

# Ports, Cities, and Hinterlands: Historical Investigation of the Economic Relationship between Karachi and the Indus River Basin

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**Abstract:** Karachi is the largest port in Pakistan, a key port in the China Pakistan Economic Corridor, and a major port in the Indus River basin. Its advantageous geographical location, vast hinterland, and superior port construction conditions have formed a certain scale effect. In the development process of Karachi Port, there are many problems such as limited spatial resources, prominent conflicts between the port and the city, and crowded collection and distribution channels. Based on the actual situation of Karachi Port, this article combined its development advantages and direction, and utilized the Karachi Port development pattern of "internal optimization, external connectivity, eastern connection, and western expansion" (Karachi Port not only needs waterway development, but also inland development, playing a true role in internal optimization and external connectivity). After adopting the method described in this article, the cargo throughput of Karachi Port was 5106.05 million tons; Kasim Port was 4806.32 million tons, and Gwadar Port was 207.63 million tons. The development mode and concept of this article have certain reference significance for similar ports and cities with prominent contradictions and insufficient collection and distribution capacity.

**Keywords:** Port City Hinterland, Economic Relations, Indus River Basin, Historical Investigation, Collection and Distribution Capacity

## 1. Introduction

Since Pakistan's independence, Karachi has evolved from a city primarily focused on transportation, integrating industry, commerce, transportation, finance, politics, and culture, while also expanding. In fact, the functions and scale of cities are usually inherently related and interact with each other. Generally speaking, a city with more functions has a larger scale, and as the city grows in size, it also derives new functions. Therefore, there is a causal relationship between the expansion of Karachi's urban functions and its expansion. This article's historical examination of the economic relationship between Karachi and the Indus River Basin is beneficial for enhancing the further development of Karachi's city.

This article suggested the construction of a special port road at Karachi Port and the addition of a collection and distribution system with ML-1 (Main Line 1) as the freight channel in the medium to long term. The main content of this article is as follows:

The first part is the background and significance of the historical investigation and research on the economic relationship between Karachi and the Indus River Basin, including ports, cities, and hinterland.

The second part is related work.

The third part is the historical investigation of the economic relationship between Karachi and the Indus River Basin and the exploration of port development.

The fourth part is the results and discussion.

The fifth part is conclusions.

## 2. Related Work

The economic development of a port and a city is interdependent. It provides a good environment for the development of industries such as industry, commerce, trade, and services, thereby further enhancing the comprehensive competitiveness of a city's industry and promoting its economic development and prosperity. Yang Wenwu believed that urban economic development is an important guarantee for port development, as well as an important way to promote port infrastructure construction and service level improvement [1]. Ye Shanchun conducted an integrated study of 40 literature using meta-analysis method. Research has found that the development of ports has a significant impact on the urban economy, but the results show heterogeneity. These two relationships are influenced by factors such as port size, port location, and the regulation of major goods [2]. Zhou Baogang's research results showed that ports such as Dalian Port and Dandong Port continued to maintain their good development momentum in the coming years and regarded them as a sustainable and stable growth driver [3]. Liu Runzhe planed to take Ningbo City as an example, selected relevant data from 1990 to 2019, used mathematical statistical methods to empirically test the key indicators that affect the development of Ningbo port and urban economy, and summarized the current situation and problems of the mutual influence between port and city. He utilized the feedback effect of strengthening the "port city" to build an "intelligent Ningbo Port", seeking new economic growth points for the "port city" and accelerating the coordinated development of Ningbo's "port city" such as "regional linkage" [4]. Taking Guangzhou Port as the research object, Han Jinghui selected the output value of the first, second and third industries in Guangzhou, import and export of foreign trade, fixed assets investment and other indicators to characterize the economic situation of the region, and applied the gray correlation method to conduct an empirical study of Guangzhou [5]. Liu Hong planed to use the Liaoning Binhai Economic Development Zone as an example to construct a port city relationship model. He believed that the state or trend of the "port port" relationship is not determined by the size of the "port" or "city", but by the development stage, industrial structure, and the interrelationship between the "port city" and the "port city" [6]. However, the research of the above scholars lacks detailed examination of the relationship between ports, cities, and hinterland.

