Spatial Analysis of River Freight Transport in Egypt

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Abstract
The Nile River has long been vital to Egypt, shaping its history and serving as the main transportation route for the ancient Egyptians. This study explores how the river continues to play a key role in transporting goods in modern Egypt. It examines the importance of the country's river transportation system in moving goods. Using the Geographic Information Systems (GIS) and statistical analysis, it examines the distribution patterns, infrastructure utilization, and regional disparities within the river transport network. The findings underscore a worrying trend of declining volumes of goods transported by the river, which now account for less than 0.5% of Egypt's total goods transport. This is particularly pronounced in specific commodities, such as agricultural, industrial, and mining goods, where coal, food products, stones, grains, and clay dominate over 90% of river trade. Notably, the port of Alexandria is emerging as a major hub for the procurement and distribution of goods via river transport, along with El-Metras and El-Nahda ports. The ports of Upper Egypt and the Delta region together handle a maximum of 10% of the total cargo volume, divided into 4% for Upper Egypt and 6% for the Delta ports. Responding to these findings, the study calls for the urgent development of river transport infrastructure. Recognizing its multiple direct and indirect benefits, the study stresses the necessity of enhancing this infrastructure and integrating it into a multifaceted transportation system. Such endeavors are essential to increase the attractiveness of river transport for investment, thereby promoting economic growth in Egypt.

Keywords: ***Spatial Analysis; Freight Transport; River Ports;*** **and** ***Nile River*****.**

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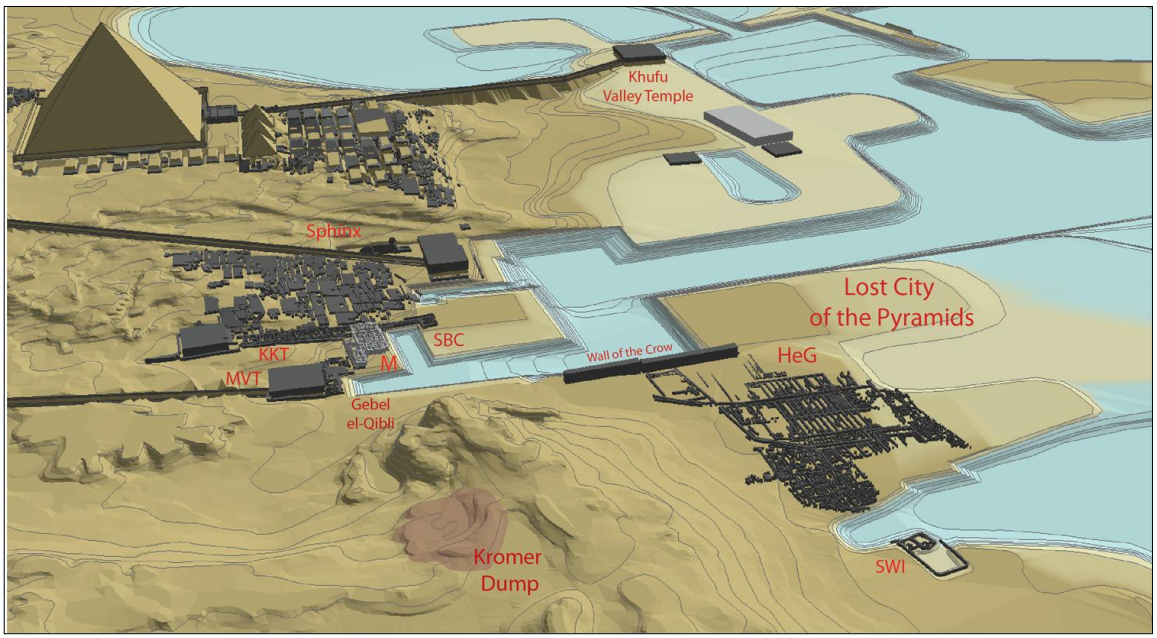
1- Introduction

The Nile River has played a significant role in shaping and prospering Egypt throughout the ages, to the extent that Egypt is often referred to as the "gift of the Nile.” In the Pharaonic era, granite stones were transported along the Nile from Aswan to Saqqara in Cairo for the construction of the Step Pyramid (JICA, 2012). Not only the Step Pyramid but later the Giza Pyramids, which are currently more than eight kilometers away from the river, had their stones transported across the Nile. The existence of ancient river ports in the pyramid area has been proven., and research projects on the Giza Plateau have been able to redraw the landscape during the construction of the Giza Pyramids.

These studies have uncovered compelling evidence supporting the existence of a man-made harbor in Giza (Fig. 1), a pivotal element in the construction of the Giza Pyramids. The significance of this harbor lies in its essential role in transporting the massive granite and limestone blocks via ships across the river. The designated delivery area was strategically positioned in front of Khafre's temple and the Sphinx statue (Lehner, 2013). Furthermore, there are discernible remnants of numerous water basins and channels, now concealed beneath the disposition of Nile mud throughout thousands of years. These features, excavated by ancient Egyptians in the floodplain west of the Nile, serve as remnants of their efforts to establish a river port (Lehner, 2014).



Source: Lehner, 2019

Fig 1: Lost Giza Pyramids Harbor Heritage

The Nile's importance to ancient Egyptian civilization went beyond mere river transport; it was a dominant force that shaped the Egyptians' way of life. The Nile meticulously structured Egyptian existence into three distinct seasons. The Flooding Season, spanning from July to October, marked a time when laborers were engaged in civil endeavors such as enhancing dams and channels, or monumental construction projects such as the pyramids. This was followed by the agricultural season, which began with the receding of floodwaters and the diversion of water from fields to ponds and channels. This phase involved plowing the land and sowing seeds. The third season, the Harvest Season, unfolded during the dry period from March to July (Smith, 2018). During the Ptolemaic era, essential grains, especially wheat, followed a route from the fields to local warehouses in the villages, facilitated by pack animals. This cargo would then continue its journey to the nearest river ports, embarking on a voyage along the river to the port of Alexandria (El-Sawi, 2003).

In Roman times, the Egyptians dredged the Trajan Canal to establish a connection between the Nile and the Red Sea. Additionally, they constructed numerous ports along the Nile, such as those in Esna, Aswan, and Qeft, to efficiently regulate transportation and trade operations. Towards the close of the Roman era, following the Arab conquest of Egypt, the Trajan Canal, which had been closed since the Roman period, was reopened and renamed the Gulf of Amir al-Mu'minin in Medina, Arabia, and became an important conduit for transporting crops to Al Qulzam (now Suez). Subsequently, ships carried these commodities to Jeddah and Yanbu, where they were then transported overland to Mecca and Medina. The decision to reopen the canal was prompted by Caliph Omar ibn al-Khattab, who directed Amr ibn al-Aas to expedite the sea transport of wheat and grains instead of relying on camel caravans. Ships, with a capacity equivalent to a full camel caravan, were considered faster in delivering supplies to the Hijaz region, thanks to favorable winds and ship sails.

During the reign of Muhammad Ali and his successors, there were notable advancements in inland water transport. Al-Riyah Al-Minufi, Al-Tawfiqi, and Al-Bahiri. These efforts significantly strengthened river navigation, solidifying its dominance in goods transportation until the advent of railways during the reign of Khedive Ismail in various parts of Egypt.

In the latter years of Khedive Ismail's reign, these waterways were placed under international supervision, and their revenues were used to pay off debts. As a result, they enjoyed protection from competition, particularly against water transport, maintaining dominance for decades. The government imposed heavy taxes and fees on water transport, adversely affecting the state of river navigation and making it impractical in many regions (Abu El-Atta, 1994).

Even though railways have become a strong competitor to river transportation, river transportation has continued to play a pivotal role in goods transportation in Egypt. This persisted until the significant development of roads, which provided door-to-door

transportation. Consequently, the role of the river in cargo transportation became symbolic, limited to certain commodities for which the economics of river transport were essential. However, its representation has dwindled to merely symbolic, accounting for less than one percent of the total domestic goods transported in Egypt.

2- Literature Review

The exploration of river transportation has received considerable attention in various studies, emphasizing its historical importance and potential. Mohammed Riad's work (1974) stands out prominently, offering a geographical perspective. The fourth chapter addresses Egyptian maritime navigation principles, river ports, and harbors, while the sixth chapter delves into the fundamentals of river transport and its challenges across diverse geographical regions.

Saeed Abdo's comprehensive study (1990) covers the characteristics of the river, river ports, the river fleet, and river transport movements from 1978 to 1987, examining key challenges. Magdy El-Sersy's focus (1997) narrows to the river transport network in the Nile Delta, covering its characteristics, river ports, the economics of river transport, challenges, and its role in passenger and tourist transportation. Reham Ezz El-Din's study (2010) comprehensively addresses river transport in Egypt, encompassing navigational passages, elements of river transport, cargo and passenger movements, and challenges.

Beyond geography, diverse disciplines have contributed to diagnosing issues in river transport and enhancing efficiency. El Sersawy's work (2005) evaluates primary river channels' dimensions in Egypt and compares methodologies for designing navigational channels. El Nakib's study (2006) provides an overview of inland water transport in Egypt, emphasizing challenges and obstacles hindering logistical service development. Younis et al.'s (2011) study explores optimal container ship sizes on the Nile, taking into account navigation characteristics, and proposing a self-made container ship design. Mahdaly and Selmy's

study (2019) highlights the significance of the VTS ship services system in monitoring ship traffic for safety and efficiency in river navigation.

Institutionally, the Japan International Cooperation Agency (JICA) and the Arab Academy for Science, Technology, and Maritime Transport (AAST) have made significant contributions. JICA 's 2003 study provided a thorough analysis of Egypt's inland water transport system, while in 2012, JICA conducted a comprehensive study on Egyptian transportation, with one of its chapters focusing specifically on river transport. AAST's detailed study focuses on the river transport system, aiming to contribute to its development, covering river ports, characteristics, and improvement plans.

Considering the lack of a detailed study on freight transport movement, particularly in the last decade, and with road transport dominating the majority of goods in Egypt, this study seeks to highlight the pivotal role of river transport, which has historically served as the lifeblood of Egypt's transportation system.

3- Research Questions

This study seeks to explore a pivotal inquiry:

To what extent does river transportation contribute to the flow of goods in Egypt? This overarching question is broken down into several sub-questions:

What components make up the river transport system in Egypt more successful?

