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The Internal Structure of Fishing Ports on the Mediterranean Coast: A Study in the Geography of Maritime Transport Using Geographic Information Systems

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ABSTRACT

The study confirmed that marine quays are a fundamental component of the infrastructure of fishing ports, as they contribute to organizing berthing and unloading operations, supporting the movement of vessels of various types, and thereby enhancing the efficiency of fishing activities and fostering the growth of the local economy. The selected ports under study (Port Said, El-Burullus, and Al-Ma'addiya) are characterized by having quays of diverse lengths and depths that suit the nature of the vessels operating in each port, where quay lengths range between 100–225m, widths between 5–20 m, and depths between 1.5–5 m. Some quays have been developed to accommodate medium-sized vessels. The study revolves around the role of quays, breakwaters, service-oriented marine facilities, and logistical capacity in the development and advancement of fishing ports. These quays are distributed across internal basins that facilitate navigational movement, and several of them have recently undergone dredging and upgrading works to improve efficiency and increase capacity. This diversity in design and function serves various fishing, unloading, and transport activities, reflecting the level of infrastructural development in the three ports and their vital role in supporting the marine fisheries sector and related economic projects.

Introduction

Seaports play a crucial role in development and in boosting national income. The number of ports, their efficiency, and the volume of exports and imports they handle are considered among the key indicators for assessing the strength and prosperity of a country's economy. Additionally, the provision of technical services, logistical systems, information technologies, and basic infrastructure within ports are decisive factors influencing their performance.

Egypt, despite its long coastlines along both

the Red Sea and the Mediterranean, suffers from a limited number of specialized ports. The total number of ports in Egypt is 28, which vary in type, structure, and function. Fishing ports constitute 21.4%[1] of these, and they are among the most significant along the Mediterranean coast. The ports of the study area (Port Said, El-Burullus, and Al-Ma'addiya) are functionally specialized fishing ports. This, however, does not exclude their performance of secondary functions. Undoubtedly, both locational and economic factors have played major roles in shaping the specialization of each fishing port, as a logical result of the interaction of these two elements.[2]

The morphological structure of ports including both terrestrial and marine facilities is one of the fundamental pillars in establishing a fishing port and defining its overall framework. Its significance lies in its central role in supporting port operations and enhancing efficiency in serving fishing activities. This is achieved through the provision of integrated infrastructure on land, including quays, warehouses, and maintenance facilities, as well as marine structures that ensure safe and smooth berthing and navigation. Such integration strengthens the competitive capacity of the port and guarantees the sustainability of its activities in line with environmental and technical requirements. Furthermore, the availability of industrial facilities for drying, packaging, salting, canning, and freezing fish products adds to its importance.

The internal infrastructure and spatial planning of ports comprising quays, breakwaters, and storage spaces designated for fish preservation represent an essential foundation for achieving sustainable development[3]. They also encompass service and administrative facilities that provide fishermen and their equipment with potable water and electricity, as well as fish collection and sorting stations, thereby improving product quality. The ports are characterized by a comprehensive logistical capacity, including fuel availability, slipway and repair services, pilotage, coast guard presence, and other diverse activities that ensure operational sustainability. Moreover, internal road networks and linkages facilitate the movement of goods and labor, thus reinforcing the role of the port as an economic hub that generates both direct and indirect job opportunities and supports local and regional economies.[4]

1- Study Area Location:

The study area extends along the northern coast of the Arab Republic of Egypt overlooking the Mediterranean Sea, as illustrated in Figure 1 and Table 1 ، It encompasses three major fishing ports of strategic and economic significance within the fisheries sector.

The Port Said Fishing Port is located on the eastern side of Port Said City, at the northern entrance of the Suez Canal, on the northeastern coast of Egypt. This strategic position grants it a pivotal role in linking fishing activities with international navigation routes.

El-Burullus Fishing Port lies on the eastern side of Lake Burullus, within the jurisdiction of El-Burullus District in Kafr El-Sheikh Governorate. It overlooks the central-northern Mediterranean coast of Egypt, acting as a vital connection between the Mediterranean Sea and Lake Burullus.

