The International Maritime Transport and Logistics (MARLOG 13) - ISSN 2974-3141
http://dx.doi.org/10.21622/MARLOG.2024.13.1.79
Towards Smart Green Blue Infrastructure

The Efficiency of River Port Logistics and its Role in Improving Inland Water Transport Operations in Egypt

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ABSTRACT

Transport via inland waterways, especially river transport, has gained geostrategic importance in recent years due to the significant economic savings and environmental sustainability it achieves. The cost of logistics in river transport is 7% of the cost of land transport and 50% of the cost of rail transport. Although river transport is the most environmentally sustainable among the various means of transport, rivers are still the least developed in many countries, including Egypt, (Rivera, et al., 2022). Effective river navigation requires maintaining the river's flow and ensuring its smoothness by carrying out dredging operations to maintain a depth that ensures safe navigation. In the river, in addition to the ease of crossing barriers, there are dams and bridges along the rivers.

River transport also suffers from several infrastructure problems, including ports and docks, a shortage of container terminals, and the lack of fueling stations along the river course because of low investment rates, in addition to the difficulty of finalizing licenses and equipment. River units are not subjected to international supervision and classification societies throughout their construction stages.

Keywords: Inland water transport, River transport, River ports, Rivers logistics, Intra-trade, Rivers sustainability, RIS system.

INTRODUCTION

Many African countries, including Egypt, have developed development plans aimed at developing the internal waterways in them to enhance their water security and ensure energy security through the generation of electrical energy from the estuary of rivers, as well as linking African countries with each other through the increasing internal water transportation rates in the rivers that link countries Africa, which supports evidence trade through rivers between African countries in particular, and that the population census in Africa is growing quickly and is expected to reach 40% of the world's population by 2100, or about 4.5 billion people.(King, et al ., 2021)

The length of the Nile River inside Egypt is about 1,530 kilometers. River ports in Egypt are distributed along the navigation course of the Nile River on four main axes as internal river navigation routes: the Alexandria-Cairo axis, the Damietta-Cairo axis, the Cairo-Aswan axis, and the Aswan-Wadi Halfa axis. The Cairo-Aswan axis is considered the largest axis, as it extends from the Delta Barrage to Aswan and Wadi Halfa in length 1,310 kilometers. The Cairo-Alexandria axis also extends for a length of 201 kilometers. It starts from the Foum El-Riyah El-Beheiry lock, west of the Rosetta Branch, until it reaches the Bolin Lock, then deviates left with the Noubaria Canal, which heads north to the Great Maleh and Small Maleh locks in the Alexandria Sea port, and the Cairo-Damietta axis. It is 240 kilometers long and starts from the beginning of the Damietta Branch of the Nile River to the Damietta Sea Port. (General Authority for River Transport, 2020)

Egypt has about 47 river ports along the internal navigation routes of the Nile River in Egypt. These ports are also owned by several companies, except for the ports of Nahda in Alexandria and Athar al-Nabi in Cairo on the Nubaria Canal, which are owned by the General Authority for River Transport. Below we present the most important ports on the four axes of the Nile River in Egypt. They are the Aswan-Wadi Halfa axis, the Cairo-Aswan axis, the Cairo-Alexandria axis, the Cairo-Damietta axis, the companies operating each port, and the capacity of each port, in addition to the most important goods and their quantities that are transported from them according to the products and industries that characterize each governorate along the course of the Nile River.(General Authority for River Transport,2020).

Table 1. The major Nile ports in Egypt, Source by: (General Authority for River Transport, 2020)

NO	Port Name	Owner	Quays (number)	Quays (length)	Quays (structure)	Equipment	Storing (capacity) (ton)
1	Armant sugar	Sugar co	4	60	Soil	2 fixed cranes	30000
2	Koss sugar	Sugar co	1	200	Stone	Fright terminal / 2 cranes	50000
3	Nagaa Hammady sugar	Sugar co	1	786	Concrete	2 cranes	50000
4	River Aluminum	Aluminum factory	2	207 143	Concrete	1 crane bridge / 2 dredging	60000
5	Asyut cement in Menkbad cement	Asyut cement co	1	450	Concrete	1 crane /1 packing unit /4 transportation gutters	60000
6	Fertilizer factory in Menkbad	Financial and industrial co	1	150	Concrete	2 cranes	50000
7	Limestone in El Tebbin	Iron and steel co	1	200	Concrete	3 overhead 16-ton cranes /1 land 16-ton crane	70000
8	Coke factory in El Tebbin	El Nasser coke Industry co	2	250 150	Steel	4 Gantry cranes	125000
9	Athar El Nabi	RTA	1	1000	Concrete	1 crane	200000
10	Ambaba Tankers	Tankers co	1	90	Concrete	2 sanction machines	60000
11	Phospgate (Ismailiya canal)	Abu Zabal fertilizers	1	115	Concrete	Suction drilling machine / belt conveyors	60000
12	El Nahda (Elnobaria canal)	RTA	1	100	Concrete	1 crane	80000

The previous table shows several Egyptian river ports. Most river ports in Egypt work in transporting a limited number of goods, namely cement, aluminium, fertilizers, phosphates, coke, and sugar, which are produced from the governorates of Upper Egypt on the Aswan-Cairo axis. The owners of the river ports are private sector companies. These ports also contain a small number of berths, with the number of berths ranging from one berth to a maximum of four berths. The length of the berths varies between 60 meters to 1000 meters in these river ports. The table also shows that these ports have a limited number of cranes with limited handling capabilities for goods, a maximum of four cranes, as in the port of Tebbin. Table1 shows the decline in capacity and storage hours of river ports in Egypt, where the largest storage capacity reaches only about 200 thousand tons in the port of Athar al-Nabi. The table also shows that most Egyptian river ports were built using cement to withstand handling operations.(General Authority for River Transport,2020).

