

## EGYPTIAN DRY PORTS AND THEIR ROLE IN ENHANCING LOGISTICS CORRIDORS: AN ECONOMIC, ENVIRONMENTAL, AND LOGISTICAL PERSPECTIVE

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### ABSTRACT

This study analyzes the role of Egyptian dry ports in enhancing the efficiency of logistics corridors by examining their economic, environmental, and logistical contributions, particularly in improving foreign trade competitiveness, reducing transportation and handling costs, and supporting sustainable development objectives. The research adopts a descriptive analytical approach the competitive environment in which Egyptian dry ports operate, complemented by a systematic review of the most recent literature up to 2025. The study offers a unique contribution by integrating economic, environmental, and logistical perspectives within a single analytical framework and linking these to broader themes of sustainability and digital transformation—an area that remains insufficiently addressed in both Arabic and international literature. The findings enrich academic knowledge by presenting a comprehensive model that future research can use to assess dry ports' roles in sustainable supply chains. Practically, the study provides policy-relevant guidance for decision-makers and logistics stakeholders, emphasizing the importance of diversifying service providers, strengthening multimodal transport integration, investing in digitization and smart logistics systems, and adopting environmentally responsible operational strategies to enhance competitiveness and support national economic development.

### 1. INTRODUCTION

In recent decades, global trade has witnessed unprecedented growth, which has placed increasing pressure on traditional seaports in terms of capacity, operational efficiency, and environmental sustainability. In this context, dry ports have emerged as a strategic solution designed to support seaports by relocating part of their operations (storage, customs clearance, cargo consolidation) inland, thereby alleviating congestion at coastal areas and improving the efficiency of supply chains as discussed by Varese et al. [1].

Dry ports are defined as inland, multimodal terminals directly connected to seaports by rail or highway, where customers can access similar services to those available at seaports, such as clearance, distribution, and storage according to Zain et al. [2]. This role makes them a key driver of integration between maritime and inland transport, enhancing transportation efficiency and reducing overall costs.

From an economic perspective, studies have shown that dry ports contribute to enhancing the competitiveness of seaports and expanding their hinterlands by reducing

transport costs, increasing cargo turnover speed, and stimulating investments in inland regions as noted by Saha and Khalil [3]. They also contribute to job creation and regional development, which supports governments' goals of promoting balanced economic growth as emphasized by Afiatno and Joyoutomo [4].

From an environmental perspective, recent research has highlighted that dry ports help reduce emissions and road congestion by promoting modal shifts from road haulage to rail, aligning with the concept of green logistics as demonstrated by Pham and Lee [5]. For example, an Italian case study showed that establishing a dry port linking the Port of Venice with inland areas resulted in an annual reduction of about 8,000 tons of CO<sub>2</sub> emissions as reported by Carboni and Orsini [6].

From a logistical perspective, experiments in China demonstrated that dry ports connected to the Ningbo–Zhoushan port improved land–sea connectivity and opened new trade corridors, boosting container throughput and supply chain speed as shown by Sun et al. [7]. Another study in Northeast China indicated that constructing seven additional dry ports could cover more than 80% of container flows while reducing total transport costs by around 22% as highlighted by Pian et al. [8].

Despite these positive outcomes, clear research gaps remain, particularly in integrating economic, environmental, and logistical analyses within a unified framework. A recent bibliometric review confirmed that most studies have focused on location and functional aspects, while relatively few have explicitly addressed sustainability dimensions according to Beyene et al. [9]. This justifies the importance of conducting applied research on Egyptian dry ports to evaluate their multiple dimensions using strategic tools.