From the perspective of development economics, the development of the hinterland economy is uneven at different stages, industries, and regions [7-8]. The role of ports has both positive and negative effects, such as promoting regional economic development through ports. The port has played a driving role in improving the industrial level of the hinterland [9]. The high correlation between ports has promoted the rapid development of regional economy. At the same time, the hinterland economy plays a multifaceted role in the development of ports. For example, the changes in the hinterland economic structure affect the direction of its development; ports take the integration of hinterland economy as an opportunity to promote the development of port logistics. The hinterland economy and port development are closely related and mutually influential [10].

## 3. Methods

### 3.1 Development Advantages of Karachi

#### (1) Location advantage

Karachi Port is located in the northern Arabian Sea, southwest of Karachi, the largest economic city in Pakistan, adjacent to the eastern outlet of the Y-shaped area of the China Pakistan Economic Corridor, and adjacent to Sindh Province [11-12]. Due to its advantageous geographical location, Karachi Port remains the largest port to Pakistan for a considerable period of time in the future.

#### (2) Hinterland advantage

The Karachi port is bordered by provinces along the China Pakistan Economic Corridor. Karachi, as the largest economic city in Pakistan, has over 20 million residents [13]. Sindh Province has a population of over 60 million and is the second largest economic entity in Pakistan, responsible for the country's largest industrial output. The China Pakistan Economic Corridor starts from Kashgar, Xinjiang, runs along the China Pakistan Highway and the Indus River, running through major population and economic development zones in Pakistan, and connects to Sindh Province in the east. Now, there are two high-grade highways running through the north and south along the route, and the ML-1 National Rail Transit runs through the north and south. The Karachi Port has a vast hinterland, smooth external transportation, abundant cargo sources, and meets development needs [14-15].

### (3) Advantages of port construction conditions

The Karachi Port is located in the northern Arabian Sea, with the main wave direction in the open sea being southwest. Its maximum wave height can reach 4.5 meters, mainly due to surging waves [16]. The Manora natural sand dam is located on the west side of the port area, forming a 10 km natural sand dam that can effectively block the sedimentation of water and sediment, avoid the invasion of ships by wind, waves, etc., and provide favorable shelter for the safety of the dock. At the same time, the port area is within -22 meters of the nearshore waterline, and the main waterways are short, providing favorable conditions for constructing large deep-water berths.

### (4) Current scale advantage

Karachi Port has 37 berths of various types, among which the 100000 ton berth is the largest. The port capacity has only been developed by about half, and there is still a lot of development space [17].

## 3.2 Port Cargo Flow and Karachi Port Positioning

Based on the development status and freight structure of Pakistani ports, the production and sales balance method and composite factor method are used to study three major categories of goods (dry bulk cargo, liquid bulk cargo, and containers). It can be predicted that the cargo throughput of Karachi Port can be completed in the fiscal years 2030-2031 and 2040-2041 [18-19]. On this basis, by analyzing the flow of various goods at Karachi Port, the existing transportation network, and the distribution of population and GDP in Pakistan, it is expected that the cargo volume of Karachi Port through Karachi City can be increased in the fiscal years 2030-2031 and 2040-2041. Most of these products are located north and east of Islamabad, Lahore, and Karachi in northern Pakistan [20].

The huge cross city freight flow has brought great pressure to Karachi's urban transportation, and there is an urgent need to establish a new collection and distribution system, or establish new distribution centers in new port areas to meet the above transportation needs. Comparing the advantages and disadvantages of Karachi and Kasim ports, it is pointed out that Karachi port has a high scale and container transportation capacity, but there are shortcomings such as limited space resources, prominent port city conflicts, and serious environmental pollution. In the future, it can be used as a port mainly exporting clean bulk goods such as containers and steel, and jointly built with Karachi to become a regional international shipping center. Kasim Port has good collection and distribution conditions, rich coastline and land resources, and is close to industrial areas. However, it also has a disadvantage, which is that it is far from the city, has a large number of cargo terminals, and is relatively scattered. It can develop into an energy hub mainly powered by bulk cargo.