RESEARCH AIMS AND OBJECTIVES

Research Aim

- Discussing the mechanisms for developing and improving the river transport system and river ports planned to be established in Egypt, in addition to presenting the benefits of operating river transport for transporting passengers and goods in Egypt and the economic returns from it, while determining the foundations of the efficiency of logistical activities in river ports and transport requirements, including docks, stations, warehouses and warehouses planned to be established in Egypt with Determining the types of goods allocated to each port in a way that serves the cities overlooking the Nile River and helps in transporting popular industries in each city, while examining the possibility of linking the Nile River in Egypt to the rest of the Nile River course in neighboring African countries such as Sudan and others, which helps in strengthening intra-African trade.

Research Objectives

- Improving the logistical services provided in the river ports in Egypt and raising the efficiency and quality of the performance of logistical activities in the river ports, whether storage, handling, loading, and unloading, transportation, distribution, and other logistical activities to reduce the cost and increase the rates of transporting passengers and goods annually by the Nile River.

- Reducing pressure on other means of transportation, especially land transportation and railways, and then reducing the rates of pollution resulting from land transportation from the escalation of carbon dioxide gases, achieving sustainable development and green transportation, and working to transform the infrastructure in river ports, including (ports - docks - warehouses - container terminals - Docks - arsenals for building and repairing river ships - fuel tanks) in addition to reducing accident rates along land routes and the resulting deaths of people and damage to goods.

- Taking advantage of the Nile River as a natural water artery that can be used in transportation operations, linking it to the Nile Basin countries, especially Sudan, and using it to transport goods and passengers between the two countries and facilitating its connection to other modes of transport within the framework of multimodal transport systems.

THE PREVIOUS STUDIES

Inland waterway transport of goods, especially by rivers, is one of the crucial issues that support various types of trade, whether international trade, internal trade, or intra-state trade between several countries connected by the same waterway. Therefore, the efficiency of inland waterways supports the smooth

transportation of goods, passengers, products, and services. In addition, it is considered Logistics services in river ports are a very important factor to ensure the efficiency of transportation operations and make them smoother and more appropriate to deal with the increasing global demand. Therefore, the geographical characteristics of river ports along the rivers must be studied and the link between the efficiency of logistics services and the productivity of river ports must be ensured, which plays an important role in promoting regional economic development. (European Commission, 2020).

Table 2. The rivers in China source by: Ministry of transport, people's Republic of China (Wu, et al., 2022)

River Name	Length (km)	Catchment Area (km2)	Provinces in the Drainage Basin
Yangtze River	6,300	1,808,500	Anhui, Chongqing, Hubei, Hunan, Jiangsu, Jiangxi, Shanghai, Sichuan, and Tibet
Yellow River	5,464	752,000	Gansu, Henan, Inner Mongolia, Ningxia, Qinghai, Shanxi, Shaanxi, Shandong, and Sichuan
Heilong River	3,420	900,000	Heilongjiang
Songhua River	2,308	557,180	Heilongjiang and Jilin
Liao River	1,390	228,960	Hebei, Inner Mongolia, Jilin, and Liaoling
Pearl River	2,214	453,690	Guangdong, Guangxi, Guizhou, Hunan, Jiangxi, and Yunnan,
Hai River	1,329	318,200	Beijing, Hebei, Henan, Inner Mongolia, Shandong, Shanxi, and Tianjin
Yarlung River	2,840	912,000	Tibet
Lancang River	4,350	795,000	Qinghai, Tibet, and Yunnan
Nujiang River	2,816	324,000	Tibet and Yunnan

The previous table shows that many countries in the world are focusing on developing inland water transport corridors, especially by rivers. The most prominent of these countries is the People's Republic of China, which has seven major rivers, the most prominent of which is the Yangtze River, as this river plays a very large role in the Chinese Belt and Road Initiative. The length of the river is about 6,300 kilometers, including 2,800 kilometers. Kilometers suitable for navigation by cargo ships there are also about 20 river ports along the river. Thus, inland water transportation covers about 70% of the distance across the Yangtze River. The Yangtze River contributes to the development of the interior regions of China. It contributes also about 40% of China's domestic product. Zhang et al., (2021) Inland River ports contribute to linking other means of transport with each other, such as land and sea transport within the framework of multimodal transport systems. The Yangzi River has about 16,800 berths, representing 92.4% of the inland port berths in China, which represents about 30.4% of the productivity of China's

ports, as it reached the volume of goods handled on the port's berths was about 4.36 billion tons in 2018. (Wu, et al., 2022)