The problem of this study lies in the existing research gap concerning the effectiveness of Egyptian dry ports in enhancing logistics corridors from economic, environmental, and logistical perspectives. Despite the growing attention to this sector within Egypt's transport and development strategies, challenges remain regarding its ability to achieve operational efficiency, reduce costs, and minimize negative environmental impacts. Moreover, applied studies addressing these dimensions within an integrated framework are still limited. Therefore, this study aims to analyze the role of Egyptian dry ports in supporting logistics corridors by evaluating their economic impact in reducing costs and stimulating investments, their environmental role in promoting sustainability and reducing emissions, and their logistical role in improving efficiency and strengthening connections between seaports and inland regions. The ultimate goal is to provide a comprehensive vision that contributes to formulating more effective policies to maximize the role of dry ports in supporting the Egyptian economy. and to identify future opportunities and challenges.

## 2. LITREATURE REVIEW

The role of dry ports in enhancing logistics corridors has attracted considerable scholarly attention over the past five years, particularly from economic, environmental, and logistical perspectives. Early studies emphasized the environmental and regional economic implications. For instance, Carboni and Orsini [10] demonstrated through a case study in Italy that the introduction of a rail-linked dry port could reduce carbon emissions by approximately 17% annually, underscoring the environmental benefits of shifting freight from road to rail. Similarly, Lovrić et al. [11] revealed in Croatia that dry port investments contribute to employment growth and improved socioeconomic indicators, particularly in less-developed regions.

Building on this foundation, Mohd Zain et al. [12] reconceptualized the seaport–city nexus, showing that dry ports act as “extended gates” that alleviate congestion in urban seaports. Ali and Ayelign [13] empirically demonstrated in Ethiopia that port performance is significantly influenced by infrastructure quality, connectivity, and integration into

logistics networks. At the same time, Varese et al. [14] conducted a systematic literature review and found that environmental assessments of dry ports remain fragmented, lacking standardized methodologies and consistent stakeholder engagement.

Quantitative modeling and resilience analysis became more prominent in 2023. Kurtuluş [15] developed a multi-objective optimization model and found that balancing cost minimization with emission reduction could achieve a 13% decrease in emissions, stressing the importance of rail capacity improvements. Shoukat and Xiaoqiang [16], in a case study from Pakistan, applied a bi-objective mixed-integer model and showed that intermodal transport is 82% more cost-effective and 78% less carbon-intensive than road-only freight. In parallel, Lu et al. [17] emphasized the resilience dimension, finding that the number of dry ports within a network contributes more to stability against cascading failures than their individual capacities, positioning dry ports as critical for supply chain robustness.

In 2024, the literature evolved toward decision-support models and investment strategies. Zhao and Sun [18] applied game-theoretic modeling and showed that even moderate dry port investments enhance competitiveness and welfare, provided transport costs remain low, while warning against over-expansion. Irawan et al. [19] proposed a hub-and-spoke network design model incorporating both cost and carbon emissions, demonstrating in the Tianjin port context that sustainable objectives alter optimal network structures.

Most recently, studies from 2025 emphasized policy design and spatial planning. Saha and Khalil [20] investigated stakeholder perceptions in Bangladesh and reported consensus on the urgent need for new dry ports outside congested seaport areas, recommending integrated multimodal planning and electronic customs systems to boost efficiency and competitiveness.