Trade dependency index:

$$TD = (X + M) / (GDP + F) \quad (1)$$

Among them, X represents the export value, and M represents the import value. This index is used to measure the degree of dependence of a country or region's economy on foreign trade.

Freight flow index:

$$GFI = (T / P) * \beta \quad (2)$$

Among them, T represents cargo throughput, and P represents urban population. This index is used to measure the proportion of goods flow in a port city relative to its population size, reflecting the logistics status of the port and its importance in the economy.

Trade geography index:

$$TGI = (M1 * M2) / D \quad (3)$$

Among them, M1 and M2 represent the economic scale of the two regions, and D represents the distance between the two regions. This index is based on a gravity model and measures the expected size of trade flow between two regions, taking into account the impact of geographical distance on trade.

## 3.3 Karachi Development Model

### (1) Internal optimization

Karachi Port has a certain scale, but some ports have not fully utilized their economies of scale due

to long construction time, outdated equipment, insufficient land depth, and chaotic functional layout. Therefore, this article intends to modernize the existing ports, improve their throughput, and combine their positioning to optimize their overall functional layout, adjust their operating areas, and achieve economies of scale. At the same time, some goods that are not suitable for the development of modern ports, require a large amount of rear land, pollute the surrounding environment, and have high traffic requirements are optimized to new port areas or adjacent ports.

#### (2) External communication

The roads and rail transit of Karachi Port are facing capacity shortages and contradictions with urban development. With the continuous expansion of the port scale, there is an urgent need to solve the traffic capacity of the existing collection and distribution corridors through new freight channels, while reducing their disturbance to the surrounding environment. Starting from the existing collection and distribution system of Karachi Port, this article utilizes the construction of dedicated road freight channels combined with railway reconstruction to improve its collection and distribution capacity. On the basis of the existing Mauripur, it is planned to build an elevated bridge in the western part of the urban area, connecting with Lyari Avenue, and connecting with the national highway in the northern part of the urban area to achieve the diversion of roads in the port area and reduce the impact on the urban area. Railway reconstruction can improve the transportation capacity of the railway in front of the port by repairing the existing port railway, setting up unloading stations and port front stations behind container berths, and then using the ML-1 line to select a freight station and logistics center outside Karachi city to achieve container disassembly and customs clearance, reducing the number of port trucks.

#### (3) Eastern union

The eastern part of Kasim Port, 35 kilometers away from Karachi Port, is an approximately 40 kilometer estuary port. At present, the port focuses on developing the transportation of various goods such as dry bulk cargo, liquid bulk cargo, liquefied natural gas, and containers along both banks of the river. Kasim Port has abundant available coastline and estuarine tidal flats, with broad development prospects. Karachi Port can be combined with Karam Port for division of labor and staggered development, and can transport some goods with high environmental pollution from Kasim Port to here. Karachi Port can develop ocean shipping and transshipment trade, while Kasim Port can develop nearshore shipping. The channel of Qasim Port is rich in maintenance and dredging soil resources, which can create a new operation area from the existing mudflat reclamation, develop petrochemical and other related industries, drive the local economic development, and transfer the crude oil processing operations of the existing Karachi Port to other places.

#### (4) Western expansion

There are currently many undeveloped open coasts and land in the western part of Karachi City, all of which belong to Balochistan Province. The sea area is about 20 kilometers away from Karachi City, facing the Arabian Sea, close to the deep-sea isobath, backed by the N25 national highway, with a superior development environment, especially suitable for the construction of large ports. Karachi Port can cooperate with Balochistan Province to establish an industrial zone in the west of the city to promote the development of the port. At the same time, a large public dock can be established at the appropriate time to transfer transportation from Karachi Port to other places through the urban area. Through the above measures, Karachi can rely on the city to form a port cluster with lower logistics costs in the surrounding areas. Each port can enhance its ability to serve the hinterland economy through complementary advantages, mutual cooperation, and orderly competition.