Due to the high costs of expanding, developing, and maintaining land roads, in addition to the accidents and damage to lives and goods they cause, in addition to the high emissions harmful to the environment, such as carbon dioxide rising from cars used to transport passengers and goods, many countries have resorted to relying on inland water transport. Including India, China, the Netherlands, the United States, Egypt, Germany, and Bangladesh, as an alternative to land and railway transport. In the Netherlands, the percentage of inland freight, whether for passengers or goods via inland waterways, is about 46%, in Bangladesh the percentage is 32%, in the United States the percentage is 14%, and in China the percentage is about 9%. Inland water transport is considered a relatively cheaper and environmentally friendly natural means of transport and achieves economies of scale in the tonnage of ships used to transport passengers and goods. (Soliman et al., 2021)

The competitive and commercial capacity of ports, including river ports that play an important role in international trade, depends on the efficiency of logistics services and the efficiency of transportation operations. Therefore, inefficiency of logistics services and transportation operations negatively affects trade. Development due to increased voyage costs, increased journey time, higher cost of logistics activities, and decreased delivery speed. Therefore, the efficiency of river ports supports reducing the cost of logistics activities, especially transportation costs, thus connecting global supply chains and supporting international and intra-regional trade, which also requires infrastructure. Strong in ports, especially storm and container terminals so they can accommodate increasing amounts of ships of large draft and large quantities of cargo. (Tovar et al., 2022)

Most investments are currently concentrated on wild roads by 62 %, especially in developing countries, including Egypt, and the rates of investment in the railway were 32 %. As for water transportation, internal and internal waterways did not exceed 6 % investment. This means the need for internal transportation to water to more investments to develop them, raise the efficiency of rivers, and improve the performance of logistical activities within the river ports. (Aritua, et al., 2021)

The efficiency of river logistics services, the improvement of river transport operations, and the efficiency of performing logistical activities depend on the application of an effective river information services system (RIS) in all countries linked by one river, which achieves a number of benefits, the most important of which is the safe and efficient transportation of goods and passengers across waterways (rivers).), taking into account the preservation of the environment by reducing polluting emissions and the safe and sustainable disposal of ship waste or oils, as their disposal is considered random. Illegal practice. The river port management also aims to reduce ship accidents, reduce damage to goods and the rate of worker injuries, and enhance security and safety procedures within river port operations, in addition to making maximum use of warehouses and stations, which increases the productivity of river ports and reduces time and cost. Cargo handling in river terminals, in addition to reducing travel time and the time of handling and storing goods, which depends on the efficiency of river port terminals and equipment. According to the above, effective management of logistical activities and port services, while working to facilitate the flow and exchange of data and information between the port community and gathering all stakeholders in one system, which starts from port management, shippers, station managers, workers, shipping and unloading contractors, customs clearance officials, etc. Effective management of logistical activities and port services helps develop river transport and increase reliance on it among other means of transport. (James et al., 2020)

Many European countries, including Poland, are implementing smart systems in inland navigation, especially across rivers, including the (RIS) system, which has helped increase Poland's logistical efficiency and attractiveness, which is reflected in the Logistics Performance Index (LPI) for logistical activities within Polish river ports, which has had a positive impact on the efficiency of logistical activities. Including transportation, shipping, storage, container handling, management systems, means of communication between ports and ships, tracking river units during their journey, with efficient container handling in container terminals inside river ports, and applying environmental sustainability standards in all logistical activities while ensuring sustainable disposal of waste resulting from logistical activities and from river ships. Poland has also developed infrastructure systems in river ports along inland water transport routes to avoid the problem of land shortages and the small areas needed to extend land roads and railways in Poland, while working to use an alternative inland water transport and ensuring that it is subject to environmental sustainability standards, with the aim of increasing inland shipping rates in Europe, which It is one of the most prominent goals of the European Union. (Durajczyk, et al., 2022)

The European continent is the most interested in river logistics due to its dependence on river transport in commercial exchanges, as the crossing of rivers and raising the efficiency of river ports are among the most prominent challenges facing the growth of river transport rates. Many European countries aim to develop logistics services in river ports and solve their problems as an alternative to land transportation, especially in crowded urban areas, by using an environmentally friendly alternative means of transportation to achieve the requirements of sustainable development, in addition to applying what is known as green logistics in all means of transportation. Whether land, sea, air, or river, in addition to achieving integration between different media and supporting government investment in developing river ports and waterways and improving internal water transport systems, in addition to paying attention to training workers in the field of transport and various means of transport and raising their efficiency, especially those working in river ports. Which reflects positively on the improvement of transportation systems in European countries that have rivers, especially in recent times, with the increasing interest in river transportation as it is the simplest and least environmentally polluting means of transportation and is capable of being an effective alternative to land and silent means of transportation. (Villarinho et al., 2019)

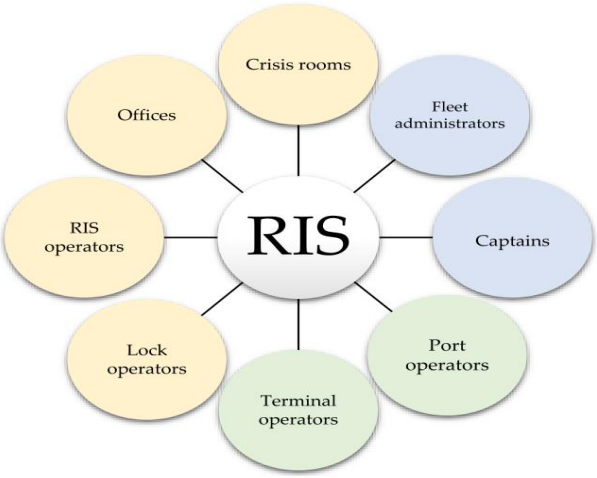

Figure 1: RIS user source by: own elaboration.