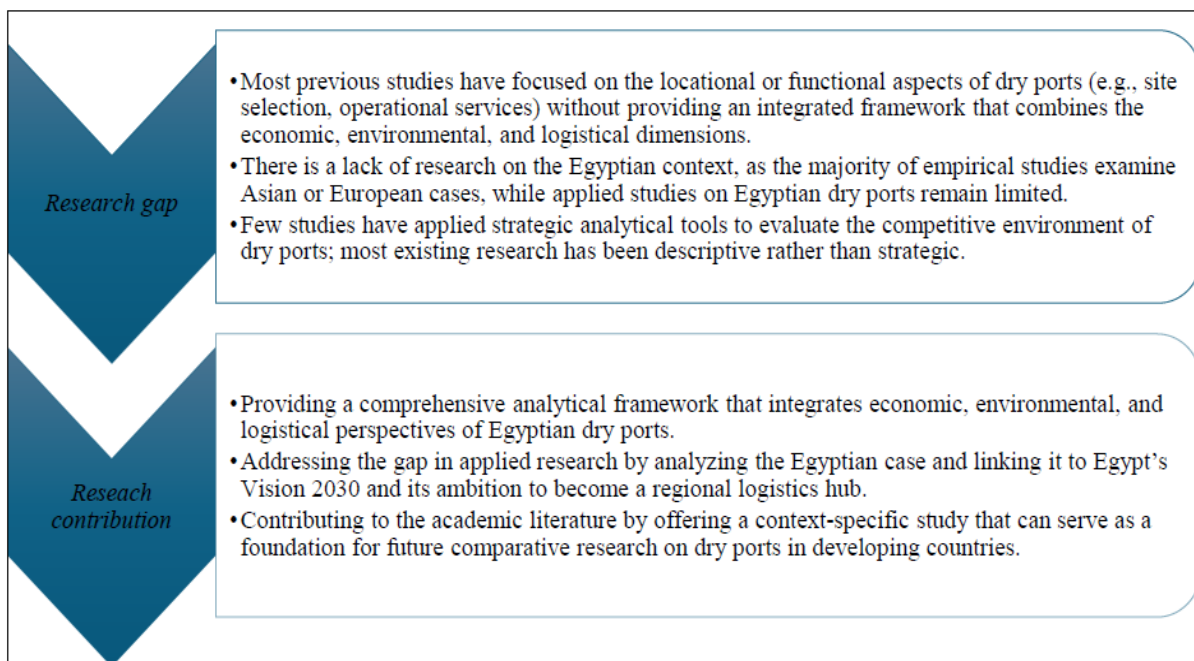


Figure 1 : Research Gap and contribution. Source: by author.

## 2.1 Research Gap and contribution:

The environmental role of dry ports represents a fundamental pillar in supporting sustainable logistics corridors. By relocating storage and customs clearance activities away from coastal areas and closer to inland industrial zones, dry ports help reduce congestion in seaports and the surrounding urban road networks. One of the most significant environmental contributions of dry ports is their ability to encourage a shift from road-based freight transport to rail-based or multimodal systems. Rail transport consumes less fuel per container and results in lower greenhouse gas emissions compared to long-distance trucking, which makes the overall supply chain more environmentally efficient.

In the Egyptian context, dry ports contribute to decreasing heavy truck movements between seaports and major industrial cities, which helps reduce traffic density, fuel consumption, and air pollution along key transport corridors, particularly those linking Alexandria to the Greater Cairo region. Additionally, the reduced congestion at seaports leads to shorter vessel turnaround times, which in turn reduces emissions generated while ships wait for berth or clearance.

Furthermore, dry ports support environmental sustainability through the application of digital trade systems, which streamline procedures and minimize manual paperwork. This digitalization reduces energy waste, improves transparency, and helps optimize container handling cycles. Future development plans for dry ports in Egypt also include integrating renewable energy sources, smart monitoring systems, and improved land-use planning in order to minimize their ecological footprint and strengthen their role in promoting green logistics.

## 3. RESEARCH PROBLEM

Despite the strategic importance of Egyptian dry ports in enhancing the efficiency of logistics corridors and supporting economic development, a clear research gap remains regarding their actual ability to achieve the intended goals from an integrated perspective that includes economic, environmental, and logistical dimensions. Although significant efforts have been made to develop this sector, challenges related to limited operational efficiency, restricted investments, increasing competition, and the influence of alternative logistics solutions still persist. Moreover, most previous studies have focused mainly on functional or locational aspects of dry ports without providing a comprehensive analytical framework that integrates different strategic dimensions. Accordingly, the problem of this study lies in analyzing the role of Egyptian dry ports in enhancing logistics corridors and assessing their effectiveness from economic, environmental, and logistical perspectives.