What percentage of domestically transported goods in Egypt can be attributed to river transport?

Which key goods are primarily transported by river, and what factors determine the preference for this mode of transportation?

Which river ports in Egypt are most important and which are less important? In what ways can Egypt optimize its share of domestically transported goods through its river?

4- Objectives of the Study

This study aimed to:

- Identify the components of the Egyptian river transport system.
- Quantify the contribution of river transport to the movement of goods in Egypt.
- Study of the movement of goods transported by river in Egypt.
- Propose a visionary plan to enhance the share of goods transported by river in Egypt.

5- The Data and Study Method

This study employed an objective method, concentrating on a specific topic, namely the transportation of goods, and applied a systems analysis approach, treating river transport as a system with several components, each of which influences the quality and efficiency of the system. The study procedure unfolds as follows:

5.1- Data Collection: We collected several datasets from various authorities, encompassing goods transported across the river at different annual, quarterly, and monthly levels. Historical data were included to identify patterns and trends in the movement of goods by river in Egypt. These datasets covered various aspects of the river transport system, including navigation routes, ports, and port operators.

For spatial data, we incorporated diverse layers such as waterways, river ports, seaports, roads, railways, industrial zones, and dry ports. These spatial data layers were prepared using maps from Google Earth and OpenStreetMap.

5.2- Geospatial and Statistical Analysis: Spatial analysis techniques such as Geographic Information Systems (GIS) are employed to analyze and spatially represent freight transport data. This includes mapping, creating spatial layers, and spatial analysis to identify movement patterns and influencing factors. Also, statistical methods are used to analyze data and spatial relationships among variables of freight movement.

5.3- Visualization and Mapping: The study used GIS techniques to represent freight movement data, with various Thematic Maps illustrating different study phenomena.

The study employed several software programs, including ArcGIS 10.8.1, Global Mapper, Google Earth Pro, and Microsoft, to process and present study data.

6- Results and Discussion

6.1- Components of River Transport System in Egypt

6.1.1- The Navigation Network in Egypt

There are four main navigable waterways in Egypt: the Nile River from Cairo to Aswan, the Al-Riyah Al-Bahary and Nubariya Canal, the Damietta Branch, and the Ismailia Canal. Overall, the country's river transport network comprises 2,635 kilometers of navigable waterways, of which approximately 65% are located in the southern region and the remaining 35% in the northern region.

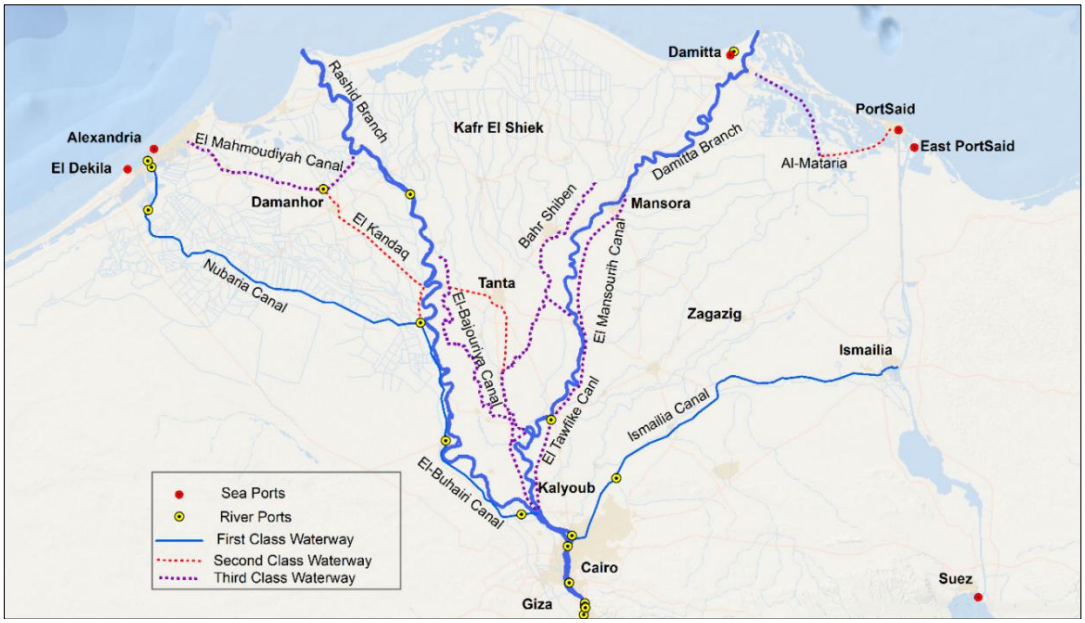


Fig 2: Inland Waterways in the Nile Delta

According to JICA (2012), navigation channels in Egypt are systematically classified into three orders based on their navigation specifications:

First-order channels: These channels have a minimum width of 35 meters, a minimum water depth of 2.5 meters, and a draft of 1.8 meters. Most of the extensive network falls under this category, covering 2,145 kilometers and accounting for 81 percent of the total navigation channels.

Second-order channels: Characterized by a minimum channel width of 12 meters, a water depth of 1.8 meters, and a draft of 1.5 meters. This category is limited to a few selected navigation canals in the Nile Delta, including the Khandak El-Sharqi Canal, the Tanta Navigational Canal, and the Port Said/Matariya Canal, with a total length of only 121 kilometers.

Third-order channels: Embodied by the Ibrahimia Canal and Bahar Yusuf, with a total length of 369 kilometers. These channels have a minimum width of 8 meters, a water depth of 1.25 meters, and a draft of one meter. Notable locations in the Nile Delta covered by these channels include Damietta/Matariya, Al-Riyah Al-Monofia/Bahr Shebin, Al-Riyah Al-Tawfiki/ Mansouria Canal, and El-Bajouria Canal.

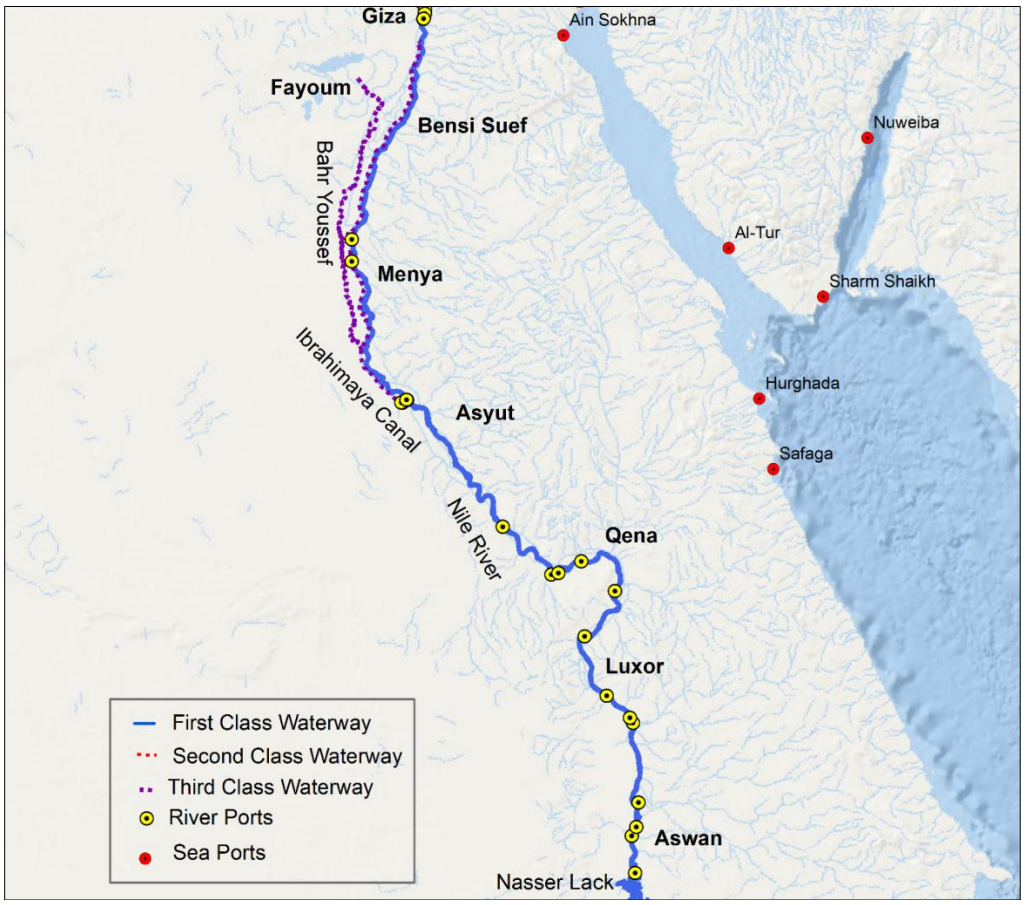


Fig 3: Inland Waterways in the Nile Delta

The navigation channel in Egypt encounters a series of artificial obstacles, manifesting as engineering structures lining the river from its source in Aswan to its mouth in the Mediterranean Sea. Below is a comprehensive overview of these impediments along the four main navigation routes:

Cairo/Aswan Navigational Route: This route has a total of 21 bridges, including 3 movable bridges. It is considered the least obstructed navigational pathway, it encounters obstacles, on average, every 46.7 kilometers.

Ismailia Canal: The Ismailia Canal stands out as the most congested sector, marked by bridges and viaducts that impede navigation. A total of 59 bridges and viaducts contribute to an

obstacle approximately every 2.2 kilometers. Consequently, the Ismailia Canal represents one of the slowest sectors in terms of navigation.

Damietta Branch: In the Damietta Branch, obstacles are present at a frequency of approximately one obstacle every 10 kilometers. The Cairo/Damietta navigation route comprises a total of 24 bridges, including 11 movable bridges and 4 viaducts.

Cairo-Alexandria Route via Al-Riyah Al-Bahary/Nubariya Canal: The obstacle frequency on this route, traversing the Al-Riyah Al-Bahary and Nubariya Canal, is approximately one obstacle every 6.7 kilometers.