Al-Ma'addiya Fishing Port is situated in Al-Ma'addiya village, part of Idku District in Beheira Governorate, at the junction between Lake Idku and the Mediterranean Sea, on the northwestern coast of the Nile Delta. This location allows the port to play a dual role in supporting both marine fisheries and inland fishing activities.

[1] Ehab ElBrins: "Burlus Fishing Port: A Study in the Geography of Marine Transportation," Issue 91, Kafr El-Sheikh Governorate, p. 5, 2018.
[2] Shraan Negm & Nadaoka, Egyptian Fishing Ports challenges and opportunities case study: Mediterranean Sea Ports, P540-549 , 2016.
[3] Ismail: "Container Transportation at East Port Said Port: A Study in the Geography of Marine Transportation," p135, 2014.
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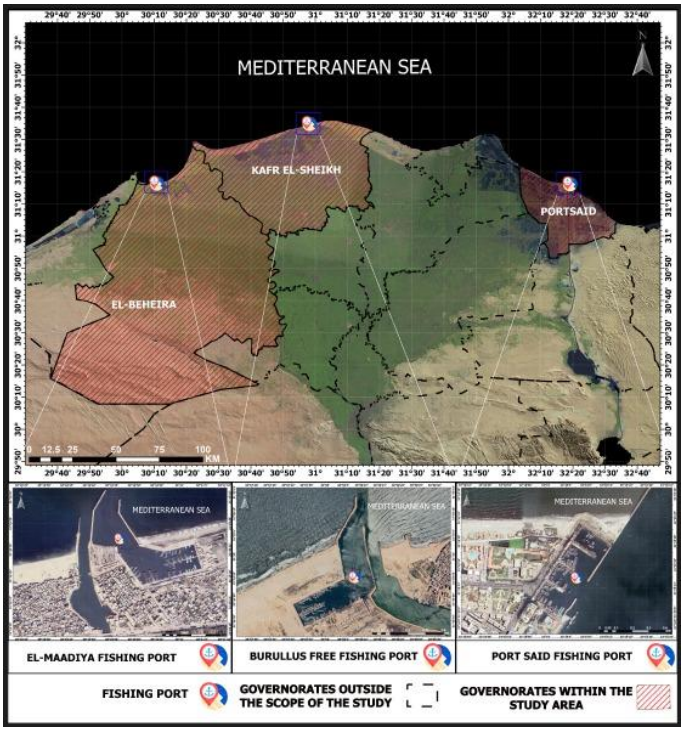

Source: Prepared by the researcher using ArcGIS 10.7.

Fig. 1 Fishing Ports on the Mediterranean Coast

Table 1. The Astronomical Location of Fishing Ports on the Mediterranean Coast

Governorate	Astronomical Location	PORT	NO
Port Said	Located at the intersection of latitude 31° 25′ 50″ N and longitude 32° 29′ 60″ E	Port Said	1
Kafr El-Sheikh	At the intersection of latitude 31° 34′ 51″ N and longitude 30° 58′ 42″ E	El-Burullus	2
Beheir	ocated at the intersection of latitude 31° 13′ 50″ N and longitude 30° 30′ 30″	Al-Ma‘addiya	3

Source: Prepared by the researcher based on ArcGIS 10.7.1 and Google Maps, 2025.

Significance of the Study

The significance of this study lies in addressing the morphological structure of fishing ports on the Mediterranean coast, as it represents one of the fundamental elements of such ports due to its major role in berthing and unloading operations and in supporting the maritime economy. The efficiency of fishing activities is largely determined from the moment of unloading until the product reaches the consumer.

Objectives of the Study

1. To identify the geographical factors influencing fishing ports.
2. To examine the morphology and assess the service facilities of fishing ports.
3. To highlight the role of fishing ports in marketing fish products.
4. To study the logistical capacity of the ports and evaluate their operational efficiency.