Based on this, the main research question of the study can be formulated as follows:

To what extent do Egyptian dry ports contribute to enhancing logistics corridors from economic, environmental, and logistical perspectives, Furthermore, the study seeks to answer the following sub-questions derived from the main research question:

- 1) What is the intensity of competition among existing dry ports in Egypt, and how does this affect their efficiency and role in supporting logistics corridors?
- 2) To what extent does the entry of new dry ports or competing logistics hubs pose challenges or opportunities for the current system?
- 3) How do infrastructure providers, financial institutions, and service suppliers influence the economic and operational performance of Egyptian dry ports?

- 4) How do shippers, freight forwarders, and logistics companies contribute to shaping the services of Egyptian dry ports and enhancing their competitiveness and sustainability?
- 5) To what extent do alternative transport modes or logistics solutions (such as direct reliance on seaports or inland trucking) substitute the role of dry ports in supporting logistics corridors?

#### 4. RESEARCH AIMS AND OBJECTIVES

This research aims to analyze the role of Egyptian dry ports in enhancing logistics corridors from economic, environmental, and logistical perspectives, to identify the opportunities and challenges they face. Research objectives are:

- To evaluate the intensity of competition among existing dry ports in Egypt and its implications for operational efficiency and their role in supporting logistics corridors.
- To examine the threat of new entrants and assess how the establishment of new dry ports or competing logistics hubs may impact on the current market structure.
- To analyze the bargaining power of suppliers and its effect on the economic and operational performance of Egyptian dry ports.
- To assess the bargaining power of customers, focusing on the influence of shippers, freight forwarders, and logistics companies in shaping dry port services and enhancing competitiveness and sustainability.
- To determine the threat of substitutes by evaluating the extent to which alternative transport modes or logistics solutions (such as direct reliance on seaports or inland trucking) may substitute the role of dry ports in supporting logistics corridors.

#### 5. RESEARCH IMPACT

##### 5.1 Practical Importance of the research:

The practical significance of this study lies in providing an integrated analytical framework that can support policymakers in Egypt in realistically assessing the role of dry ports from economic, environmental, and logistical perspectives. The study will offer a practical tool to identify strengths and weaknesses, while also uncovering the opportunities and challenges facing dry ports in a dynamic competitive environment. The findings can contribute to government policies aimed at developing transport infrastructure and enhancing logistics corridors in line with sustainable development strategies. Moreover, the study has practical value for improving investment strategies and fostering effective public-private partnerships in the logistics and transport sector.

##### 5.2 Scientific Importance of the research:

The scientific importance of this study stems from its attempt to fill a clear research gap in the literature on dry ports, where most previous studies have not offered a comprehensive approach that integrates economic, environmental, and logistical dimensions into a unified framework. The study opens avenues for future applied and comparative research that can examine international experiences in developing dry ports and achieving sustainability in the transport and logistics sector.

#### 6. RESEARCH METHODOLOGY:

This study adopts a descriptive and analytical research methodology in order to examine the role of Egyptian dry ports in enhancing logistics corridors from economic, environmental, and logistical perspectives. The research relies on a qualitative analysis of secondary data collected from academic literature, government reports, and

international case studies on dry ports. To provide a structured evaluation, the bargaining power of suppliers and customers, and the threat of substitutes. This methodological approach not only facilitates the identification of strengths, weaknesses, opportunities, and challenges facing Egyptian dry ports, but also helps in generating policy-relevant insights that can guide decision-makers in formulating more effective strategies for the development of logistics corridors.

The study provides a clearer understanding of the competitive environment surrounding Egyptian dry ports. The analysis shows that competition among existing and planned dry ports is increasing, driving operators to enhance service quality and improve connectivity with seaports and industrial zones. The bargaining power of customers is moderate but rising as more dry ports become operational, which highlights the need to offer efficient, reliable, and value-added logistics services. Supplier power remains significant, particularly due to reliance on the national railway network, indicating the importance of developing multimodal transport options. The threat of substitutes, such as direct seaport clearance or long-distance trucking, is present but less effective in serving inland industrial clusters. The threat of new entrants is limited by high investment and regulatory requirements, although public-private partnership frameworks are gradually opening the market.