The previous form shows the scheme of the RIS system in Poland, which was implemented in all countries of the European Union, in addition to displaying the elements benefiting from it in the river transport community, where the (RIS) system can provide services that help to raise the efficiency of river transport operations, including tracking river ships, their observations and reporting On the ships (ERI), if they are exposed to dangers, in addition to displaying the electronic plan and the information system for

internal navigation, where the internal transportation of goods helps the use of internal navigators (ECDIS) in river transport operations between cities. Holguín,et al.,(2020) that the waterway pass (rivers) passes in addition to that the priorities of the countries of the world at the present time have become improving its efficiency The transfers and shipping of goods by applying sustainable and friendly standards to the environment at the present time and evaluating the environmental performance logistics in the river ports on the entire transportation of transportation to raise the efficiency of logistical activities in the framework of the environment, and the use of internal water transport reduces the time of transportation operations and improves the performance of the valid transport and delivery processes of the goods. The internal water transport by rivers is an alternative to land transport as the corridors are water is the only infrastructure with free capacity. Król, Rolbecki, (2019) and reduce crowding and suffocation to the maximum extent possible. (Durajczyk, et al., 2021)

GAP ANALYSIS

Neglecting to study the impact of improving logistics operations and logistics services for river ports in Egypt and mechanisms for linking river transport to other transport networks such as land and railway transport, while paying attention to aspects of environmental sustainability in Egyptian river ports, which contributes to achieving the sustainability of inland water transport operations in Egypt and transforming the infrastructure of river ports along the course of the Nile River into green, environmentally friendly infrastructure, which contributes to achieving sustainable development and reducing rates of river pollution.

CONTRIBUTION

Studying the possibility of linking the Alexandria Sea port to the Nile River and the Damietta Sea port to the Nile River and using them to transport goods at larger levels up to Aswan and then transporting them overland by land roads to Sudan and other African countries, especially after the completion of the extension of the Cairo-Cape Town Road, which will connect Cairo to Cape Town, the capital of South Africa. All of this helps in activating the multimodal transport system and increasing the rates of intra-African trade, especially after Egypt's accession to the Land Transport on International Roads (TIR) Agreement under the International Land Transport Cards. This requires removing navigational bottlenecks along the navigational course of the Nile River in Egypt at the level of axes, and this will not be achieved except by improving efficiency of logistics services and efficiency of operations in river ports and improving the capabilities of those ports, including berths, modern trading equipment, stations, warehouses, warehouses, and automated smart management systems based on the latest Internet of things applications, similar to the leading European river ports in river transport of passengers and goods. Providing the river channel with the necessary guards to guide the river units and avoid slopes and islands along the course, in addition to identifying flood areas and studying obstacles along the course, such as bridges, barrages, dams, and so on, and working to improve the efficiency of the locks in those dams and barrages necessary for the transfer of ships loaded with goods from a certain water level to another water level another safely to ensure the safety of the transportation process and the preservation of ships, goods and passengers.

RESEARCH PROBLEM

The decrease in the volume of goods transported internally in Egypt via the Nile River, as well as the decrease in passenger transport rates on Nile ships along the course of the river, in addition to the weakness of the capabilities of the Egyptian day ports necessary to handle, store and transport goods, in addition to the decrease in the logistical performance indicator (LPI) in the Egyptian river ports and the weakness of the logistical services provided. In river ports, in addition to the weak role of river transport

between different modes of transport, where land and railway transport is relied upon to a greater extent in transporting passengers and goods internally in Egypt.

RESEARCH AREA

The research area is the Arab Republic of Egypt, specifically the four axes of the Nile River, as there are four main axes of the Nile River in Egypt, which are the Aswan-Wadi Halfa axis, the Cairo-Aswan axis, The Cairo-Alexandria axis, and the Cairo-Damietta axis. The research focuses on a number of ports that were explained in the introduction to the research and which are located on the four axes of the Nile River the types of goods that are traded there, according to the goods produced according to the governorates through which the Nile River passes, were also presented, and the storage capacity of each port and the number of cranes used were explained, the number of Quays in each port in order to describe the current situation of river transport in Egypt.

RESEARCH METHODOLOGY AND ANALYSIS

The research methodology was based on a review of many literatures with the aim of describing the current situation of river transport in the world and identifying its most important features and its role in supporting international trade as well as intra-trade between the countries of those rivers. In addition to identifying problems related to river transport services, whether for passengers or goods, in addition to identifying the strengths, weaknesses, opportunities and threats related to the application of river transport in Egypt, while identifying several relevant future studies that must be strengthened. The methodology also relied on conducting a questionnaire containing a set of questions discussing the possibility of using river transport in Egypt as an alternative to land transport or railway transport for transporting passengers or goods. In addition to the above, interviews were conducted with several freight carriers in several freight transport companies to obtain their opinion on the possibility of implementing river transport and to determine the most important features that encourage shippers to use river transport over other means of transport.