Table 1: Egypt's Navigational Waterways Properties

No	Region	Waterway	Stretch		Order	Length (KM)	Width (KM)	Min Depth (M)	Min Draft (M)	Bridges Number	Locks Number
			from	to							
1	Nasser Lake	Aswan High Dam/ Wadi Halfa	El Sed ElAli	Wadi Halfa	1st	350	>35	2.5	1.8	-	-
2	Nile Valley	Aswan/Cairo	Aswan	Detta Barrage		980				24	3
3		Ibrahimia Canal	Asyut	Malawi	3rd	80	> 8	1.25	1.0	17	2
4		Bahr Youssef	Dairut	El Lahun		289				18	4
5	Nile Delta	Beheriy Canal	Entrance Lock	El Nubaria (Boulin)	1st	84	> 35	2.5	1.8	6	2
6		Nubaria Canal	Boulin	Alexandria		121				21	5
7		Damietta Branch	Delta Barrage	Mediterranean Sea		241				16	3
8		Ismailia Canal	Cairo	Ismailia		128				34	8
9		Rashid Branch	Delta Barrage	Mediterranean Sea		241				6	3
10		El khandal Elsharki Canal	Boluin	Mahmoudi Canal	2nd	56	> 12	1.8	1.5	10	3
11		Tanta Navigational Canal	Tanta Lock	Daljamon Lock		37				10	3
12		Port Said / El-Matariya	Port Said	Matariya		28				1	--
13		Damietta / El-Matariya	Damietta	Matariya	3rd	34	>8	1.25	1.0	-	-
14		El Riyah El Minufi / Bahr Shibin	Delta Barrage	Bahr Shibin		134					
15		El Riyah El Tawfiki / Mansouria Canal	Delta Barrage	Mansoura		107					
16		El Bajouria Canal	El Riyah El Minufi	Rashid branch		86					

Source: Jica, 2012

6.1.2 Ports

River ports are a cornerstone of Egypt's river transportation system. The 1960s marked a substantial surge in the establishment of these ports. Previously, the banks of the main river channel and its tributary canals served as docking points for river transport vessels. Subsequently, a number of river ports were established,

including Iron and Steel Port, Kima in Aswan, as well as ports in Aswan, Esna, Luxor, and Qena along the Nile. Other ports include Athar al-Nabi Port in Cairo, the Iron and Steel Port in Tebbin, and the Embaba Silos Port. Initially, these ports had docks elevated 6-8 meters above the Nilewater level to cope with higher floods. However, after the construction of the High Dam, this elevation posed a challenge to loading and unloading operations at these ports.

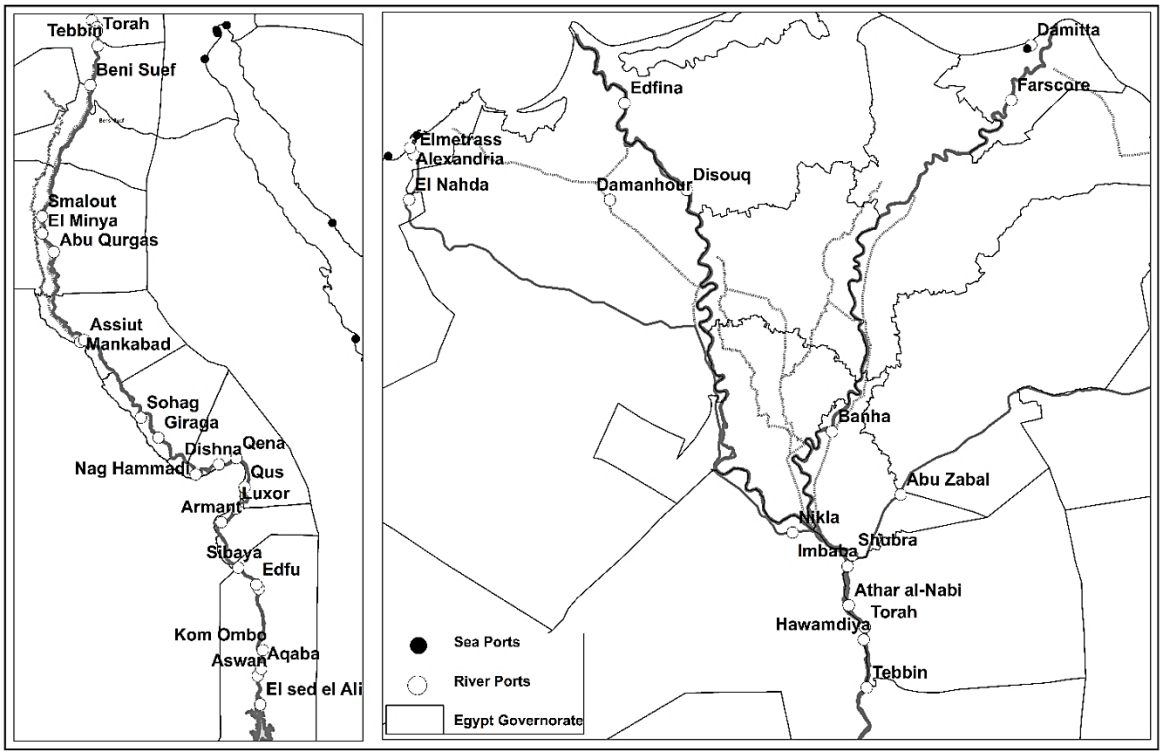


Fig 4: Main River Ports in Egypt

Currently, Egypt has a total of 44 river ports: 16 in the Nile Delta and 28 in Upper Egypt. This indicates that the number of ports in Upper Egypt is nearly double that in the Nile Delta., in addition to 10 berths, eight of which are dedicated to the loading and unloading of petroleum. Furthermore, two berths are positioned in the Al Khatatba and Al-Mahmoudia Canal area in Alexandria, specifically designated for the handling of sand and gravel. Most of the river ports in Egypt are privately owned and

associated with factories, companies, and silos located along the riverbanks. State ownership is limited to a few, such as the Port of Athar al-Nabi in Cairo and the Renaissance Port on the Nubariya Canal. Both were established by the General Authority for River Transport to serve as barging ports. Interestingly, many river ports in Egypt find alternative applications beyond their designated functions. Notably, ports such as Luxor, Idfu, and Qena have been transformed into berths catering to tourist ships. The Athar al-Nabi's Impact in Cairo has encountered challenges from urban encroachment, curtailing its operational capacity. Furthermore, the activities of additional ports, including Al-Metras in Alexandria, Iron and Steel in Tebbin, and the Aswan River Port, have declined due to the cessation of iron ore extraction from the Aswan mines (Arab Academy for Science, Technology, and Maritime Transport, p. 4).

6.1.3 Fleet

The river units involved in domestic cargo transportation show a diversity between those belonging to the public sector and those operating in the private sector. As of 2018, their total number amounted to 452 units. Notably, half of these units possessed a cargo capacity of no more than 10 tons, and the majority did not surpass 100 tons. The maximum load capacity for any vessel was capped at 600 tons, with only three vessels exceeding this limit.

Shifting the focus to the private sector involvement, it comprised 281 units, with only 100 exceeding the 100-ton threshold. Notably, only 16 vessels had a cargo capacity exceeding 600 tons (CAPMAS, 2021).

6.1.4 Management Overview

In 1979, the General Authority for River Transport was instituted through Presidential Decree No. 474 with the mandate to oversee all river transport activities in the Arab Republic of Egypt. Its multifaceted responsibilities include the supervision of all river transport initiatives, the issuance of licenses for river vessels, and the execution of purification and enhancement efforts for internal navigational channels and basins, along with their ongoing maintenance.

The Authority plays a key role in defining navigation routes, identifying basins and public docks, and formulating regulations for their use. At the same time, a large number of private sector

enterprises and factories actively administer most river ports for their exclusive benefit, as illustrated in the following table.

Table 2: Categorization of River Ports in Egypt Based on Their Affiliation

Sector	Owner	Ports	Properties
Public	The General Authority for River Transport	Al-Nahda	Established in 1967 as a transshipment port for retail docks in Alexandria.
		Athar al-Nabi	Many parts of it have been seized
		Luxor	It serves as berths for tourist ships.
		Qena	Privilege for the Nile Heavy Transport Company.
		Aswan	It operates as a taxi stand.
		Al-Tebbin	Used for transporting petroleum products (mazut – diesel). It also serves as a dock for loading and unloading dry materials.
Private	Sugar Companies	Kom Ombo Idfu Armant Qus Dishna Nag Hammadi Girga Al-Hawamidiya	It operates in receiving sugar cane, transporting molasses, and delivering sugar raw materials to refining factories
	Iron, Steel, and Coke Companies	Al-Tebbin Al-Mutarras	Its activity dwindled following the discontinuation of iron ore extraction from the Aswan mines.
	Aluminum Company	Naj Hammadi Al-Ma'sarah Al-Mutarras	Currently, it serves as storage facilities, handling 90% of the transportation for both raw aluminum and aluminum products by roads.
	Imbaba Silos Company	Imbaba Silos	The predominant mode of transporting crops is now roads
	Cement Factories	Assiut Helwan Portland Tura	Most of the cement is currently transported by roads.