Overall, the analysis indicates that enhancing integration, digitalization, and multimodal connectivity is essential for strengthening the competitiveness and sustainability of Egyptian dry ports.

## 7. RESEARCH LIMITATIONS

### 7.1 Geographical Scope:

This study is limited to Egyptian dry ports, considered as a case study to examine their role in enhancing logistics corridors. The focus is on the most significant dry ports currently operating as well as those under development within the framework of Egypt's national transport and logistics strategy.

### 7.2 Time Scope:

The study covers the period from 2016—the year Egypt launched its Sustainable Development Strategy (Vision 2030) and associated logistics projects—up to 2025, in order to capture recent developments and connect them with future plans.

### 7.3 Subject/Methodological Scope:

The research focuses on analyzing the role of dry ports from economic, environmental, and logistical perspectives. The study does not examine in detail the legal aspects or purely technical issues (such as engineering design specifications of dry ports), but rather concentrates on dimensions related to economic development and logistics sustainability.

Table 1. presents a detailed analysis for the Egyptian dry port declared by the government.

**Table 1. current Egyptian Dry Ports .**

Force	Item	Explanation
Rivalry among Existing Competitors	Existing dry ports	Egypt currently operates several dry ports including 6th of October Dry Port (Launched in June 15th 2023 to reduce port congestion and demurrage costs), as well as Badr Attaka Dry Port (48 KM from Sokhna port, which are listed among the country's key facilities).
	Government plan (32 dry ports)	The government has announced plans to establish a network of 32 new dry ports and logistics centers with a total annual capacity of about 6 million TEUs, aiming to reduce congestion at seaports.
	Competition for cargo flows	Both operational and planned facilities are competing to capture container flows from industrial and logistics zones, particularly in major hubs such as 6th of October (El Sweedy) and 10th of Ramadan.
	Role in easing congestion and reducing costs	Dry ports serve as a strategic logistics alternative by reducing congestion at seaports, lowering inland transportation costs, and supporting Egyptian producers, with positive effects on final product prices.
Bargaining Power of Buyers	Buyers (customer base)	The main users of Egyptian dry ports include importers, exporters, shipping companies, logistics providers, and nearby industrial zones. For example, the New Fayoum Dry Port project explicitly targets importers, exporters, customs brokers, and surrounding industries.
	Alternatives available	Customers can bypass dry ports by dealing directly with seaports or relying on overland trucking, which provides them with leverage over service pricing and conditions.
	Integrated services reduce buyer leverage	Dry ports offer value-added services such as inland customs clearance and on-demand storage, which reduce delays and enhance supply chain efficiency. These integrated services weaken the bargaining power of buyers compared to traditional logistics settings.
	Impact of expansion on buyer power	As the number of dry ports increases, buyers will have more options, potentially strengthening their bargaining position. However, competition among dry ports is expected to balance this by improving service quality and efficiency.
Bargaining Power of Suppliers	Heavy reliance on railways	Egyptian dry ports depend heavily on the national railway operator, which is the sole provider of container rail services. Current capacity allows only about four trains per day to and from the 6th of October Dry Port due to congestion on the Cairo corridor, highlighting strong supplier leverage.
	Fuel prices and infrastructure costs	Dry ports rely on trucking as well as energy inputs (mechanical, electrical, fuel). Rising fuel prices or shortages increase inland transport costs, directly affecting operators' efficiency and profitability.
	State control limits dominance	The government mitigates supplier dominance through fuel subsidies, infrastructure expansion, and railway development projects, reducing the extent of supplier power.
	Overall supplier power	Supplier power is considered moderate; the absence of strong alternatives (especially for rail transport) provides suppliers with relative influence, but this is balanced by government regulation and investment in infrastructure.
Threat of Substitutes	Substitutes (seaports, warehouses, logistics centers)	Alternatives to dry ports include reliance on traditional seaports (Alexandria, Dekheila, Port Said, Sokhna), direct trucking, or logistics/warehousing facilities near factories.
	Challenges of alternatives	These alternatives often suffer from congestion, customs delays, and high demurrage charges, making them less efficient compared to dry ports.
	Technological substitutes	E-clearance systems, supply chain digitalization, and secure logistics platforms can partially substitute dry ports by streamlining trade processes.
	Geographical advantage of Egypt	Egypt's position between the Mediterranean and Red Sea, along with inland industrial hubs far from ports, makes dry ports a strategic and necessary complement to seaports. Overall, the threat of substitutes is moderate, depending on future efficiency gains in seaports or digital systems.
Threat of New Entrants	Buyers (customer base)	The main users of Egyptian dry ports include importers, exporters, shipping companies, logistics providers, and nearby industrial zones. For example, the New Fayoum Dry Port project explicitly targets importers, exporters, customs brokers, and surrounding industries.
	Alternatives available	Customers can bypass dry ports by dealing directly with seaports or relying on overland trucking, which provides them with leverage over service pricing and conditions.
	Integrated services reduce buyer leverage	Dry ports offer value-added services such as inland customs clearance and on-demand storage, which reduce delays and enhance supply chain efficiency. These integrated services weaken the bargaining power of buyers compared to traditional logistics settings.
	Impact of expansion on buyer power	As the number of dry ports increases, buyers will have more options, potentially strengthening their bargaining position. However, competition among dry ports is expected to balance this by improving service quality and efficiency.