### ***3.4 Development Ideas for Karachi Port***

The current collection and distribution system of Karachi Port still has a serious capacity gap, and there is an urgent need to solve this problem by building a new collection and distribution system. Reasonable decisions can only be made after a comprehensive analysis of the cargo structure, investment, benefits, and engineering feasibility of Karachi Port. By analyzing various waterway schemes and their combinations, it is concluded that the use of new waterways can meet the requirements of existing cargo transportation structures, and the completion of waterways does not require the transformation of existing transportation modes, which has high social acceptance and minimal impact. This project has the characteristics of low investment and short construction period, and can quickly solve various difficulties encountered by Karachi Port. After the completion of this project, it can be used as a port waterway in the short term and can be converted into an urban highway

in the long term. Shipping can increase its annual freight capacity by tens of millions of tons through the promotion of the ML-1 line, adjustment of freight structure, and increasing freight demand, with the ML-1 line as the main freight channel. At that time, the newly constructed road is able to meet the freight needs of Karachi Port throughout the city in 2040. Tunnel engineering can only be maintained through government subsidies and other means due to its low investment returns. Taking the Lingang area as an example, it is a good development strategy to develop an industrial new city based on reclamation, and then subsidize low-income projects with commercial properties. For this reason, Karachi Port can consider "building a city by enclosing the sea" in the western water migration area, or use the existing land in the urban area of the Port Authority for commercial development, and integrate the development of the port area through various means such as new cities, existing land commercial development, and waterway engineering. Karachi Port should timely promote its eastward connection, westward expansion, and internal optimization based on its own development needs, in order to achieve sustainable development.

#### 4. Results and Discussion

##### 4.1 Monthly Increase in Annual Freight Capacity for Fiscal Years 2030-2031 and 2040-2041

Karachi Port experienced a monthly economic growth of 10% in 2022 and 12% in 2023. Based on this trend, this article presents the annual monthly freight capacity growth for the fiscal years 2030-2031 and 2040-2041. In the development forecast of Karachi Port, the monthly increase in annual freight capacity for fiscal years 2030-2031 and 2040-2041 is shown in Table 1. A total of 20.33 million tons are increased in the fiscal year 2030-2031, and 36.11 million tons are increased in the fiscal year 2040-2041.

Table 1: Monthly increase in annual freight capacity for fiscal years 2030-2031 and 2040-2041

Time(month)	2030-2031 financial year(10000tons)	2040-2041 financial year(10000tons)
7	5	92
8	10	107
9	26	190
10	32	214
11	94	237
12	150	251
1	184	257
2	184	341
3	268	361
4	320	387
5	375	536
6	385	638

##### 4.2 Cargo Throughput and Proportion at Different Ports

The cargo throughput of Karachi Port is 5066.05 million tons; Kasim Port is 4776.32 million tons, and Gwadar Port is 157.63 million tons. Karachi Port has the highest proportion of cargo throughput. The throughput and proportion of goods at different ports are shown in Figure 1.

The throughput and proportion of goods at different ports after adopting the method described in this article are shown in Figure 2. The cargo throughput of Karachi Port is 5106.05 million tons; Kasim Port is 4806.32 million tons; Gwadar Port is 207.63 million tons. Karachi Port still has the highest proportion of cargo throughput.