Source: AAST study

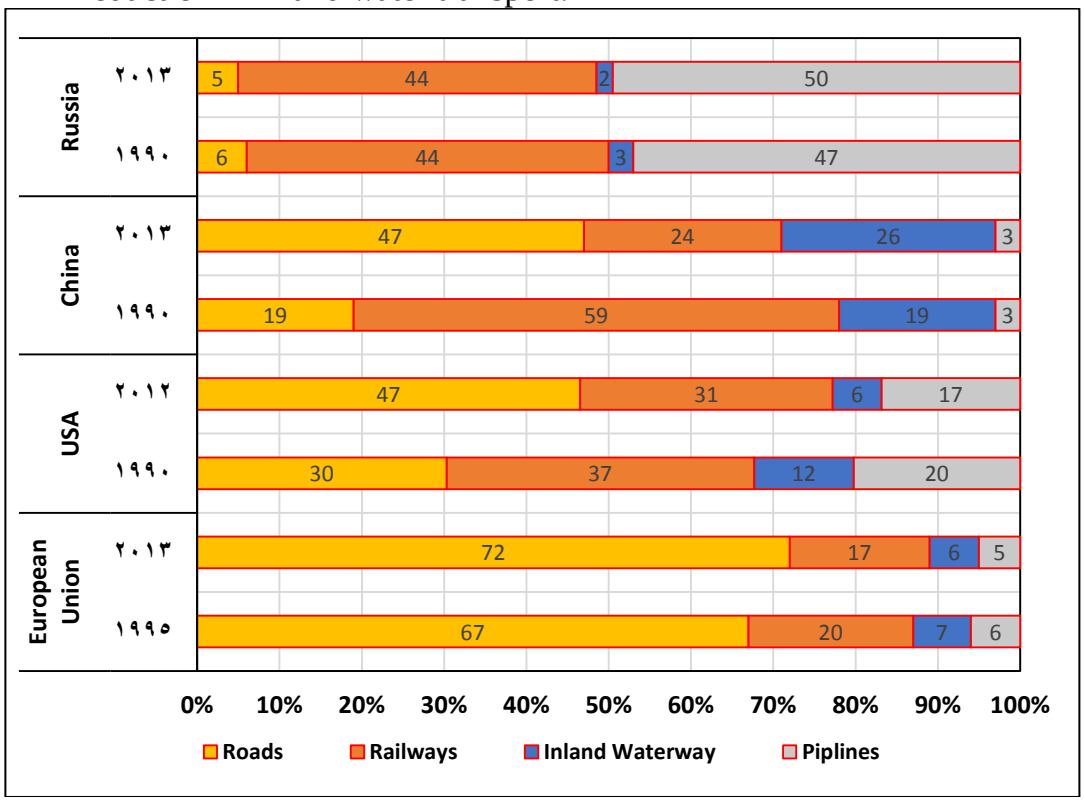
6.2 The Share of River Freight Transport in Egypt

Transportation through waterways offers numerous advantages, notably a substantial decrease in energy consumption. For example, transporting one ton by river over 550 kilometers requires only five liters of fuel. In contrast, these five liters are insufficient to transport one ton by air beyond 7 kilometers or by road beyond 100 kilometers using trucks. Moreover, river transportation plays a pivotal role in reducing emissions, noise, and accidents on a per-ton/kilometer basis. It stands out as the safest method for transporting hazardous goods. The river transport system seamlessly integrates into multi-modal supply chains. Beyond alleviating road congestion, it surpasses the capacity of 45 freight trucks or 40 railway wagons, as a single vessel with a 1200-ton capacity can manage the same load. Consequently, river transport not only yields environmental benefits but also plays a key role in reducing road congestion.

Furthermore, river transport has many positive social impacts. When assessing the environmental footprint per ton transported via rivers, it becomes evident that river transport has a lower environmental impact. Recent European data highlights that the environmental performance per ton/kilometer is superior in water transport compared to other modes of transportation. Ship emissions contribute only 10% of carbon dioxide (CO_2) emissions when compared to trucks, along with 13% of nitrogen oxides (NOx) and 5% of particulate matter (PM). In the United States, statistics reveal that waterborne ton-miles contribute only 8% to carbon dioxide emissions from trucks, 4% to nitrogen oxides, and 25% to particulate matter on highways (Aritua et al., 2021; Protopapas et al., 2013).

Despite the significance of river transport, technological advances and substantial improvements in paved roads and railways have significantly increased their performance, turning them into formidable competitors for river transport. In the last decades of the twentieth century, Europe has witnessed a trend

characterized by a rise in road usage, a decline in railways, and a reduction in inland water transport.



Source: Wiegmans& Konings, 2016

Fig 5: The Share of Transportation Modes in Major Global Regions

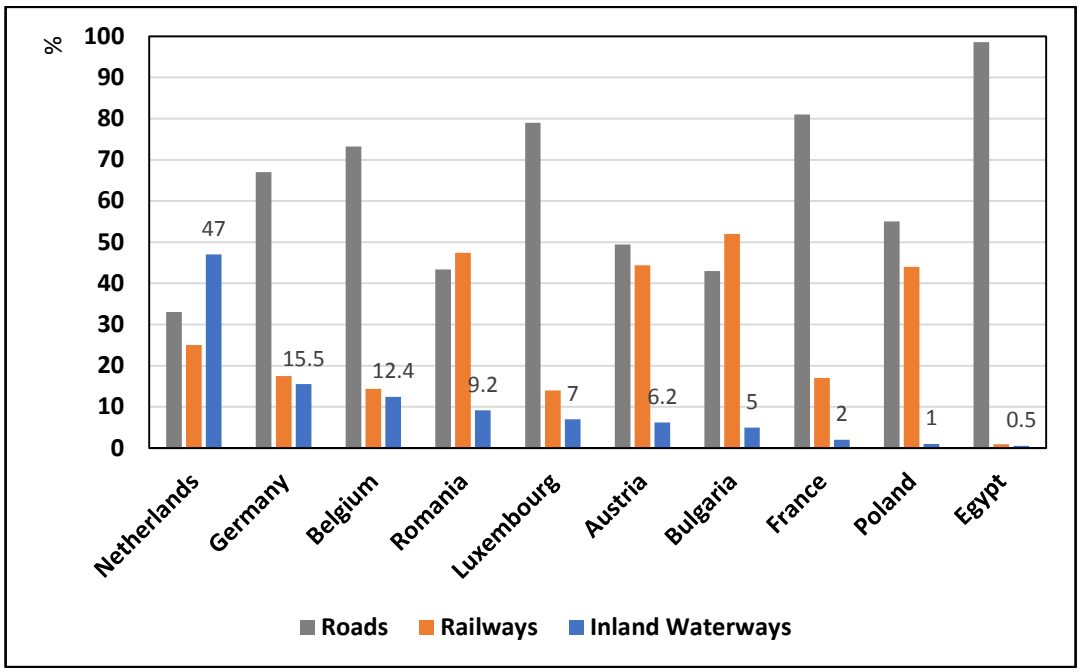
However, the landscape varies in Russia and China, both of which have witnessed a notable uptick in the prominence of water transport. In Russia, half of the goods are currently transported by waterways, while the other half uses alternative transportation methods. The annual volume of goods moved through inland water transport in Russia has reached a substantial 120 million tons. The primary water arteries in Russia are predominantly found in the European part, with the Volga River, stretching approximately 3530 km, taking precedence. Meanwhile, in China, the cargo volume transported on the Yangtze River has increased from 106,000 twenty-foot equivalent units (TEUs) in 1990 to an

impressive 19.6 million TEUs in 2018. This represents a more than 180-fold increase in river transport volume within 30 years, setting a record that solidifies the Yangtze River as the world's leading waterway in terms of transported goods volume. China has excelled in efficiently moving substantial quantities via water transport, reaching around 3.74 billion tons in 2018.

In general, six rivers worldwide annually transport over 100 million tons. Three of these are in China: the Yangtze, which carries 2,200 million tons; the Pearl River, which carries 662 million tons; and the Grand Canal, which carries 345 million tons. The remaining three are the Rhine in Europe, which carries330 million tons; the Mississippi in North America, which carries285 million tons; and the Mekong in Southeast Asia, which carries132 million tons, mostly in Vietnam (Aritua et al., 2021, p. 8). In contrast, large river systems such as the Amazon, Nile, Ganges, and Volga, surrounded by populous regions, carry minimal amounts of goods relative to the economic size of the countries where they are situated.

Despite the decrease in the share of inland water transport in many European countries due to strong competition, especially from trucks that provide door-to-door services, European Commission's strategy for achieving zero emission by 2050 involves actively shifting 75% of the goods currently transported by roads to rail and water transport (Aritua et al., 2021).

Comparing Egypt to several other countries with extensive waterways, such as some European Union nations, it is clear that Egypt has not yet fully exploited the potential of the Nile River for freight transport. The share of river transport in Egypt barely exceeds half a percent of the total domestically transported goods. In contrast, the share of river transport has reached 47% in the Netherlands, 15.5% in Germany and 12.5% in Belgium. Notably, these countries do not have waterways comparable in size to those in Egypt.



Source: Eurostat (2022)., JICA (2012).

Fig 6: Distribution of Goods Among Transportation Modes in Egypt and Comparable Countries

I wish that river transport in Egypt had maintained its share of goods. The amount of transported goods had decreased both in terms of quantity and relative weight compared to the total amount of goods transported in Egypt. Let's consider an example: In 1979, Egypt internally transported a total of 83 million tons of goods, of which 4.3 million tons were transported by river, constituting about 5.2% of the total goods volume. In 2010, after about 40 years, the share of river transport was halved to about 2.2 million tons. Meanwhile, the volume of domestically transported goods in Egypt had increased to 439 million tons, which means that the volume of goods has multiplied more than five times. The volume of transported goods has been halved, and its relative weight is now only half a percent of the total goods, after initially accounting for5% (JICA, 2012).

The decline in the share of goods transported by river is not the primary concern. The more pressing issue is the dominance of road

transport, accounting for 98.6% of the total domestically transported goods in Egypt. The role of railways has dwindled to approximately 0.9%, and river transport to a mere 0.5%. The ramifications of this dominance manifest in environmental pollution, traffic congestion, rising accident rates, and the rapid deterioration of road infrastructure. Furthermore, there is an indirect fallout on the degradation of river and railway transport infrastructure, as an overwhelmingly disproportionate share of investments has been funneled into the road sector. While recent attention has been focused on improving these two modes of transportation, there is an urgent need for a comprehensive, long-term plan that is resilient to changes in leadership.

6.3 River Freight Movement in Egypt

6.3.1 Annual River Freight Movement

The volume of goods transported by the river between 1991 and 2020 exhibits notable year-to-year fluctuations (Fig. 7). These variations may manifest as considerable declines, as witnessed between 2002 and 2006, or substantial leaps, as observed in 2019. Nevertheless, the prevailing feature of river transport performance is its irregularity.