Source: by author.

Dry port Analysis revealed that:

- The results indicate that rivalry among Egyptian dry ports is at an early stage but is steadily intensifying. Existing facilities, such as the 6th of October, 10th of Ramadan,

and Badr Attaka dry ports, are competing to expand their market share, while the government is developing a wide network of around 18 new dry ports with a planned annual capacity of 6 million TEUs. This expansion creates intense competition to attract container flows from major industrial and logistics zones, particularly in hubs such as 6th of October and 10th of Ramadan. Accordingly, rivalry in the sector is growing, which enhances market efficiency but simultaneously exerts pressure on operators to improve service quality and efficiency.

- The customer base of Egyptian dry ports consists mainly of importers, exporters, shipping companies, and industrial zones. These actors possess a reasonable degree of bargaining power, as alternatives such as direct use of seaports or inland trucking remain available. However, the integrated services provided by dry ports, including inland customs clearance and storage, reduce buyer leverage by lowering trade cycle times and operational costs. As the number of dry ports increases, buyers will gain more options, thereby enhancing their power. Nevertheless, competition among dry ports is expected to shift the focus toward service quality and efficiency, mitigating the influence of buyer dominance.
- The operation of Egyptian dry ports heavily depends on infrastructure and service providers, particularly the national railway operator, which holds a monopoly over container rail transport. This reliance grants suppliers relative leverage, as disruptions in the railway network directly affect dry port efficiency. Additionally, rising fuel prices and infrastructure costs place further pressure on operations. However, state intervention through fuel subsidies, infrastructure development, and expansion plans helps to limit supplier dominance. Consequently, supplier power in the sector can be considered moderate: it is strengthened by the lack of alternatives yet partially constrained by government regulation and ongoing investment.
- Several alternatives to dry ports exist, including direct reliance on seaports, logistics centers within industrial zones, and warehousing facilities near factories. Nevertheless, these substitutes are often constrained by congestion, delays, and high demurrage fees, which reduce their effectiveness compared to dry ports. Technological solutions, such as e-clearance and supply chain digitalization, provide partial substitution but cannot fully replace the role of dry ports. Given Egypt's geographical position—with inland industrial hubs located far from seaports—dry ports remain a strategic and indispensable complement to seaports. Therefore, the threat of substitutes is moderate and largely dependent on improvements in seaport operations and digital logistics systems.
- The dry port sector in Egypt faces a low-to-moderate threat of new entrants due to the presence of high financial and regulatory barriers. Establishing a dry port requires substantial capital investment in infrastructure, rail connections, and land, which raises the threshold for entry. Nonetheless, government initiatives such as Public-Private Partnerships (PPP) encourage private sector participation, with projects like the 6th Of October ( El Sweedy) dry port and others in Fayoum, Sadat, Obour, Tor, and Qena being opened to investors. Non-financial hurdles, including customs approvals and coordination with multiple agencies, further slow entry. Thus, while opportunities remain for financially and operationally strong logistics players, the overall threat of new entrants is constrained, keeping market entry limited to capable investors aligned with Egypt's Vision 2030.