Previous Studies

Numerous geographical studies have discussed the topic of seaports, their functions, and their different types in general. Among the most notable are:

1. **Hassan (1982):** *The Port of Alexandria: A Geographical Study in Maritime Transport*. This study provides a comprehensive geographical analysis of Alexandria Port, addressing its location, economic importance, and role in maritime transport, along with the

natural and human factors affecting its efficiency and development.

2. **Abdo (1989):** *Seaports of the United Arab Emirates: A Study in the Geography of Maritime Transport*. The study analyzes the seaports of the UAE, examining their locations, functions, and significance within the maritime transport network, as well as the factors influencing their development and their role in regional and international trade.
3. **Abu Madina (2000):** *Libyan Ports: A Study in Economic Geography*. This work analyzes Libyan ports from the perspective of economic geography, highlighting their role in maritime trade, their importance in the national economy, and the natural and human factors influencing their activity and development.
4. **Ismail (2012):** *Nuweiba Port*. This study presents a comprehensive analysis of Nuweiba Port, focusing on its geographical location, its role in maritime and land transport between Egypt and neighboring countries, and its importance in trade and passenger services.
5. **Sherif (2017):** *Ain Sokhna Port: A Study in Transport Geography*. The study examines Ain Sokhna Port from the perspective of transport geography, emphasizing its strategic location on the Red Sea, its significance in supporting trade and maritime transport, and analyzing its infrastructure and the factors influencing its operations and development.
6. **Suleiman (2020):** *Sfax Port: A Study in Transport Geography*. This research explores the Port of Sfax in Tunisia, highlighting its location and significance within the maritime transport network, its role in regional and international trade, and the geographical and economic factors shaping its activity.
7. **El-Barnes (2017):** *El-Burullus Fishing Port in Kafr El-Sheikh Governorate: A Study in the Geography of Maritime Transport*. This study analyzes El-Burullus Fishing Port, emphasizing its location and importance in supporting fisheries activities in the governorate, as well as its infrastructure and the environmental and human factors affecting its efficiency and development.
8. **Abu Madina (2008):** *Zliten Fishing Port and the Impact of Geography on Its Emergence and Operation*. This detailed study of Zliten Fishing Port in Libya analyzes the impact of geographical factors on its establishment and operations, its role in supporting local fishing activities, and the natural and human challenges it faces.

Research Methodology and Approaches

1. Approaches

The study relies on a combination of methodological approaches that align with its objectives, including:

- **Historical Approach:** This approach is used to examine the origins of each port, providing a historical analysis of their past forms and tracing their development to their present state.
- **System Analysis Approach:** The study adopts a systems analysis perspective, viewing ports as interconnected systems comprising natural resources, infrastructure, fishing activities, port services, and logistical operations. It analyzes the interactions among these components and the influence of environmental and economic factors, with the aim of understanding port mechanisms, identifying strengths and weaknesses, and highlighting opportunities for development.
- **Fundamentalist Approach:** This approach is applied to investigate the geographical factors affecting fishing ports.
- **Descriptive Analytical Approach:** The study employs a descriptive-analytical method through collecting relevant data and information on the fishing ports under study, describing their geographical and morphological characteristics, and analyzing these data to uncover the relationships and patterns that shape their infrastructure, logistical capacity, and role in fish product marketing.

2. Techniques

The study also employs a set of techniques and tools that complement the adopted approaches, including:

- **Quantitative Technique:** Serving as the core of the analysis, this involves the use of various statistical measures such as correlation coefficients, averages, percentages, relative importance, and growth rates.
- **Cartographic Technique:** Applied mainly to produce research maps that facilitate understanding and analyzing phenomena through spatial representation.
- **Photographic Technique:** Utilized to illustrate certain features that cannot be effectively represented on maps. Field photography is also employed to capture the morphological characteristics of the ports.
- **Field Study:** The researcher conducted fieldwork in April 2024 and May 2025 at the fishing ports of **Port Said, El-Burullus, and El-Maadia** to observe their internal structures and morphological details, and to collect photographic evidence inside the ports.

Research Plan

To achieve the study objectives, the research is structured into five major themes:

1. Infrastructure and internal layout.
2. Storage areas within the ports.
3. Service and administrative facilities.
4. Logistical capacity of the ports.
5. Future prospects of the ports.