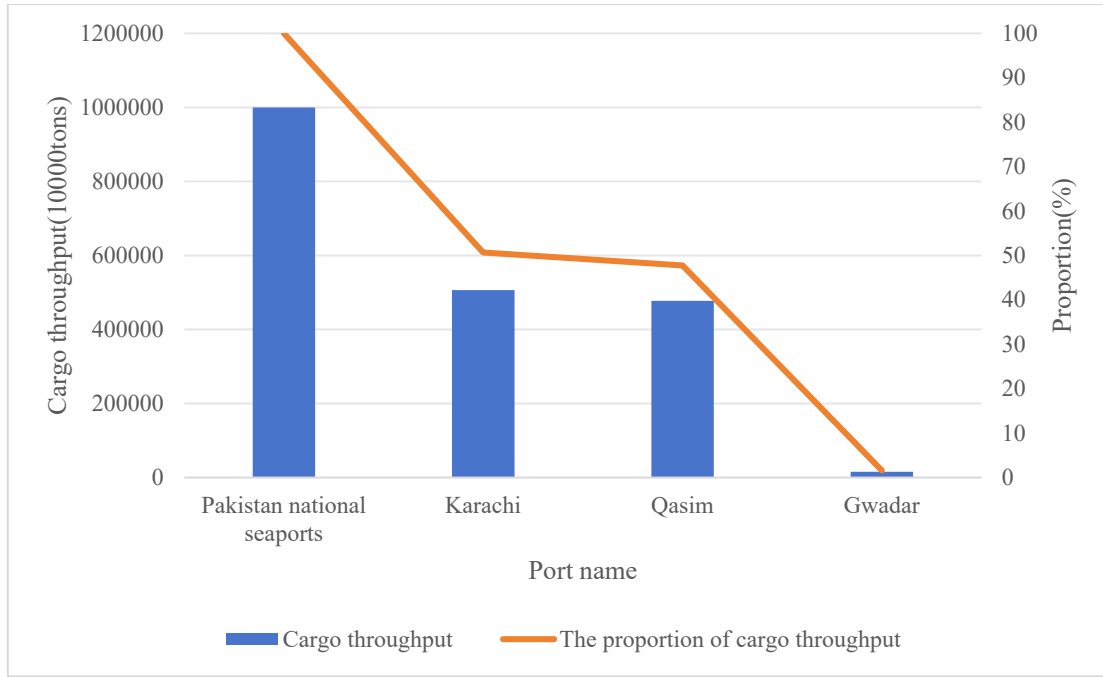


Figure 1: Cargo throughput and proportion at different ports

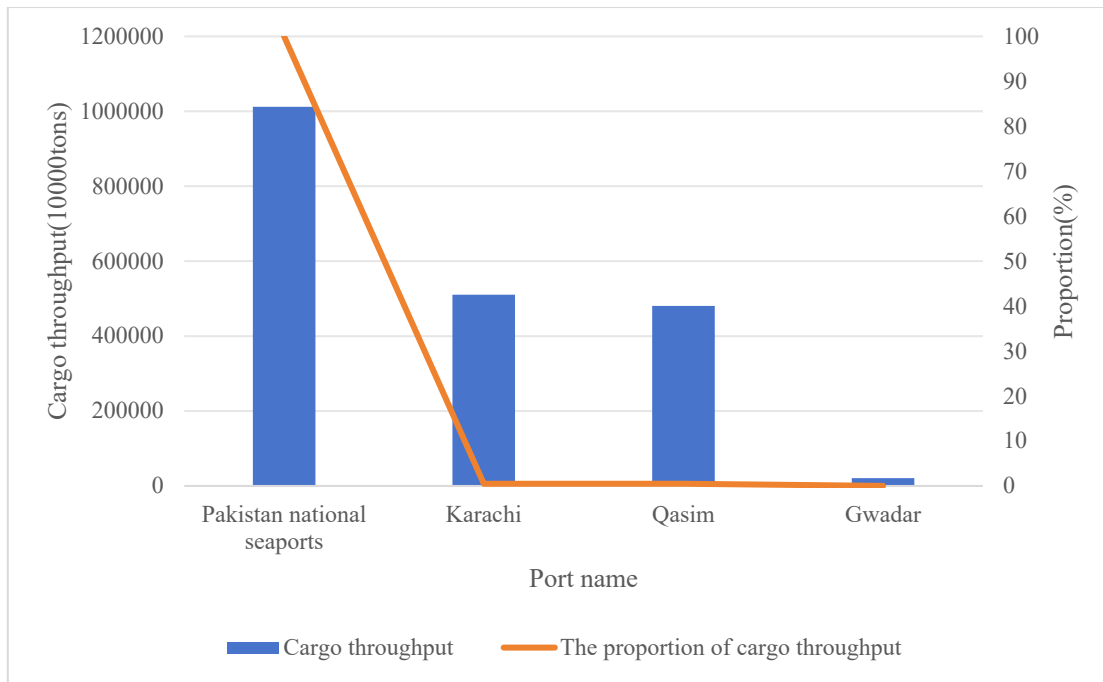


Figure 2: Cargo throughput and proportion at different ports after adopting the method proposed in this article

### 4.3 Impact of Trade Activities on Economic Growth

The economic growth rate of the Indus River Basin region, as shown in Figure 3, increased by 1.4% in 2022 due to the increase in trade activities at the Karachi port.