Questionnaire

The questionnaire includes several questions discussing mechanisms and procedures for improving the efficiency of logistics services in Egyptian river ports, and their role in improving internal transportation operations in Egypt via the Nile River as an alternative to land roads and railways within the framework of the global trend to transform means of transportation with its various paths into green means of transportation and reduce pollution rates with the aim of reaching the highest standards of sustainability. Egypt has about 47 river ports used to transport various types of goods along the four Nile River axes in Egypt, which are the Aswan-Wadi Halfa axis, the Aswan-Cairo axis, the Cairo-Alexandria axis, and the Aswan-Wadi Halfa axis. - Cairo-Damietta axis, which is more than 1,500 kilometers long within Egyptian territory.

Results of questionnaire

Table 3. Source by: Authors

Questions	Criteria	Frequency	percentage
The term inland water transport and river logistics are among the most popular terms recently	Strongly Disagree.	1	1.6 %
	Disagree	27	44.3 %
	Neutral	7	11.5 %
	Agree	8	13.1 %
	Strongly Agree	18	29.5 %

River transport can be linked to other means of land and rail transport with the Nile Basin countries within the framework of the multimodal transport system.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	0 0 8 25 28	0 % 0 % 13.1 % 41 % 45.9 %
Logistics activities and logistics services in river ports in Egypt have a low level of efficiency and need further development.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	1 20 7 2 31	18 % 32.8 % 11.5 % 3.3 % 50.8 %
One of the factors influencing the increase in river transport rates in Egypt is the presence of river ships equipped to transport passengers and goods.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	3 18 10 7 23	4.9 % 29.5 % 16.4 % 11.5 % 37.7 %
Egyptian river port quays are capable of receiving high-tonnage ships with a large draft.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	29 10 12 9 1	47.5 % 16.4 % 19.7 % 14.8 % 1.6 %
Cargo handling equipment in river ports is suitable in terms of (number - lifting capacity - ease of control - ease of maintenance)	Strongly Disagree. Disagree Neutral Agree Strongly Agree	21 17 14 8 1	34.4 % 27.9 % 23 % 13.1 % 1.6 %
The storage capacity of river ports in Egypt can accommodate all quantities of incoming goods.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	19 15 15 11 1	31.1 % 24.6 % 24.6 % 18 % 1.6 %
Container terminals in river ports are equipped to receive, handle and store containerized goods.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	20 16 14 10 1	32.8 % 26.2 % 23 % 16.4 % 1.6 %
The necessary navigational beacons and markers are available to guide river ships along the course of the Nile River	Strongly Disagree. Disagree Neutral Agree Strongly Agree	7 14 20 14 6	11.5 % 23 % 32 % 23 % 9.8 %
River ports have highly efficient communication capabilities that enable them to communicate with Nile ships throughout the river journey.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	5 17 14 16 9	8.2 % 27.9 % 23 % 26.2 % 14.8 %
Locks along the course of the Nile River require efficient operation and maintenance to reduce the time it takes	Strongly Disagree. Disagree Neutral Agree	0 27 9 5	0 % 44.3 % 14.8 % 8.2 %

to move ships from one water level to another.	Strongly Agree	20	32.8 %
Among the most important obstacles to the efficiency of river transport (sedimentation, siltation, slopes, and low water levels in shallow areas)	Strongly Disagree. Disagree Neutral Agree Strongly Agree	0 28 10 2 21	0 % 45.9 % 16.4 % 3.3 % 34.4 %
River ships in the river transport fleet are distinguished by their readiness to sail and the availability of handling, towing and distress equipment on them.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	4 17 18 14 8	6.6 % 27.9 % 29.5 % 23 % 13.1 %
Digitization and Internet of Things applications have been introduced into river transport operations at a high rate in most river ports along the course of the Nile River.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	11 15 16 16 3	18 % 24.6 % 26.2 % 26.2 % 4.9 %
River ship waste disposal operations are subject to environmental sustainability standards.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	9 19 14 12 7	14.8 % 31.1 % 23 % 19.7 % 11.5 %
Egyptian river port management systems are still primitive and need further development.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	0 23 6 4 28	0 % 37.7 % 9.8 % 6.6 % 45.9 %
River transport is able to compete with other modes of transport, such as land and rail transport, in transporting passengers and goods.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	2 25 8 9 17	3.3 % 41 % 13.1 % 14.8 % 27.9 %
River transport results in the lowest rates of environmental pollution among other means of transport, which helps in achieving sustainable development.	Strongly Disagree. Disagree Neutral Agree Strongly Agree	1 23 5 8 24	1.6 % 37.7 % 8.2 % 13.1 % 39.3 %

The sample of the questionnaire included many workers in the field of river transport, shipping goods and passengers via river ships from river transport companies, and transporting goods across the Nile River in Egypt, in addition to a random sample of citizens and academics working in the field of international transport and logistics. The results of the questionnaire showed that about 45.9% of the sample, the term inland water transport and river logistics is not new to them, and about 39.6% of the sample, consider the term river logistics and inland water transport new to them. The results of the questionnaire showed that about 86.9% of respondents confirmed that river transport across the Nile River in Egypt can be linked with land and railway transport and other modes of transport within the framework of multimodal transport systems.