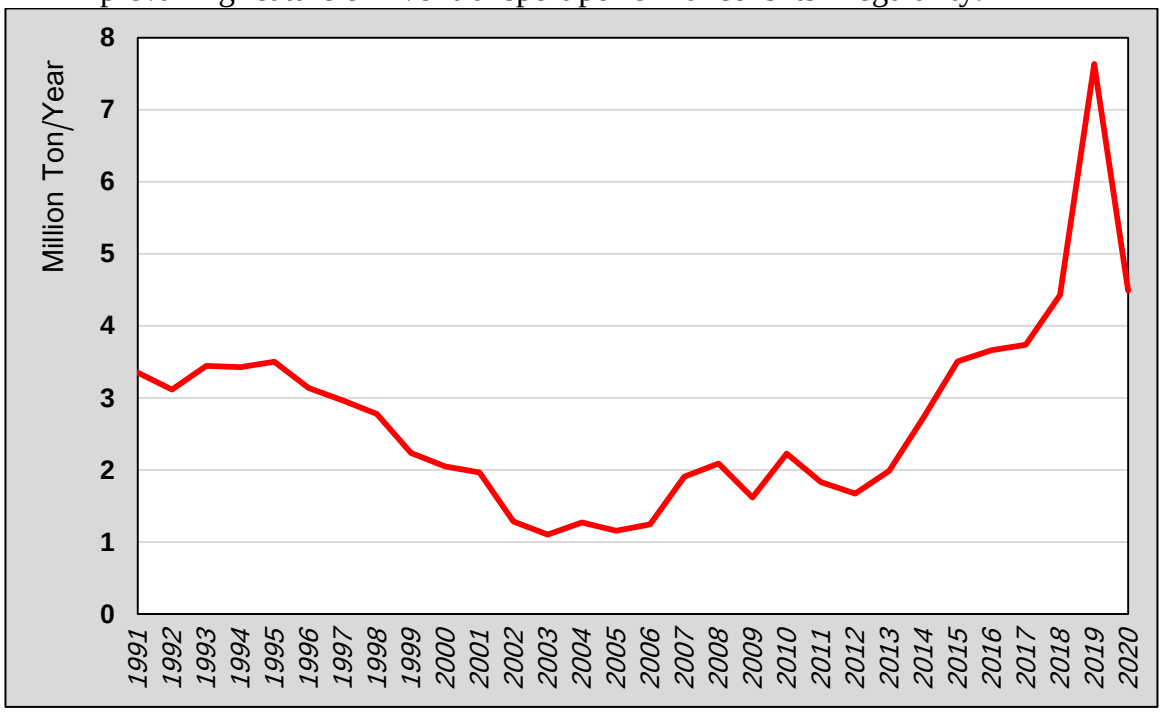


Fig 7: Development of Egypt River Freight Volume between 1991-2020.

Examining the preceding chart reveals a pronounced decline in the volume of river-borne cargo between 2001 and 2006, plummeting to a mere 1.3 million tons. This substantial reduction is ascribed to the diminished conveyance of various commodities, encompassing petroleum products, sand, gravel, coal, and sugar. Furthermore, the transportation of grains via river routes came to a complete standstill during this period.

Since 2007, the river transportation of freight has exhibited a continuous upward trend, surpassing the threshold of 2 million tons annually. In 2018, it exceeded 4 million tons annually for the first time in decades. The peak in 2019 marked a historic milestone, surpassing 9 million tons, due to a notable increase in the quantities of specific transported goods. The substantial resurgence of coal imports, driven by the escalating demand for industrial operations and electricity generation, alongside stones and food products, played a pivotal role in this significant increase. In 2020, however, river transport witnessed a decline, approaching 4.5 million tons, primarily due to the profound impact of the COVID-19 pandemic and the protracted lockdown period, which extended beyond three months.

When scrutinizing the yearly evolution of commodity movement over the last three decades, we find that eight specific commodities serve as the backbone of river transport in Egypt. These key commodities include coal, stone, food products, molasses, petroleum, and clay. However, in the last five years, several goods have experienced a notable surge in river transport quantities compared to others. Notably, coal, food products, and grains witnessed significant increases. Conversely, certain goods experienced substantial declines in transported quantities, most notably petroleum products, phosphates, clinker, and aluminum products.

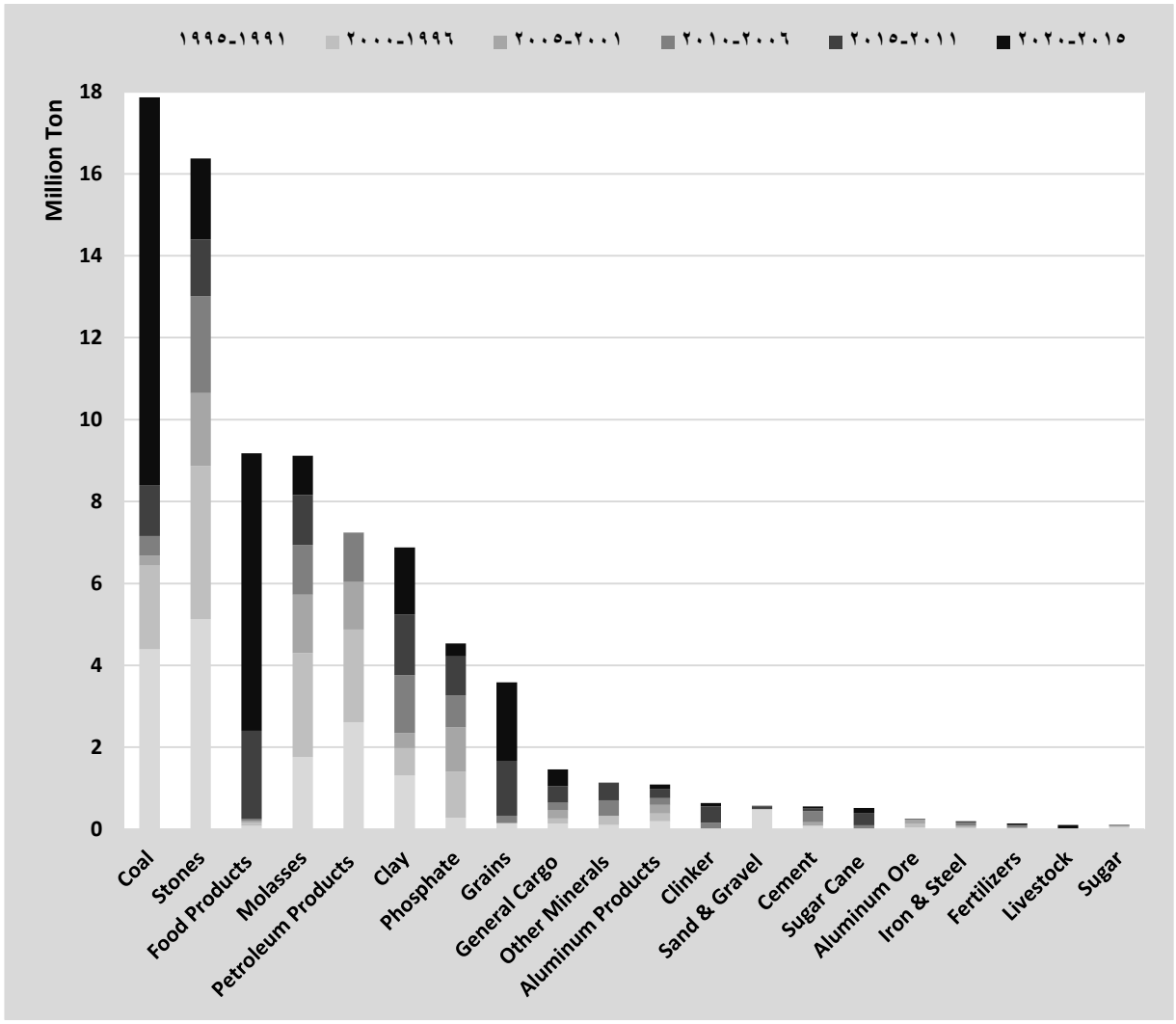


Fig 8: River Freight Volume at 5-Year Intervals from 1991 to 2020.

6.3.2 Monthly River Freight Movement

In a broader context, the peak of river-borne cargo activity is generally observed in the months of May, July, and September, while the lowest occurs in November, January, and March (Fig. 9). The initial quarter of the year remains the least active period for river transportation of goods, primarily due to the winter water

blockage season in Egypt, spanning from December 24 to February 3. During this period, water levels in the Nile and canals recede to facilitate essential maintenance of water canals.

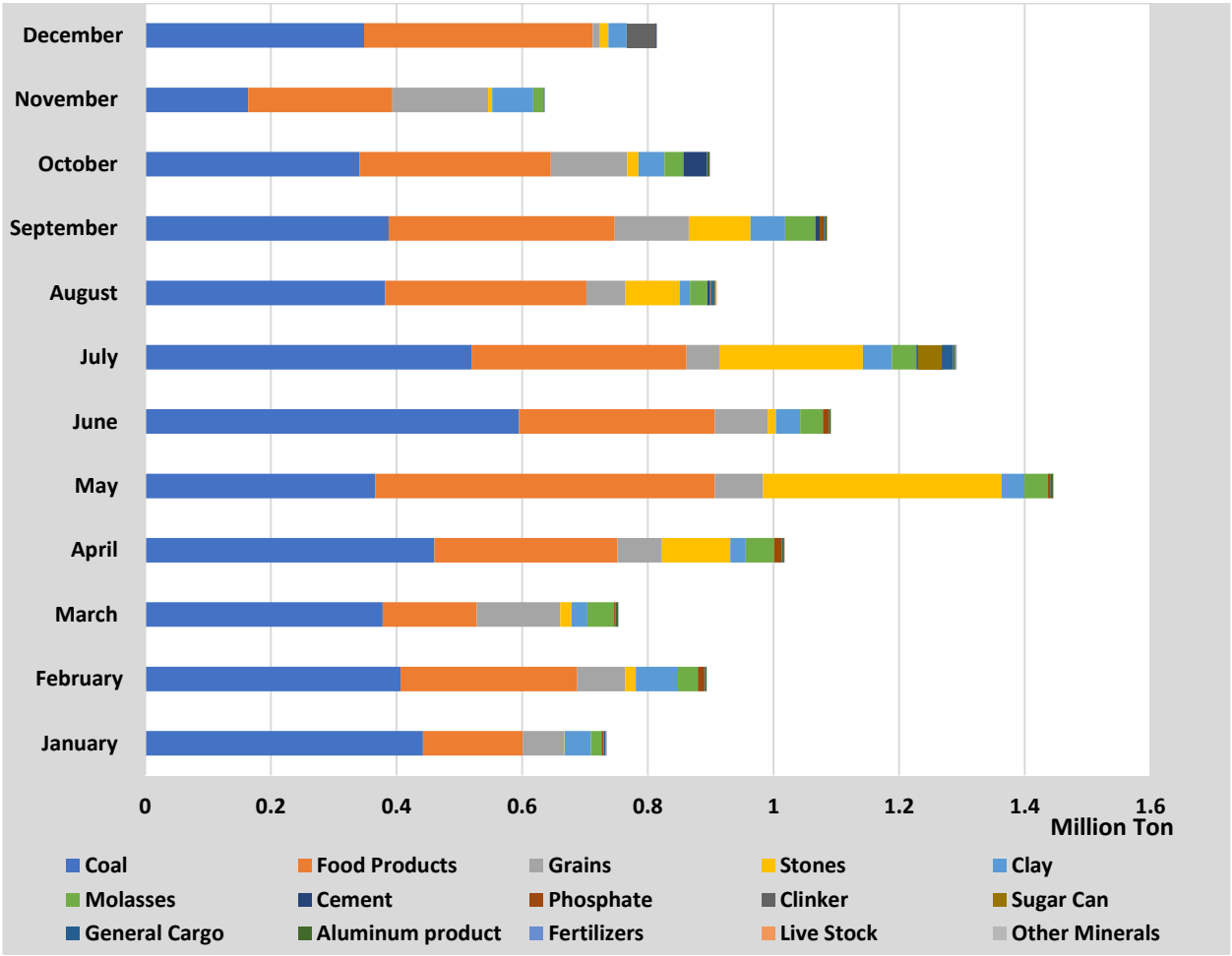


Fig 9: Monthly River Freight Volume in Years2019-2020.