Infrastructure and Internal Layout[5]

Fishing ports have witnessed continuous developments since their establishment, including the expansion of the marine quay, the creation of maintenance workshops, fuel stations, and fish trading markets. Additionally, modern service facilities such as refrigerators and ice factories have been provided.

- **Port Said Fishing Port:** Strategically located at the entrance to the Suez Canal (Figure 1), the port includes five quays ranging from 99 to 194.21 m in length, 9–20 m in width, and a depth of 5 m, suitable for accommodating different fishing vessels. It contains four basins surrounded by 5 m-high fences. Dedicated exclusively to fishing (with no commercial vessels allowed), the port is protected by two breakwaters: a western one (160 m) and an eastern one (280 m). The port also has approximately 55 storage units (Figure 1) with a total area of around 1,375 m², used for spare parts storage and regular maintenance. External cranes are employed when necessary.
- **El-Burullus Fishing Port:** Located on the Mediterranean coast (Figure 1), the port is considered one of the most important fishing ports. It has six quays ranging from 210 to 225 m in length and 5–10 m in width. The port is protected by two breakwaters: the western (525 m) and the eastern (105 m), which define the navigational entrance and reduce wave impact inside the basin. El-Burullus Port contains about 83 storage units (Figure 1) with a total area of 2,490 m², in addition to a large 6,000 m² cargo storage yard. A heavy-duty crane, with a capacity of 700 tons, is installed for operations.
- **El-Maadia Fishing Port:** Situated on the Mediterranean coast (Figure 1), the port is equipped with quays ranging between 160 and 180 m in length, 6 m in width, and a depth of 4 m, facilitating loading and unloading operations. The port is protected by three breakwaters: central (200 m), western (100 m), and eastern (230 m). It has around 45 storage units (Photo 1) with a total area of 1,350 m², in addition to designated areas for routine maintenance of small fishing units. External cranes are used when required.

Secondly: Administrative Service Facilities 6

Fishing ports along the Mediterranean coast provide various essential services to fishing

[5] - FIeld Study by the Student: 2025, Fishery Port Management Authority, Computer Science Department, Unpublished Data, 2025.

[6] FIeld Study by the Student: 2025, Fishery Port Management Authority, Computer Science Department, Unpublished Data, 2025.

vessels, whether directly involved with the port or seeking specific facilities. These services play a vital role in facilitating fishing activities and the associated operations

Al – Ma'addiya Fishing **Port Elburullas Fishing** **Port Said Fishing Port**

Source: Field Study, 2025

Figure. 1 Various Activities in the Fishing Ports of the Study Area

Port Said Fishing Port

The port obtains water from an external supply network, with storage facilities provided by the Suez Canal Authority and the municipality, in coordination with the Holding Company for Drinking Water. Electricity is supplied mainly by the Canal Company for Electricity Distribution. The port does not have dedicated fish markets; instead, the catch is unloaded directly at the quay and transported either to the nearby marketing shelter adjacent to the port or to the new fish market, as illustrated in Figure 2.

Burullus Fishing Port

Burullus Port is supplied with fresh water through the Baltim Water Station. The port is characterized by relatively well-developed infrastructur, including an overhead tank with a capacity of 20 m^3 and an underground tank of 45 m^3. Electricity is provided through the Borg distribution panel located near the port, along with a 1 MW transformer. The port includes 28 fish trading areas (Figure 2), three cold storage rooms with a storage capacity of 45 tons.

El-Ma‘adiya Fishing Port

El-Ma‘adiya Port receives its freshwater supply from Idku Water Company and includes a water tank with a capacity of approximately 40 m^3. The port is equipped with a dedicated transformer with a capacity of about 100 watts. It hosts 13 fish trading points (Figure 2), six ice crushers, six refrigerators, two ice factories, and three facilities for fish packaging, salting, and processing.

Al – Ma'addiya Fishing Port **Elburullas Fishing Port** **Port Said Fishing Port**

Source: Field Study, 2025

Figure. 2 Some Fish Markets in the Fishing Ports of the Study Area.