The results of the questionnaire also showed that about 52.4% of the sample confirmed that the level of efficiency of performing logistical activities and logistics services in Egyptian river ports is low and needs further development and improvement to maximize the benefit from river transport. The results of the questionnaire showed that 49.4% of the sample confirmed that among the important factors for increasing the rates of river transport in Egypt, improving the efficiency and development of river ships, and improving the efficiency of their equipment, which contributes to the ease of transporting passengers and goods and improving the efficiency of cargo handling operations on the docks. The results of the questionnaire showed that most of the sample, 63.9%, confirmed that the berths of the Egyptian river ports are unable to receive high-draft ships with large tonnage. This is due to the low capabilities of the berths in terms of the length of the berth, the depth of the draft on the berth, and the equipment necessary for ship loading and unloading operations.

Most of the sample, with a percentage of 62.3%, explained that the cargo handling equipment present in the Egyptian river ports is poor, incapable, and inappropriate in terms of number, lifting capacity, and ease of control, in addition to the difficulty of carrying out the necessary maintenance operations for it and its high cost. The results of the sample also showed that 55.7% confirmed that the storage capacity of the Egyptian river ports was low, and they were unable to receive all the quantities of goods coming to them. In addition, about 59% of the sample confirmed that the container terminals in the Egyptian river ports were unable to receive unload and store the contained goods, which led to Decreased productivity of river container terminals.

The sample was divided almost equally between the fact that lighthouses and navigational signs necessary to guide river ships along the course of the Nile River are available in some regions and governorates along the Nile voyage for ships and are not available in other regions. The results of the questionnaire confirmed that about 41% of the sample confirmed that river ports have highly efficient communication capabilities that help them communicate with the ship during the Nile cruise. Also, about 36.1% confirmed the weakness of the means of communication between river ports and Nile ships in some governorates of Egypt, and thus the inability to respond quickly. For ships in cases of emergency, stranding, or fire, which threatens the safety of Nile ships and the safety of transported goods. The results of the questionnaire also showed that about 41% of the sample confirms that the locks located along the course of the Nile River, most of them need maintenance to reduce the time required to move ships from one water level to another level efficiently without causing damage to the ships.

The results of the questionnaire also showed that about 45.9% of the sample do not see sedimentation, siltation, and slopes as an obstacle to the development of river transport operations in Egypt, while about 37.7% of the sample see that siltation, sedimentation, slopes, and a decrease in the water level in some places along the course of the Nile River. It is considered an obstacle to increasing the rates of river transport, whether for passengers or goods, as the sample results showed that about 36.1% confirmed that river ships need to develop their capabilities and provide towing and relief equipment on them to raise their ability to navigate and facilitate the operations of transporting passengers and goods by the Nile River. The sample results showed also that a percentage of 42.6% of the sample confirmed that digitization and Internet of Things applications have not been introduced into river port operations and that they are still routine and take a lot of time and cost. The results of the questionnaire showed that 45.9% of the sample confirmed that the disposal of Nile ship waste is carried out in unsustainable ways and causes pollution of the Nile water and harm to living organisms, which negatively affects the blue economy that is produced from the Nile River. The results of the questionnaire showed that 52.5% of the sample confirmed that the management of the Nile ports is still primitive and needs further development with the aim of linking the river port community and raising the efficiency of operations within the port, which reflects positively on the productivity of river ports and the efficiency of performing logistical activities.

The results of the questionnaire also showed that about 44.3% of the sample confirmed that Egyptian river transport is unable to compete with other means of transport, especially railways and land transport, as it provides door-to-door goods transport service in addition to the speed of the transport process. 42.7% of the sample confirmed that river transport can compete with other means of transport and maximize benefits from them, provided that its technical, operational, and administrative aspects are developed. The results of the questionnaire showed also that 52.4% of the sample confirmed that river transport leads to lower rates of pollution and accidents compared to other means of transport, especially land transport, which means that river transport achieves dimensions of sustainable development.

SWOT analysis

Strength points

- River transport is considered thriving in Europe, as Europe has a fleet of commercial river ships that cross the rivers of Europe, where the number of ships is about 11,000 ships, which amounts to a load of 10,000 trains and about 440,000 land trucks. Therefore, the most important advantage of inland water transport via rivers is achieving economies of scale. The large one, where one ship can carry an amount of goods that requires about 40 land trucks to carry it.

- Reducing the cost of extending long-distance land roads and railways, which are very expensive for developing countries, in addition to reducing the burden on land roads, as river transport makes the transportation process more effective and safer.

Inland water transport via rivers contributes to reducing environmental damage by reducing the number of trucks on land roads and thus reducing the resulting carbon dioxide exhausts that cause the problem of global warming and harm the environment, in addition to reducing accident rates and the resulting deaths and damage to goods transported daily on Land roads.

Weak points

- One of the most important weaknesses of river transport is the length of time required for the river trip compared to land transport, which is considered faster than river transport, especially for time-sensitive goods.

- There are no fuel stations for river ships except in Cairo and Luxor. Consequently, ship owners may resort to purchasing diesel from the other expensive sources, which causes high transportation costs for passengers and goods.