Regarding the goods, there are some that are consistently transported throughout the year, while others have a seasonal concentration. Among the perennially transported commodities, coal takes prominence, experiencing heightened demand in June and July, and a decline in November. Similarly, stones maintain a steady demand, particularly during June and July, with reduced quantities transported during the winter months of January and

December. Food products, on the other hand, traverse the river throughout the entire year, but there is a notable surge in May. In terms of seasonal goods, agricultural products like sugarcane are concentrated in July, livestock in August, and cement becomes more prominent during the summer months.

6.3.3 Freight Movement According to River Port Operators

There are five primary operators currently overseeing the transportation of goods via the Nile in Egypt, as shown in Table 3:

- The National River Transport Company (formerly known as the River Transport Company), which was established in 1963 as an Arab joint-stock company, changed its affiliations, transitioning from various ministries. In 2009, the Maritime Industries and Services Authority under the Ministry of Defense acquired the company, subsequently renaming it the National Nile River Transport Company, replacing the former General Nile River Transport Company.

This company has docks for the efficient loading and unloading of petroleum products and dry bulk cargo at various river ports, such as Nahda, Tebbin, Shubra Al-Khaimah, Minya, Qena, and Aswan. It effectively commands nearly half of the river-borne cargo, with key transported commodities encompassing wheat, coal, phosphate, clinker, ferrosilicon, and limestone.

- The private sector, consisting of a diverse range of companies, contributes significantly to the river-borne cargo, accounting for an average share of approximately 26% from 2016 to 2020. This sector offers a diverse range of products, with a notable focus on clay and stones.

Table 3: Quantity of Goods Transported, Measured in Tons, Categorized by Major Operators.

Port Operator	2016	2017	2018	2019	2020	Total 2016-2020	%
River Transport Company	2458536	2625898	2243165	1949298	1304798	10581695	42.8
Private sector	595844	592779	1965567	1716475	1546426	6417091	26.0
Al Qalaa Company	230805	197463	531612	1377355	1396926	3734161	15.1
Governmental	34904	18635	28232	2467988	39500	2589259	10.5
Sugar companies	251519	222078	230545	244558	161527	1110227	4.5
Nile Valley Company	36994	46702	13787	36032	28518	162033	0.7
Business sector	35916	28123	11958	22288	9405	107690	0.4
Others	15005	3184	2357	0	0	20546	0.1
Total	3659523	3734862	5027223	7813994	4487100	24722702	100.0

Source: RTA, 2020

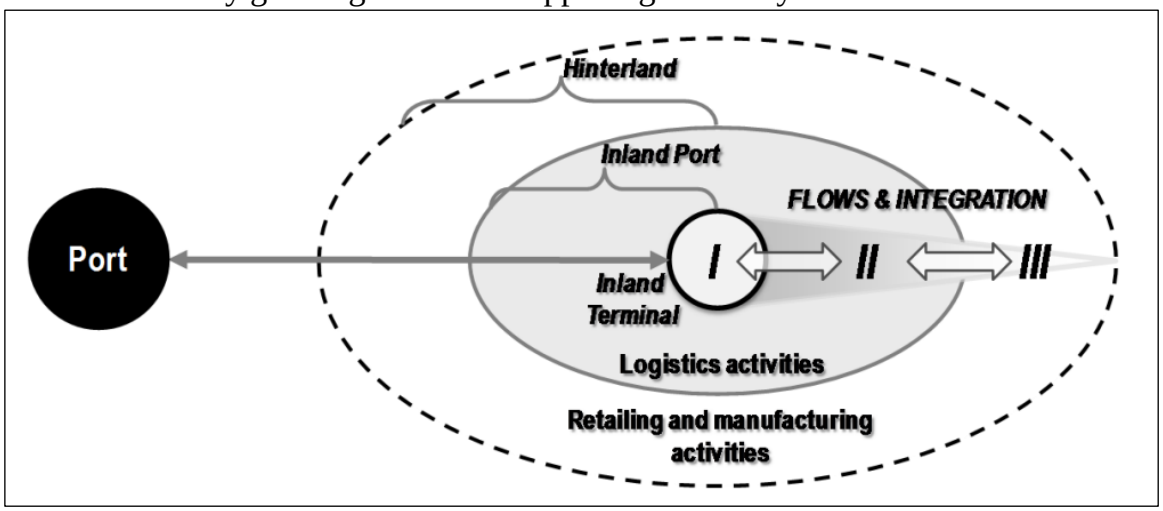
- Al-Qalaa Company is a holding company with investments in 15 countries and a wide range of industries, encompassing transportation and logistics, among others. Its subsidiary, Nile Logistics, specializes in innovative river transportation solutions. The company boasts a fleet of barges operating in Egypt, Sudan, and South Sudan (Al-Qalaa Holding, 2021). The volume of goods transported through Al-Qalaa Company experienced significant growth. From a modest 6% in 2016, its share surged to approximately 31% of the total river-borne cargo by 2020. Specialization appears to be a key factor in enhancing the company's market share. While the company initially handled a wide range of products, it has narrowed its scope since 2016, focusing primarily on coal, food products, and selected other minerals (RTA, 2017).
- The government and the business sector transport specific goods, including food products, grains, phosphate, and aluminum, with the total share of goods transported not exceeding 11%. The year 2019 witnessed a peak in government-owned cargo, accounting for 18% of the overall river-borne shipments. This surge can be attributed to a significant shift of large quantities of grains and food products for river transportation.

- The Nile Valley Authority, a joint Egyptian-Sudanese entity, is engaged in cargo and passenger transportation between the El-Sed El-Aali Port in Aswan and Wadi Halfa Port. Enjoying exclusive privileges, it serves as the sole international carrier on Lake Nasser. The authority operates with six mechanical units dedicated to transporting goods between the two ports, boasting a combined capacity of 2,100 tons per trip. The quantity of goods transported by river between Egypt and Sudan is considerably modest in contrast to the overall trade volume between the two nations, averaging no more than 50,000 tons annually from 2016 to 2019. Although there was a surge in transported goods in 2020, reaching 162,000 tons, this still constitutes less than 1% of the total river transportation. The value remains relatively limited when compared to the overall traded goods between Egypt and Sudan. Egypt primarily imports livestock from Sudan through river transport, while it exports a range of products, including fertilizers, cement, general cargo, and food products, to Sudan through the same means.
- Sugar companies focus on transporting their core commodities, including molasses and sugarcane, in addition to general cargo. In 2019, molasses alone represented a significant portion, making up 82% of their total shipments. These companies transport molasses from the sugar factories in the Nile Valley to the refining factory in Al-Hawamdiya.

6.3.4 Freight Movement between River Ports

Inland ports have changed a lot and become very important for logistics and development, as shown in Fig 10. They use advanced technology to make their operations more efficient. These ports have centers where they handle containers well and use robots to work faster. They also improve how goods move around inside the port. They focus on security and the environment to run the port better. They keep trying new ideas to make technology better. They also provide services like customs and training to help workers do their jobs better.

Inefficient port operations slow down trade by making it more expensive and less competitive. Ports and their connections to roads and railways are crucial for global trade. How well ports work, the quality of their buildings, and how they clear goods affect trade costs, how competitive they are, and how much the economy can grow. These things can turn ports from helping trade to making it harder, so it's important to fix problems to keep the economy growing and trade happening smoothly around the world.



Source: Rodrigue et al., 2010

Fig 10 Functionality of Modern Inland Port

The current number of Egyptian river ports is about 44; however, many of these ports are essentially docks that lack additional infrastructure. For example, ferry boats, which carry vehicles loaded with goods, are considered part of the river cargo. Nevertheless, they do not actively participate in river port trade. They function more like other river bridges, facilitating the movement of individuals and goods between the two riverbanks and serving no additional purpose.

Table 4: The Tonnage of Freight Exchanged through River Ports during the Period from 2016 to 2020.