Third: The Logistical Capacity of the Ports

The logistical capacity represents one of the most essential requirements supporting fishing vessels, which must be available in fishing ports. This capacity is closely related to the geographical location of the port, the land and maritime transport networks connected to it, as well as the availability of land-based and maritime facilities that enable the reception of fishing vessels, unloading, storing, and transporting fish products efficiently.

1- Port Said Fishing Port

The port is served by two fuel stations, each with a capacity of 200 m³, as shown in Figure (3). There is no slipway in the port, and fishing vessels are sent to the Port Said Engineering Company for maintenance. Recently, the fourth basin has been allocated for vessel repair and maintenance. At the entrance of the port, there is a revenue checkpoint and a border guard station. Although the port lacks a lighthouse, buoys are placed near the quaysides on all sides. The port has been officially registered with the Egyptian Authority for Maritime Safety since 1994.

Several services and activities exist on the land side of the port, including warehouses for fishing gear and nets, fish cold stores, cafeterias, welding and lathe workshops, as well as a three-story administrative building belonging to the Fisheries Authority and a building for the Border Guard office. In addition, there are two mosques for prayer, two fuel stations, garbage collection containers distributed across the quays, and a security room at the main gate.

Port Said Fishing Port is connected to a strong road network within the city, including the Corniche Road, Port Road, and the Coastal International Highway, which links the Canal cities with Sinai and the Delta. This network facilitates the movement of fishermen and the transportation of fish to markets and refrigeration stations, while also providing rapid access to the railway station and the ring road leading to industrial zones and other ports. Furthermore, an internal road network links the quays and basins of the port, ensuring efficient operations.

2- El-Burullus Fishing Port

The port is supported by two fueling stations, one located at kilometer 109 and the other inside the port, covering an area of 120 m², as shown in Figure (3). It includes two mechanical slipways for the maintenance and repair of fishing vessels, with a total area of 7,200 m². At the entrance of the port, there are two solar-powered beacons: a red one at the head of the eastern breakwater and a green one at the head of the western breakwater. Additionally, the lighthouses at the entrance of the navigational channel have recently undergone maintenance. The port has been registered with the Egyptian Authority for Maritime Safety, with a navigation notice issued under No. (5) of 2016.

El-Burullus port hosts 28 commercial outlets for various activities, each with an average area of 40 m², as well as 12 workshops serving fishing vessels, averaging 60 m² each. The port also includes several administrative and public service facilities, such as a two-story administrative building, a mosque that has been recently expanded to 400 m², two public restrooms, two garbage collection points, and a security room at the main entrance.

Strategically, the port is located at kilometer 109 on the Coastal International Highway, providing direct connections with Baltim and Kafr El-Sheikh. It is also linked to several paved local roads that connect the port with fish farms and industrial areas, thereby facilitating seafood transport. Despite the efficiency of the international highway, some of the secondary access roads require improvement and maintenance to ensure smooth mobility, particularly during peak seasons and adverse weather conditions. Internally, an 850-meter road network connects the port's facilities, supporting operational efficiency.

3- El-Maadiya Fishing Port

The port is served by three fuel stations: the first located inside the port with a capacity of 450 m³ (Figure 3), the second on Edku's ring road, and the third approximately 0.3 km from the port. It also features two mechanical slipways for vessel repair and one slipway dedicated to smaller fishing boats. Two solar-powered lighthouses are

installed at the port entrance to facilitate both day and night navigation, while three pairs of buoys mark the navigational route inside and outside the port, ensuring safe vessel movement. Security is reinforced by the presence of border guards and intelligence services, who monitor vessel inspections, fishermen's movements, and fishing equipment, thereby enhancing the safety of this vital hub.

El-Maadiya port accommodates a wide range of facilities, including an administrative building, an under-construction fire pipeline, a cold storage building, three fueling stations, three slipway areas, and 38 workshops supporting fishermen and vessel maintenance, each averaging 45 m². Other facilities include a transformer room, a fry collection storehouse, and 14 commercial outlets serving as restaurants, cafeterias, and grocery shops.