- River transport needs a supporting means of transport, mostly railways or trucks on land, to be able to achieve door-to-door transport services for goods and passengers.

There are many barrages and bridges along the course of the Nile River, and therefore there is a need to use a lock to transport the river ship from a certain water level to another level. Therefore, any malfunctions in these locks may cause traffic jams for the river ships, in addition to wasting more time, which causes a longer river journey time.

Opportunities

- The possibility of linking river transport with land transport by transporting goods by river from the governorates of Lower Egypt, then unloading them in Aswan and then transporting them by land trucks on the Cairo-Cape Town Road to African countries, with the application of the Land Transport on International Roads (TIR) Agreement, which Egypt recently joined. This therefore increases prices

intra-trade between Egypt and African countries and vice versa, while facilitating the transfer of products from countries that have joined with Egypt in intra-trade agreements such as COMESA.

Threats

- The water level in the Nile River within the Egyptian borders decreased because of the upstream countries of the Nile River building several dams and reservoirs without coordination with the downstream countries, causing a decrease in the amount of water coming to Egypt. Perhaps the most prominent of these is the Ethiopian Renaissance Dam, which caused its filling by Ethiopia unilaterally. In the decrease in the amount of water coming to Egypt, which may cause the depth of the Nile River to decrease and parts of it to turn into shallow areas unsuitable for navigation and Egypt to enter a stage of water poverty and high rates of drought and desertification.

- Increased rates of sedimentation and siltation in the Nile River due to the growth of Nilotic plants, especially in the shallow areas of the riverbed, where the Cairo-Damietta axis suffers from this problem, which means the need to remove Nile plants and continuous dredging to ensure maintaining a suitable depth that ensures smooth river navigation.

CONCLUSION AND RECOMMENDATIONS

Conclusion

In this paper, the researchers presented the most important river transport capabilities in Egypt in its four axes, in addition to presenting the most important river ports along the course of the Nile River in Egypt and their current capabilities, in addition to present the most important previous studies that dealt with river logistics and ways to improve the efficiency of logistical activities in river ports and the role of transportation. Inland waters globally in international trade operations, especially in the transport of goods in China, Europe, and others. In addition to presenting the possibilities of linking river transport in Egypt with the rest of Africa and increasing the rates of river transport in Egypt by improving the infrastructure in the river ports and transforming them into smart, automated infrastructure and the obstacles, challenges and threats that prevent this, in addition to presenting the most important recommendations necessary to improve the efficiency of performing activities. Logistics in river ports on the docks, in container terminals, in warehouses and others, while working to improve the efficiency of operational operations in river ports and the necessary methods to benefit from river transport as it is the least polluting means of transport to the environment and achieves economic savings in addition to being an environmentally friendly transport mean that achieves sustainable development.

Recommendations

1. Necessary to develop inland water transport in Egypt, implement an independent and comprehensive inland river transport system, and work to develop smart infrastructure (ports - docks - loading and unloading equipment - container terminals - stores and warehouses - floating and dry docks).

2. Introducing digitization and automation into all river port operations to achieve digital transfer and applying intelligent management systems and intelligent operating systems those have the ability to self-aware, self-interact, self-learn, self-execute and coordinate independently to achieve the highest efficiency in the function of the inland waterway, the inland transportation system, regulation of river traffic, and smooth navigation in The course of the Nile River in Egypt, which contributes to raising the productivity of Egyptian river ports.

3. It is necessary to develop economic activities in the river ports planned to be built in Egypt like the ports of major countries, the most important of which is China, as it is an economically advanced country in addition to being a developing country in terms of population. The most important of these

additional logistical activities is handling, loading, unloading, transportation, packaging, and other value-added activities on goods which contribute to increasing port productivity.

4. The river port is part of the global supply chain through its contribution to the transport of goods and materials with the aim of achieving a balance between global supply and demand. Therefore, work must be done to raise the efficiency of operations within the river ports, which contributes to improving international trade and the global supply chain, in addition to developing the coastal cities adjacent to the river's course and improving its economies and provide job opportunities for residents of the cities downstream of the Nile River in Egypt.

5. Increasing the productivity of river ports in Egypt by raising the efficiency of operating operations within the ports and working to provide modern equipment for handling goods to ensure the efficiency of loading and unloading operations, ensuring that the ports are not congested, and ensuring the provision of port supplies from internal terminals, equipped berths, stores, and warehouses to raise the capacity of the ports and facilitate container transportation in Egypt. Using the course of the Nile River, in addition to planning container terminals on a sound basis and ensuring their integration and linking them to other means of transport, whether land or railway transport.

6. Paying attention to the operations of maintaining the course of the Nile River and providing the minimum depth along the distance from Alexandria to Aswan to suit the draft and loads of the ships used in transporting goods.

7. Paying attention to dredging operations and providing the necessary equipment for navigation, especially at night, including beacons and light signals, and ensuring that no soil sedimentation occurs along the course of the Nile River to maintain an appropriate draft and removing all obstacles along the course of the Nile River, especially sharp curves, rocks, and slopes, to ensure the suitability of navigation along the course of the river.

8. Ensuring the easy flow of the Nile River water and ensuring its flow through dredging and dredging operations to maintain a depth that ensures safe navigation of ships at appropriate speeds while ensuring the preservation of the width of the shipping lane and considering the apparent landing of ships at different speeds.