Port	Freight by Ton					
	2017	**2018**	**2019**	**2020**	**Total**	**%**
Alexandria	1506980	1773989	2419544	2065177	9195430	**37.1**
Al-Mitaras	1161744	1194114	1699825	1458984	6420388	**25.9**
Al-Nahda	114532.5	541879	683575.5	549929	2371485	**9.6**
Imbaba	296	161081	769465	53222.5	986173	**4**
El Minya	225968	364762	7753	7153.5	635521.5	**2.6**
Al-Hawamdiya/Masara	118335	97969	114339	85450.5	525555.5	**2.1**
Nakla/Al-Manashy	0	91512	356007.5	19750	467269.5	**1.9**
Idfina	0	47500	409500	0	457000	**1.8**
Shubra	197845.5	53887.5	56222	27375.5	425380	**1.7**
Smalut	64764.5	134736	43590.5	0	373330	**1.5**
Al-Tabin	72233.5	35088.5	42490.5	31950.5	300433	**1.2**
Nag Hammadi	15108	214150	14873	14460.5	278711	**1.1**
Idfu	59094	46037.5	64714.5	36927	277026	**1.1**
Aswan	72629	48451.5	36447.5	23274.5	209557	**0.8**
Sabaiya	62612	12729.5	19774.5	4201	161141	**0.6**
Kom Ombo	36888	33037	28945.5	22133	150570	**0.6**
Armant	26463.5	22566	25941	21598	121512.5	**0.5**
Qus	18334	11434.5	17940.5	32051.5	98929.5	**0.4**
El sed el Ali	23351	6893.5	18016.5	14259	81017	**0.3**
Abu Qurqas	0	72000	275.5	0	72275.5	**0.3**
Wadi Halfa	23351	6893.5	18016	1407.5	68165	**0.3**
Deshna	2128.5	11192.5	23547	1533	6698.5	**0.2**
Damietta	2150	2100	2228	8446	24210.5	**0.1**
Aqaba	2995	6050	495	490	19683	**0.1**
Qena	3095	10817	10	100	14022	**0.1**
Luxor	2915.5	2053.5	497.5	245	11699.5	**0**
Tora	2300	1300	0	0	11125	**0**
Deir Mawas	0	7677.5	104.5	0	7782	**0**
Gerga	753.5	678.5	782	11	7155	**0**
Asyut	22.5	706.5	0	96	2825	**0**
Helwan/Kafr	400	900	0	0	1300	**0**
Sohag	7.5	617.5	55.5	0	680.5	**0**
Abu Tasht	0	0	635	0	635	**0**
Banha	0	419	0	0	419	**0**
Another	0	0	938437	0	944432.5	**3.8**
Total	**3817155**	**5019202**	**7815068**	**4480990**	**24792954**	**100**

Source: RTA, 2020.

The table emphasizes that the Port of Alexandria dominates river-borne cargo, functioning as the primary hub for both exports and imports via the river, comprising 37% of the total volume. On the other hand, the port of Damietta, although linked to river transport through its branch, it plays a minor role, handling slightly more than 1% of the cargo volume. This limited share persists despite concerted efforts to enhance river transport from Damietta, such as improvements to the river port and navigation in the Damietta branch.

The Port of Al-Metras is situated in the immediate hinterland of the Port of Alexandria, allowing it to handle a substantial share of goods, surpassing a quarter of the volume transported by river. Acting as a crucial intermediary, Metras Port connects Alexandria with overland transportation routes, facilitating the transfer of goods from Alexandria to Al-Metras and onward via land transport.

Al Nahda Port is situated on the eastern bank of the Nubaria Canal, boasting a shoreline of 431 meters and covering approximately 55,621 square meters. It includes a quay that spans 132 meters in length and features a concrete depth of 50 meters. Ranking as the second-largest river port by total cargo volume, Al Nahda Port handles upwards of half a million tons annually, constituting about 9% of the total annual cargo. Administratively, it is under the management of the National Nile River Transport Company.

When classifying Egypt's river ports according to their specialization in handling specific commodities, several patterns emerge. Ports such as Minya, Samalout, Luxor, and Tebbin focus on handling stones, with Tebbin Port historically significant due to its association with the now-closed Nasr Coke Factory, leading to a decline in its activities post-2022, restricting it to stone reception. Other ports, such as Damietta and Imbaba, specialize in grain trading and boast silos for storage. Meanwhile, ports like Armant, Qus, Abu Tisch, Idfu, Girga, and Kom Ombo cater to specific commodities. Ports in Damanhur and Damietta specialize in food products, while provincial capitals manage general goods alongside ferry ports facilitating truck transport across Nile banks, including Abu Qirqas, East Abu Qirqas, East and West Beni Mazar, East and West Deir Mawas, East and West Minya, East and West Mallawi, East and West Qena, and Farskor.

Beyond these, ports such as the High Dam Port handle diverse trade, including fertilizers, general goods, and minerals, alongside Wadi Halfa Port in Sudan. Metras Port handles coal, phosphates, grain, and food products, whereas Naj Hammadi Port focuses on aluminum, general goods, and food products.

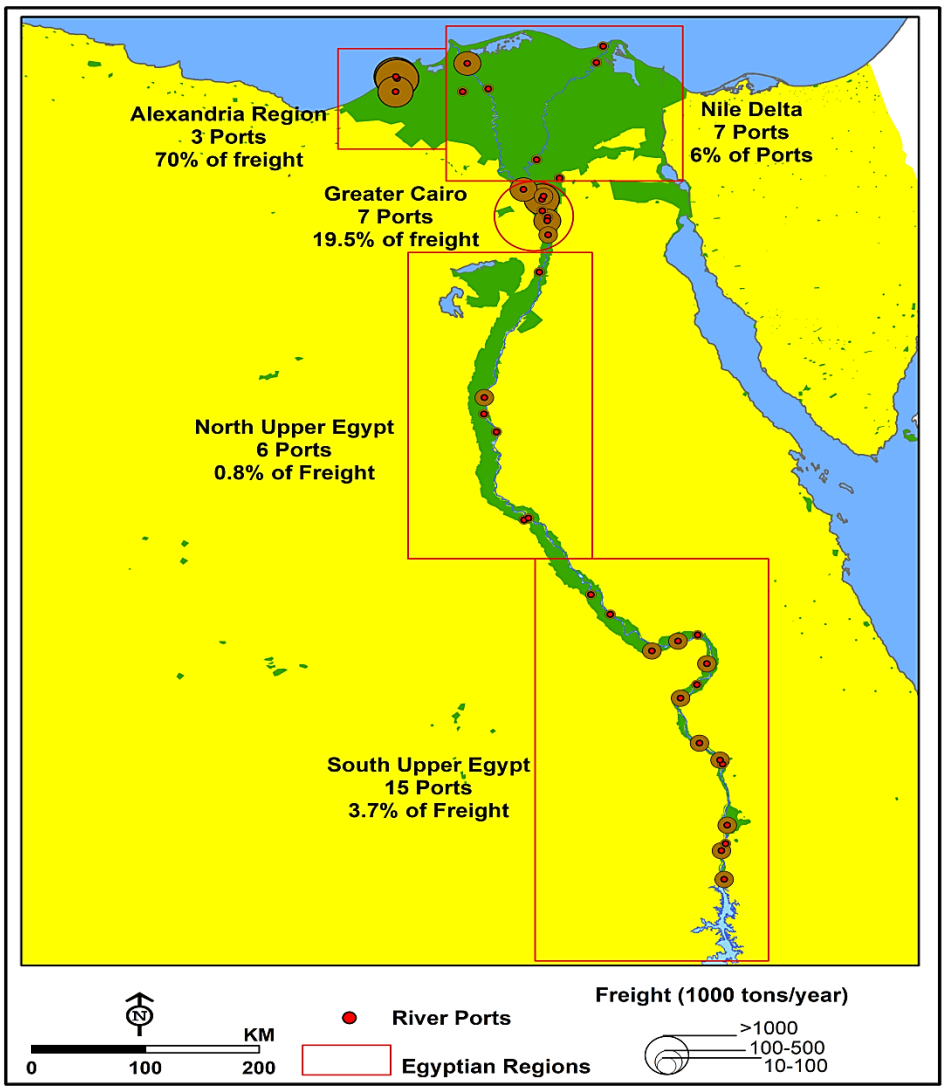


Fig 11: Egyptian Region's Share of River Ports and Freight in 2019

Regionally, as shown in Fig 11, the Alexandria region dominates river transport, with ports such as Alexandria, Metras, and Al Nahda together handling about 70% of the total cargo. The Greater Cairo region follows, handling around 20% of the cargo. Together, the Greater Cairo-Alexandria axis accounts for 90% of all river transport activity, leaving the rest of the country's ports with the remaining share. Upper Egypt manages less than 4% of the total cargo volume, while the Nile Delta handles less than 6%.

6.3.4 River Freight Movement According to Its Type

In this section, we explore the transportation of goods categorized by type, recognizing that the volume of cargo transported varies depending on the specific type of goods, as demonstrated in Table(4).

Table 5: Nile River Fright from 2016 to 2020 by Ton

Type	2016	2017	2018	2019	2020	Total	%
Coal	1289918	1536472	1845109	2627825	2162632	9461956	**38.27**
Food Products	839684	842763	1175248	2698682	1215451	6771828	**27.39**
Stones	281324	143818	260797	1202681	86591	1975211	**7.99**
Grains	313154	286509	290494	393989	632555	1916701	**7.75**
Clay	298416	446902	404641	297994	189050	1637003	**6.62**
Molasses	203044	221076	182659	201083	153193	961055	**3.89**
Ferry Boats	0	0	600397	180493	0	780890	**3.16**
General Cargo	174469	58796	142766	22753	8324	407108	**1.65**
Phosphate	123648	125224	25459	39549	8402	322282	**1.30**
Sugar Cane	47557	47557	37434	38168	0	170716	**0.69**
Aluminum Products	35874	27753	11830	21777	9072	106306	**0.43**
Clinker	0	0	35418	46088	0	81506	**0.33**
Livestock	27779	37315	10015	4948	0	80057	**0.32**
Cement	0	1870	1500	35280	16851	55501	**0.22**
Fertilizers	3253	5063	2006	1603	4979	16904	**0.07**
Sand and Gravel	11900	391	0	0	0	12291	**0.05**
Other Minerals	8180	0	1450	1081	0	10711	**0.04**
Sugar	900	285	0	0	0	1185	**0.00**
Raw Aluminum	423	126	0	0	0	549	**0.00**
Iron & Steel	0	499	0	0	0	499	**0.00**
Total	**3659523**	**3734862**	**5027223**	**7813994**	**4487100**	**24722702**	**100.00**

Source: RTA, 2020.

Analyzing the data from the preceding table, the following observations come to light:

The data indicates that only five commodities, including coal, food products, stones, grains, and petroleum, accounted for roughly 90% of the goods transported via the Nile River between 2016 and 2020. Conversely, the remaining fifteen commodities together account for only 10% of the total transported goods.