Based on the results, the researcher proposes a set of recommendations aimed to enhancing the efficiency of this sector and strengthening its competitive capacity, as follows:

- Given the intensifying competition among existing and planned dry ports, it is recommended to promote integration rather than mere rivalry by establishing mechanisms for coordination among facilities and linking them effectively to national

transport networks. The government should also develop balanced pricing and service policies that prevent monopolistic practices while ensuring service quality and diversity tailored to different industrial zones.

- As importers, exporters, and industrial zones gain increasing bargaining power with the expansion of dry ports, it is recommended to diversify value-added services (such as e-clearance, smart storage, and digital tracking solutions) to reduce customer leverage. Moreover, improving the customer experience through streamlined procedures and shorter trade cycles will help shift competition toward quality and speed rather than price alone.
- Since the primary suppliers are the national railway operator and fuel providers, the study recommends expanding multimodal transport options to reduce dependency on a single supplier, including developing river transport and engaging the private sector in operating additional routes. Furthermore, government efforts to stabilize fuel prices and infrastructure investments should be reinforced to mitigate supplier dominance and ensure the sustainable operation of dry ports.
- Given the availability of substitutes such as direct seaports and industrial warehouses, it is recommended to strengthen the competitive advantage of dry ports by accelerating customs clearance and adopting digital logistics systems (e.g., e-clearance and smart supply chain platforms). Additionally, enhancing integration with seaports will reduce congestion and position dry ports as strategic support nodes rather than mere alternatives.
- Since the threat of new entrants is low-to-moderate, it is recommended to establish clear and transparent regulatory frameworks that attract local and foreign investment while maintaining market stability. Public-Private Partnership (PPP) mechanisms should be further enhanced with financial and operational incentives to ensure the participation of only highly capable investors, thereby boosting sector competitiveness and supporting Egypt's Vision 2030 to become a regional logistics hub.

## 8. CONCLUSION

This study aimed to analyze the role of Egyptian dry ports in enhancing logistics corridors from economic, environmental, and logistical perspectives. The analysis demonstrated that dry ports contribute to improving trade competitiveness by reducing transportation costs, expanding seaport hinterlands, and increasing the efficiency of cargo distribution to industrial regions. Environmentally, dry ports support cleaner logistics operations by reducing truck congestion, lowering fuel consumption, and promoting modal shifts toward rail-based transport. Logistically, they enhance supply chain connectivity and reduce clearance and handling times.

With respect to the research objectives, the findings show that competition among existing and planned dry ports is gradually intensifying, encouraging operators to improve service quality and integration with multimodal networks. The threat of new entrants remains moderate due to financial and regulatory barriers, although public-private partnership initiatives are opening new spaces for investment. Supplier power—particularly that of the rail operator—remains significant, but ongoing infrastructure development is contributing to a more balanced logistics ecosystem. Customer bargaining power is increasing as more dry ports come online, reinforcing the need to offer value-added and time-efficient services. Meanwhile, substitutes such as direct trucking or seaport-based clearance remain viable but less efficient compared to integrated dry port systems, particularly in inland industrial regions.

Overall, the study confirms that dry ports represent a strategic tool for strengthening Egypt's logistics corridors and advancing national development goals. Realizing their full

potential, however, requires continued investment in multimodal infrastructure, digital customs systems, and sustainable environmental practices, alongside coordinated policy frameworks that align dry port operations with broader trade and transport strategies.

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