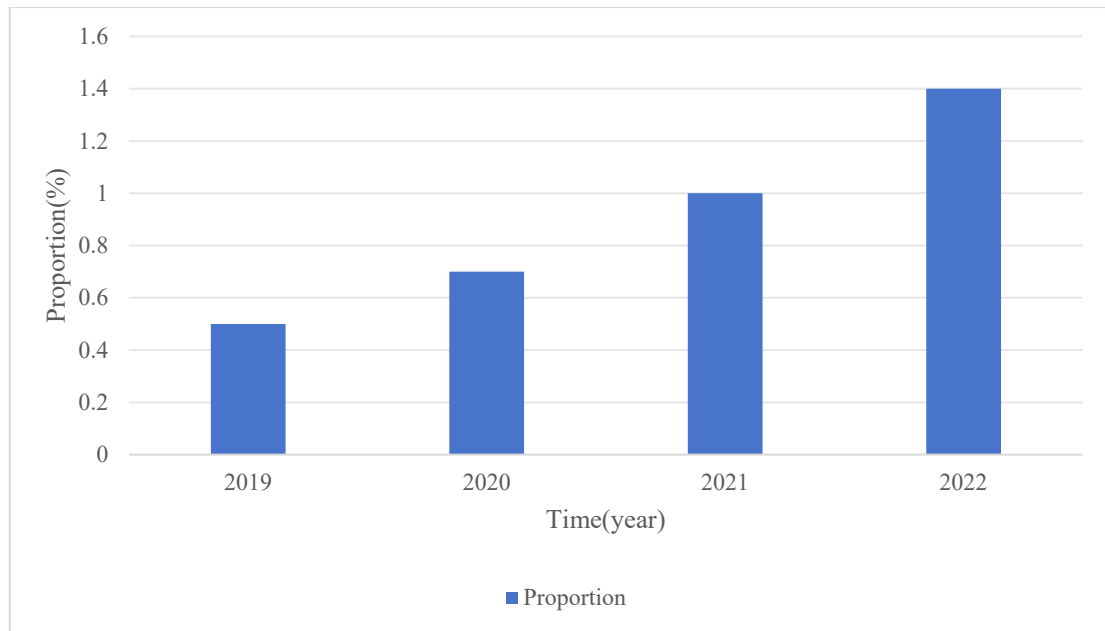


Figure 3: The proportion of increased economic growth rate in the Indus River Basin region due to trade activities at the Karachi port

## 5. Conclusions

The formation and development of a city are closely related to its economic development, and each stage would lead to changes in its regional spatial characteristics, and new demands would be placed on its research and development strategies. Essentially, a port is a type of service industry that has the same characteristics as other services, that is, it must rely on productivity and trade. Therefore, when the hinterland economy develops to a certain extent, its production and trade would become more developed, and it would have greater development space. Karachi's history is not long, and since Pakistan's independence, it can be divided into different periods. Based on the development of Karachi and port engineering, this article aimed to improve the cargo throughput and proportion of different ports through methods such as internal optimization, external communication, eastward connection, and westward expansion. In the near future, it would become a port primarily engaged in clean dry bulk goods such as containers and steel, as well as a regional international shipping center.