Coal is emerging as the primary cargo transported along the Nile River in Egypt. Between 2016 and 2020, coal constituted 38.3% of the total goods transported, roughly equating to two-fifths of the total. Remarkably, coal shipments consistently surpassed one million tons each year, reaching over two million tons by 2018. Even amidst the 2020 closure prompted by the COVID-19 pandemic, and the overall decline in river transport from 7.8 million tons to 4.5 million tons, coal's volume did not decrease at the same rate as other goods, resulting in coal solely accounting for half of the total transported goods in 2020.

This surge in coal transport via the river is attributed to Egypt's expanded utilization of coal across various sectors. In 2014, the Egyptian cabinet approved the use of coal in the cement industry, followed by an amendment two years later to incorporate coal in electricity generation as well.

After coal, food products stand out as the river's second most significant commodities in trade. Before 2013, food items held minimal sway in the river's cargo transport landscape. In 2012, the total volume of food products transported amounted to just 18,621 tons, representing only 1% of the total transported goods. However, the quantity of food products transported via the river began to surge from 2013 onward, reaching 2.7 million tons in 2019. This accounted for approximately 34.5% of the total goods transported via the river during that year, and approximately 27% of the total goods transported during the period 2016-2020. This upward trend can be attributed to the Ministry of Supply and Internal Trade's directive to transport food commodities via the Nile River for distribution to various governorates.

Stones are significant commodities that are widely transported by the Nile River. Their Large in size coupled with their comparatively low value renders river transport an optimal choice. Among these stones, limestone holds particular importance, sourced from quarries in Minya and Samalout, alongside granite and marble extracted from quarries in Aswan and Luxor.

Source: https://ats4rt.wordpress.com/

Fig12. River Barges Transport Limestone along the Nile River

Grains are experiencing a notable surge in river transportation volumes, with the amount doubling from 300,000 tons to over 600,000 tons between 2016 and 2020. This uptick occurred despite a significant decrease in overall freight transported in 2020 compared to the previous year. This increase can be attributed to two primary factors: firstly, the rise in imported grain quantities, particularly wheat, aimed at bolstering strategic grain reserves. Secondly, the expansion of efforts by the Ministry of Supply and Internal Trade to transport grain via river channels.

When it comes to clay, it serves a variety of industries, notably ceramics& Cement. Aswan emerges as a significant extraction hub

for clay, with a considerable portion of Aswan's clay transported to the port of Shabra. Conversely, imported clay primarily enters through the port of Alexandria and is subsequently transported via the river to the adjacent port of Al-Metrass. From there, it is transported overland to its final destination.

Certain commodities, notably petroleum products, have been removed from the roster of goods transported via the river, with their river transportation coming to a complete halt since 2012. Moreover, several other commodities, including iron, steel, sand, gravel, aluminum ore, and sugar, have experienced a notable decrease in river transport volumes.

6.4 Conclusion and Recommendations

The Nile River has been a cornerstone in the history of Egypt, shaping its geography and fostering the growth of its civilization. Historically, the river was a vital artery for transportation, with stones for the pyramids ferried from southern Egypt to Giza and grains shipped to the royal storages in Alexandria. During the reign of the Muhammad Ali dynasty, river transport saw significant advancements, including the construction of numerous canals and bridges. However, the advent of railways in Egypt drastically reduced the reliance on river transport for goods. With the continued development of land transport, trucks have emerged as the preferred method for moving goods across Egypt, largely due to a greater emphasis on road infrastructure over railways and river transport.

Despite Egypt's extensive network of navigable waterways, spanning over 2,600 kilometers with more than 80% classified as first-class (over 35 meters wide, with water depths exceeding 2.5 meters and draughts over 1.8 meters), these channels have not significantly increased the volume of goods transported by river. This is primarily due to numerous obstacles along the waterways, including over 162 bridges and more than 36 locks, which reduce the speed of river transport and extend journey times. Additionally, navigation on the river is limited to daylight hours due to the absence of lighting and navigation aids for night travel.

The situation is similarly challenging for the ports. Although there are around 44 river ports in Egypt, many exist only as geographical locations or names without any substantial activity in river transport. Some have been repurposed, while others are used for non-transport activities. Many of the operational river ports are merely docks for receiving ships and lack advanced equipment for loading and unloading. Furthermore, most of the river fleet's ships have limited capacity; in 2018, no ship had a load capacity exceeding 600 tons. This is small compared to river ships in many countries that rely heavily on river transport, where capacities can reach up to 10,000 tons, such as in China.

This situation has led to a continuous decline in the share of river transport for goods in Egypt. By 2010, it had decreased to about 2.2 million tons, representing only 0.5% of the total goods transported domestically, down from 5.2% in 1979. This is in stark contrast to the global trend, where many countries, including China, have significantly increased their reliance on river transport. China now has three rivers each transporting over 100 million tons annually. The European Union is working to shift goods from road to rail and water transport to achieve zero emissions by 2050, and the Netherlands transports about 47% of its goods via inland waterways.

The decline of river transport in Egypt is primarily due to decades of neglect and lack of development. This has resulted in numerous direct and indirect consequences, including higher prices for goods transported by trucks rather than river, higher road maintenance costs, and a rise in the number of accidents. Although the government has offered many sites for investment as river ports to the private sector, the river transport sector remains unattractive to investors compared to other sectors such as road transport, due to significant infrastructure deficiencies.

Recent government policies have significantly increased the volume of goods transported by river, which jumped to 7.8 million tons in 2019—nearly tripling from 2010 to 2019. This growth was driven by the transportation of food supplies via the river and the expanded use of coal for electricity generation in industries such as

ceramics and cement. However, the volume of goods transported by river quickly declines again in 2020, falling to 4.5 million tons due to the COVID-19 pandemic and the subsequent lockdowns.

Although these government policies have temporarily increased the volume of goods transported by river, they act as a temporary fix. Once these policies are withdrawn, river transport returns to its previous state. This increase does not indicate an improvement in the infrastructure of river transport or its attractiveness to investors; rather, it is the result of direct government intervention.

Despite the variety of goods transported by river, including agricultural products, mining materials, and raw materials - about20 different commodities-just five accounted for over 90% of the total river transport volume in 2019. These five commodities were coal (33.6%), food products (34%), stones (15.4%), grains (5%), and clay (3.8%). Some of these goods, such as food products and grains, are transported by river due to government mandates, while others, like coal, stones, and clay, are moved because of the economic advantages of scale.

Even though the Nile River is crucial for economic integration between Egypt and Sudan, river transport plays a minor role in the trade volume between the two countries. The amount of goods transported by river between them did not exceed 200,000 tons, consisting mainly of livestock, fertilizers, and cement.

This study highlights key recommendations, such as:

- Strengthening the pivotal roles of river and railway transportation.

In the strategic planning of Egypt's transportation network, it is crucial to account for the country's geographical characteristics. Given its extensive longitudinal stretch, a transportation system integrating both river and rail elements is imperative. The significant investments in constructing roads on both sides of the Nile within the valley, while representing a financial burden, may not align with strategic foresight, overlooking economic principles related to distance.

Communicating with all transportation planners in Egypt becomes essential, emphasizing that the country's topography

highlights the preference for length in river and rail networks, while the width is more suited for routes. The current challenge of internal competition prompts reflection: should we persist in building competing infrastructures, risking inefficiencies and losses, or succumbing to negligence and non-development, leading to the deterioration of existing facilities?

To navigate this dilemma, adopting a comprehensive regional perspective is paramount. Extensive planning, coupled with a long-term vision, can provide the remedy needed to steer away from internal competition, fostering a more cohesive and sustainable transportation infrastructure for Egypt.

-Facilitating River Transportation Infrastructure:

Establishing a robust infrastructure for river transportation to attract diverse investments. Notably, the Chinese government's approach went beyond mere infrastructure development. In response to reluctance from banks and the private sector due to associated risks, the government undertook strategic measures. These included the replacement of outdated vessels with modern ones, the enhancement of internal ports, and the establishment of a dedicated fund for domestic water transportation under centralized governance. The internal ports boast 21,748 ship berths, capable of accommodating vessels with a capacity of up to 10,000 tons (Aritua, 2021).

-Revitalizing Modern Internal Ports:

Transforming internal ports into dynamic hubs that serve not only as storage facilities but also integrate various logistical activities, manufacturing, packaging, and more.

-Integrating River Ports with Transportation Networks:

Creating a seamless integration of the river port network with roads and railways for comprehensive connectivity.

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التحليل المكاني لحركة النقل النهري للبضائع في مصر

ملخص

لعب نهر النيل دورا كبيرا في تاريخ مصر وتحديد جغرافيتها وساهم بشكل فعال في بناء حضارتها وعمل كوسيلة رئيسية للنقل عند المصريين القدماء. وتهدف هذه الدراسة إلى توضيح الدور الحالي للنهر في حركة نقل البضائع داخل مصر. وتناولت الدراسة شبكة النقل النهري في مصر، محللة مكوناتها، وحصة النقل النهري من البضائع، وحركة البضائع المنقولة نهريا، وقد تم تجميع العديد من البيانات من الهيئات المختلفة، ثم تم معالجة هذه البيانات وتحليلها وتمثيلها بيانيا وكارتوجرافيا بما يخدم اهداف الدراسة، وقد توصلت الدراسة الي تضاءل حجم البضائع المنقولة نهريا والذي لم يعد يتجاوز ٠.٥% من اجمالي البضائع المنقولة في مصر والتي اقتصرت علي بضائع بعينها عبارة عن سلع ومواد خام زراعية وصناعية وتعدينية وقد شكل الفحم والسلع الغذائية والاحجار والحبوب والطفلة أكثر من ٩٠% من اجمالي المتداول، وكان ميناء الاسكندرية البحري هو المنبع والمصب الاكثر تأثيرا في النقل النهري كما شكلت موانئ المتراس والنهضة النسبة الاكبر من البضائع المنقولة في مصر في حين لم تتجاوز موانئ الصعيد والدلتا أكثر من ١٠% من جملة البضائع المتداولة منها ٤% للصعيد و٦% لموانئ الدلتا. وقد أوصت الدراسة بضرورة تطوير مرفق النقل النهري لما له من فوائد مباشرة وغير مباشرة وذلك من خلال تطوير البنية التحتية للنقل النهري وربطة بمنظومة النقل متعددة الوسائط وجعلة أكثر جاذبية للاستثمار.

الكلمات المفتاحية: التحليل المكاني، نقل البضائع، الموانئ النهرية، نهر النيل.