In terms of connectivity, the port is linked to Edku's ring road, which connects it to the Coastal International Highway through multiple access points. This network facilitates the movement of goods and services from and to the port. In addition, paved local roads connect the port with factories, fuel stations, fish farms, and the cities of Rosetta (Rashid) and Damanhur. Such connectivity enables efficient transport of fish and ice, while also supporting the operation of factories and packaging centers located within the port.

The study area plays a vital role in supporting both the local and international economy, serving as one of the key nodes in the marine supply chain that facilitates the export and import of fish products. Moreover, the Mediterranean fishing ports provide significant employment opportunities in diverse fields, including dock labor, maritime transport, vessel maintenance, fish trading, administrative work, workshops, and technical services, among others.

Al – Ma'addiya Fishing Port **Elburullas Fishing Port** **Port Said Fishing Port**

Source: Field Study, 2025

Figure. 3 Fuel Stations in the Fishing Ports

4. The Future of the Study Area

According to the International Transport Forum, the size of fishing ports is expected to increase fourfold starting from 2025 in order to meet the rising demand for maritime transport. Despite the advantageous geographical location of **Port Said Fishing Port**, its current site is limited in size and does not allow for future expansion as it is located within the dense urban fabric of the city. Therefore, it is necessary to consider relocating the port to a more suitable site. The most appropriate location may be near **El-Ferdous Village, close to the Port Said Inlet and Lake Manzala**. This new site would provide a wider area for development, facilitate vessel movements, reduce congestion inside the governorate, and enhance operational efficiency, thereby contributing to a more sustainable fishing industry.

On the other hand, **El-Burullus Port** has the potential to expand eastwards, offering vast opportunities for development and transformation into a fully integrated commercial port. This transition would strengthen its economic role, broaden its activities, and support maritime trade in the surrounding region. Similarly, **El-**

Maaddiya Port has the capacity for eastward expansion due to the presence of unused land owned by the port that has not yet been exploited. This would help achieve sustainable development and improve both internal logistics and operational efficiency of the ports.

5. Conclusion

5.1. Findings

- The three ports of the study area have a long historical background, as confirmed by various sources and references. **Port Said Fishing Port** was established in 1956 and officially opened in 1958. **El-Burullus Port** was developed based on the approval of the Armed Forces Operations Authority No. 2103/98 between 2001 and 2009. **El-Maaddiya Port** dates back to ancient times when it served as a fishing and trading area, and was modernized in 1995 through a Japanese grant and later handed over to Egyptian administration.
- The three ports enjoy **strategic geographical locations** along the Mediterranean coast, which enhances their economic, commercial, and navigational importance.
- **El-Burullus Port** is the largest fishing port among the three and stands out in terms of design and structural features, as it was planned with the assistance of a specialized consultant. Morphological analysis confirms that it is the most efficient fishing port.
- The total quay lengths are: **Port Said (960.47 m), El-Burullus (840m), El-Maaddiya (505 m)**.
- All three ports provide basic services for fishing vessels and fishermen, including **fuel, storage facilities, slipways, and fish markets**.
- The efficiency of the ports is strongly influenced by their road networks: **Port Said Port** benefits from a strong and well-connected road system; **El-Burullus Port** acts as the main link between Baltim and Kafr El-Sheikh; while **El-Maaddiya Port** directly overlooks the Mediterranean and is connected to the coastal highway through multiple access points, facilitating transportation.

5.2. Recommendations and Proposals

- Develop and expand the three fishing ports to accommodate more vessels, with regular dredging operations.
- Provide **training programs** for fishermen and port workers to familiarize them with modern systems and reduce reliance on traditional methods.
- Utilize **unused land** in both El-Burullus and El-Maaddiya Ports for future development. For Port Said, select a new site to establish a more suitable fishing port that allows for expansion.
- Introduce **modern electronic management systems and technologies** to maximize fish production and operational efficiency.
- Streamline **security and licensing procedures**, including those related to coast guards and navigation services, to enhance operational speed and reduce bureaucracy.

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