## References

- [1] Yang Wenwu. *Analysis of the Relationship between Ports and Urban Economic Development*. *Modern Commerce and Industry*, 2023, 44 (14): 89-90.
- [2] Ye Shanchun, Ou Weixin, Xiao Bin. *Research on the Relationship between Port Development and Urban Economy: Based on Meta Analysis Perspective*. *Journal of Guangzhou Maritime College*, 2021, 029 (003): 46-51.
- [3] Zhou Baogang, Yang Bo. *The relationship between the radiation capacity of Liaoning ports and urban economic development*. *Journal of Shenyang Institute of Education*, 2021, 023 (003): 279-286.
- [4] Liu Runzhe, Wu Ling. *Empirical Analysis of the Interactive Development between Ningbo Port and Urban Economy*. *Journal of Ningbo University of Engineering*, 2021, 33 (3): 57-63.
- [5] Han Jinghui. *Grey correlation analysis between the cargo throughput of Guangzhou Port and regional economy*. *Technology and Industry*, 2022, 22 (11): 275-279.
- [6] Liu Hong, Yan Yuqing, Zhou Baogang. *A Study on the Driving Relationship and Influencing Factors of Port Cities Based on Green GDP: Taking the Liaoning Coastal Economic Belt as an Example*. *Henan Science*, 2023, 41 (1): 97-107.
- [7] Gu Y, Loh H S, Yap W Y. *Sustainable port-hinterland intermodal development: Opportunities and challenges for China and India*. *Journal of Infrastructure, Policy and Development*, 2020, 4(2): 228-248.
- [8] He D, Sun Z, Gao P, et al. *Spatial-temporal evolution of the port-hinterland relationship: A case study of the Midstream Yangtze River, China*. *Growth and Change*, 2019, 50(3): 1043-1061.

- [9] Attema P A J, Carafa P, Jongman W M, et al. *The Roman Hinterland Project: integrating archaeological field surveys around Rome and beyond. European Journal of Archaeology*, 2022, 25(2): 238-258.
- [10] Huang G, Feng X, Chen M, et al. *Spatial evolution model of port group hinterland from the perspective of intermodal transport. Maritime Policy & Management*, 2023, 50(3): 390-411.
- [11] Ahmed K, Hassan N, Akhter N, et al. *Chemical and morphological characteristics of heavy and hazardous metals in settled dust associated with different functional areas of Karachi. Pakistan. Journal of Biodiversity and Environmental Sciences*, 2019, 15(3): 46-58.
- [12] Ahsanullah, Khan S H, Ahmed R, et al. *Morphological change detection along the shoreline of Karachi, Pakistan using 50 year time series satellite remote sensing data and GIS techniques. Geomatics, Natural Hazards and Risk*, 2021, 12(1): 3358-3380.
- [13] Akbar S H, Iqbal N, Van Cleempoel K. *Saddar Bazar Quarter in Karachi: A Case of British-Era Protected Heritage Based on the Literature Review and Fieldwork. Heritage*, 2023, 6(3): 3183-3210.
- [14] Alamgir A, Khan M A, Fatima N, et al. *Impact of domestic and industrial effluent on marine environment at Karachi Port Trust (KPT) coastal area, Pakistan. Environmental Monitoring and Assessment*, 2023, 195(11): 1-22.
- [15] Amin G, Shahzad M I, Jaweria S, et al. *Measuring land deformation in a mega city Karachi-Pakistan with sentinel SAR interferometry. Geocarto International*, 2022, 37(17): 4974-4993.
- [16] Chhabria S. *Citing the poor: commercial sovereignty and capitalist integration in colonial Karachi. Journal of Urban History*, 2019, 45(5): 987-1005.
- [17] Ghayas S, Siddiquie J S, Safdar S, et al. *An application of principal component analysis for the temporal variations in water quality data of Manora channel: Karachi. International Journal of Computer Science and Network Security*, 2019, 19(5): 1-8.
- [18] Jabeen H, Afzal N. *Development of Communication System: Key to Socio-Economic Development of Karachi (1857-1900). Jahan-e-Tahqeeq*, 2021, 4(3): 372-385.
- [19] Mahmood H, Khan M M. *Urban solid waste management in Karachi, Pakistan. International Journal of Economic and Environmental Geology*, 2019, 10(1): 78-83.
- [20] Gachuno Onesmus. *Relationship between Marine Resources growth and Marine Economy Based on Neural Network. Frontiers in Ocean Engineering*, 2022, 3(4): 28-35.