of the COVID-19 pandemic, which accelerated the need to digitize processes and minimize physical interactions in port operations. However, none of the studies analyzed systematically addresses the impact of the pandemic on South American port policies, representing a significant gap in recent literature.

## 5.4. Sustainability and socio-environmental responsibility

Although less prominent than other issues, the socio-environmental dimension of port policies appears with increasing relevance in the studies analyzed. Schweitzer et al. (2020) identify significant tensions between the needs of urban growth and the territorial expansion of port activities, highlighting land use incompatibilities, environmental risks for neighboring populations, and negative externalities due to inadequate transportation infrastructure. Recent experiences in Brazilian port cities, such as the Porto Maravilha project in Rio de Janeiro, illustrate the complex dynamics between port development and urban regeneration (Angotti et al., 2019).

This problematic port-city interface reflects a broader challenge: the insufficient integration of sustainability criteria in port policies traditionally oriented to economic and operational objectives. The findings suggest an incipient evolution towards more comprehensive approaches that consider the triple impact (economic, social and environmental) of port activities, albeit with heterogeneous implementation across countries.

It is notable that the incentive policies analyzed rarely incorporate significant incentives for

investments in clean technologies, energy efficiency or emissions reduction, in contrast to trends observed in European and North American ports. This gap offers both a challenge and an opportunity to reformulate incentives that align economic competitiveness with environmental sustainability. Recent research by Le and Nguyen (2023) demonstrates that developing countries implementing green port initiatives face specific challenges related to financing, regulatory frameworks, and stakeholder coordination, though successful implementation can achieve significant environmental and economic benefits.

### 5.5. Implications for public policy

The findings of this review have significant implications for port policymakers in South America. First, they suggest the need to transcend the predominantly infrastructural approach to a more holistic vision that encompasses human capital, innovation, sustainability, and digitalization. Second, they highlight the value of establishing formal university-business-government collaboration mechanisms to close sector-specific knowledge gaps. Third, they underscore the importance of gradually harmonizing national regulatory frameworks to facilitate regional logistics integration.

Particularly relevant is the finding on the need for policies that encourage not only investments in physical infrastructure but also in human capital and innovation. As Fuenzalida-O'Shee and Valenzuela-Klagges (2019) point out, stimulating private investment in R&D is crucial, as public investment in science and technology alone will hardly reverse the current limitations of the sector in Latin America.

### 5.6. Regional integration and connectivity

The analysis reveals that connectivity and digitalization emerge as critical factors for port competitiveness in developing countries. Recent research demonstrates that PCS has significant potential to improve operational efficiency while reducing environmental impacts (Sahu et al., 2023). However, implementation in developing countries faces unique challenges, including limited IT penetration, fragmented systems, and insufficient institutional capacity (Almeida & Okon, 2025). The integration of sustainability goals with digital transformation initiatives represents a promising approach, as evidenced by recent studies showing that over 72% of port digitalization initiatives directly contribute to UN SDGs (Almeida & Okon, 2024). The most effective port policies are those that transcend purely port visions toward integrated logistics corridor approaches, taking advantage of complementarities and economies of scale possible only through transnational collaborative approaches.

## 6. CONCLUSION

This systematic review has analyzed the scientific literature of the last five years (2019–2024) on port policies and their incentives in developing countries, with particular focus on South American nations. The analysis allows identification of common patterns, best practices, shared challenges, and opportunities for improvement in regional port management.

The review reveals significant heterogeneity in regulatory frameworks and port governance models among developing countries, reflecting distinct historical-institutional trajectories. However, there is evidence of a converging trend toward schemes incorporating greater private participation, management autonomy, and service-oriented approaches to competitiveness. This evolution, while positive, has been uneven and faces obstacles related to institutional capacities, rigid legal frameworks, and sectoral resistance to change.

The studies consistently corroborate the fundamental importance of specialized training in port management as a necessary condition for the successful implementation of innovative port policies. This skills gap spans multiple dimensions: from technical knowledge in logistics and operations to managerial skills, digital competencies, and capabilities for sustainable management. Evidence suggests that even the best policies and incentives fail when adequate human capital is not available for effective implementation.

Port communities in developing countries face a necessary but incomplete digital transformation. Digitization of processes, automation of operations, and implementation of integrated information platforms still present insufficient and heterogeneous development levels between countries and ports. Port policies are gradually incorporating digital objectives, but often lack the necessary tools, resources, and evaluative frameworks for effective implementation.

Developing country ports show significant progress in infrastructure and equipment, but significant deficiencies persist in integration with comprehensive logistics chains. Connectivity emerged as a critical factor for port competitiveness, being a necessary condition for the consolidation of multimodal networks and hinterland expansion. The most effective port policies are those that transcend purely port visions toward integrated logistics corridor approaches.

The socio-environmental dimension of port policies has gained relevance, evidencing tensions between port development, urban growth, and environmental sustainability. The incentives analyzed rarely incorporate significant mechanisms for investments in clean technologies or the reduction of environmental impacts, representing an opportunity to reformulate policies that align economic competitiveness with socio-environmental responsibility.

The need to strengthen collaboration mechanisms between various actors in the port ecosystem (authorities, operators, shipping companies, academia, and communities) is evident. The most successful port development models identified are those implementing effective collaborative governance schemes, where best practices are shared and challenges posed by growing demand for port services are jointly addressed.

This review has limitations that should be considered. First, the methodological heterogeneity of the studies analyzed makes direct comparisons between findings difficult. Second, the search was limited to indexed academic publications, potentially excluding technical reports or relevant policy documents. Third, the time window (2019–2024) allows us to capture recent trends, but not longer-term historical developments. Future research should focus on systematic impact assessment of port policies, comparative analysis of regulatory

and fiscal incentives, case studies on PCS implementation, and predictive models on port adaptation to climate change and energy transition.

The findings suggest that policymakers in developing countries should develop comprehensive, specialized training programs, implement formal inter-sectoral coordination mechanisms, design incentive schemes promoting investments in human capital and technological innovation, move toward flexible regulatory frameworks, and establish indicators and monitoring systems for evidence-based policy adjustments. Finally, sustainable and competitive port development in developing countries requires not only isolated national actions but also coordinated regional integration efforts. The most effective port policies will be those that, in addition to addressing specific challenges of each port and country, contribute to strategically positioning regions in global value chains, taking advantage of complementarities and economies of scale possible only through transnational collaborative approaches.

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