9. The Egyptian state should pay attention to raising the efficiency of the river transport infrastructure by developing the already existing river ports, increasing the number of berths in them, providing them with the necessary equipment for handling goods, increasing the carrying capacity of the berths and stations, and providing the stores and warehouses necessary to store goods and easily conduct additional activities on them.

10. Paying attention to the operations of dredging the course of the Nile River to reduce the possibility of Nile ships running aground at shallow depths, while providing the necessary towing equipment to rescue the dredging units at relatively small depths along the river course and providing means of communicating with them and determining their location easily.

11. Providing fueling stations for river ships along the course of the Nile River, as there are no fueling stations for ships and ships except in Cairo and Luxor governorates, which means ship and yacht owners buying diesel from the black market, which causes an increase in the cost of passenger and cargo transport operations.

12. working to transform the infrastructure in river ports, including (ports - docks - warehouses - container terminals - Docks - arsenals for building and repairing river ships - fuel tanks)

13. Working to increase the carrying capacity of the locks systems necessary to transport ships from one water level to another, maintaining them continuously, increasing their number, speeding up the crossing of ships through them, and reducing the number of bridges along the course of the Nile River, in addition to ensuring the appropriate height of bridges and overpasses, allowing the passage of large ships easily, whether It carried passengers or goods.

14. The Egyptian state should support the Egyptian arsenals operating in the industry of building and repairing river transport units, whether used in transporting goods or tourist yachts, goldfish, and floating hotels used in transporting passengers, and facilitating investment and financing procedures for their owners, facilitating the necessary licensing procedures for these arsenals, and facilitating the import of decorative equipment and tools necessary for river ships, as well as facilitating the importation of Spare parts needed for river ships.

15. Working to provide Egyptian Arab design offices to design river ships, as well as providing the iron ore necessary for the river ship building industry with the appropriate engineering and technical specifications such as (degree of strength - thickness - length - width).

16. Supporting local and foreign investment in the river transport sector by developing and improving the river transport system, raising the efficiency of river ports, raising the sponsorship of river container terminals planned to be established, determining the types of goods allocated to each port, and establishing ports that serve industrial cities, existing factories, and the agricultural crops for which each governorate is famous, while working to purify Dredging and deepening the shipping corridor and improving the performance of logistical services along the Nile River, as river ports play an important role in establishing logistics centers and distribution centers near them.

17. Working to quickly implement systems for tracking and monitoring floating river units (RIS) in the Nile River and providing the necessary supplies to them in emergency situations, or in cases of stranding, deterioration, or fuel depletion, which ensures the safety of passengers and goods along the river journey.

18. Paying attention to providing safe captains for river ships (river ship crews) and raising their efficiency and training on an ongoing basis. Paying attention to training workers and raising their efficiency in using river port equipment, whether in container terminals or handling equipment on docks or in warehouses, which helps in raising the productivity of river ports and working to ensure the safety of workers and all elements of the river port community.

19. Working to connect all parts and axes of the river port and facilitating communication and coordination between individuals in all parts of the river ports using wired and wireless devices, while paying attention to the insurance aspect by applying effective monitoring systems on the docks, warehouses, and goods, paying attention to security and safety procedures for workers and goods, and supplying warehouses, warehouses and ship holds with extinguishers fire and gas leak detection devices.

20. The possibility of exporting the products of Upper Egypt factories by transporting them from production governorates, such as sugar cane, molasses, and aluminum near Qena, cement from Asyut, grains, petroleum, fruits, minerals, and marble from Aswan to the port of Alexandria, then crossing the lock bridge at the port of Alexandria, then transporting it across the Mediterranean Sea to any European country, thus activating the role of multimodal transport, increasing export rates and achieving economic returns for the Egyptian economy.

21. Necessary to discuss partnership mechanisms between the public and private sectors and give a greater opportunity for local and foreign private sector investments in strengthening river port

logistics and raising the efficiency of performing activities and logistical services in river ports to achieve the operational efficiency of Egyptian river ports.

22. The necessity of applying environmental sustainability practices in Egyptian river ports and working to integrate environmentally friendly initiatives and technologies into all logistical activities within the river ports along the course of the Nile River in the four axes, namely the Damietta-Cairo axis, the Alexandria-Cairo axis, the Cairo-Aswan axis, and the Aswan-Wadi Halfa axis, to enhance the sustainability of water transport operations. Inland Egypt via the Nile River.

23. The state must develop thoughtful plans to ensure the preservation of the Nile River from pollution by criminalizing the throwing of waste of all kinds, whether factory waste, chemicals, solid waste, plastic, sewage waste, or the waste of ships passing in the Nile River, such as diesel, oils, waste of passenger cruise ships, and other waste. To protect the Nile River and its fish wealth, achieve the highest rates of environmental sustainability, and transform Inland water way transport across the Nile River into green transport, which has become a global trend recently.

24. The state must begin to open local and foreign investment horizons to finance projects to start building strong Nile ships that will allow the use of inland water transport more effectively and be used in transporting passengers and goods, while working to integrate inland water (river) transport into multimodal transport chains with better planning for the use of the fleet. The Egyptian River, improving the performance of river shipping projects, and raising the efficiency of the transportation process using the Nile River.

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