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Are the Egyptian Cities Ready to Allocate Export Processing Zones (EPZs)? Comprehensive Spatial Assessment

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ABSTRACT

Export Processing Zones (EPZs) are key economic tools for developing countries, attracting foreign direct investment, modernizing industries, creating jobs, increasing exports, and facilitating technology transfer. This study evaluates the spatial and urban readiness of Egyptian cities for traditional EPZs, given that such factors significantly impact the success of these zones. The analysis includes five main indicators: city urbanization, connectivity and gateway cities, industrial facilities and support, infrastructure networks, and availability of development-ready land. These indicators were applied to 76 Egyptian cities, each having industrial significance, port access, or metropolitan status characteristics typical of EPZs locations. Using factor and cluster analysis, the study identified the cities most suited for EPZs allocation. Findings reveal that only 6 cities demonstrate excellent readiness for traditional EPZs, 22 show good readiness, 21 are moderately ready, and 19 have low readiness, while 8 cities rank lowest in readiness. By deepening understanding of spatial and urban aspects for EPZs development, this research aids policymakers in making informed allocation decisions for EPZs.

1. INTRODUCTION

Export Processing Zones (EPZs) are considered one of the most important types of Special Economic Zones (SEZs) worldwide and are the most common. They are generally defined as industrial areas enclosed by fences, primarily targeting foreign markets. These zones are subject to customs control and provide companies with free trade conditions, aiming to export most of the produced goods (at least 80%) [1]. EPZs are a tool of regional policy aimed at attracting capital and foreign direct investment to stimulate the economy, enhance development and economic competitiveness, and create new job opportunities [2]. In these zones, the government applies different rules from the rest of the country in administrative, regulatory, and financial systems [3-5].

EPZs are generally classified into three main types:

- Traditional EPZs: This type, which is the focus of this research, designates the entire area exclusively for export-oriented factories licensed under the regime [6].

- Single Factory EPZs: These zones provide incentives to individual enterprises regardless of location. Factories do not have to be located within a designated zone to receive these incentives [4].

- Hybrid EPZs: In this model, EPZs are divided into two main areas. The first is a general EPZ open to all industries, while the second is a separate EPZ area specifically for registered export-oriented enterprises [6].

In addition to this definitional framework, EPZs aim to achieve broader objectives such as enhancing trade growth, increasing exports, foreign exchange earnings, and supporting economic and industrial diversification [7]. They also seek to attract new technologies, accelerate economic development, and contribute to economic reform strategies, moreover, these zones help address widespread unemployment, foster linkages with local firms [8], and are considered potential catalysts for development, especially in emerging economies [3]. Therefore, the success factors for any zone include its ability to achieve these goals, its role in structural transformations, and its impact on social and environmental objectives [9].

The Asian experience, for example, has demonstrated the success of EPZs in driving significant economic transformations. For instance, the Asian bloc, led by China, successfully utilized EPZs to drive economic development, turning the region into a global economic powerhouse. This success has inspired many developing countries to adopt similar models [10].

Although many studies have addressed the theoretical, economic, and institutional aspects of EPZs, there remains a gap in understanding the spatial and urban factors affecting these zones, particularly in developing countries like Egypt. Therefore, the main objective of this research is to assess the spatial and urban readiness of Egyptian cities for allocating traditional EPZs. Factors such as urban expansion, connectivity, gateway cities, industrial facilities and support, infrastructure networks, and availability of development-ready land significantly impact the success of these zones.

By applying a set of indicators across 76 Egyptian cities, the research identifies the most suitable cities for EPZs allocation, providing valuable insights for policymakers. It also contributes to filling the existing knowledge gap and offers practical recommendations for the optimal distribution of EPZs in Egypt.

2. THE ALLOCATION FACTORS OF EPZs

EPZs are an effective tool for promoting industrialization and structural transformation, but only when implemented correctly and under favorable conditions. The zone must be adapted to the specific circumstances of the host country and should build upon its competitive advantages [1]. Moreover, it is essential to treat the requirements for EPZ allocation as an interconnected set (geographical, economic, regulatory, etc.) [11]. This highlights the importance of coordination between these factors for sustainable success of the zone. However, these factors may be interrelated and complex in some cases, as the integration of economic, regulatory, and physical factors may not always be smooth, especially when infrastructure or government policies are misaligned with market requirements or the investment environment.

UNCTAD classifies the key success factors for EPZs into three main groups: regulatory factors, economic factors, and physical or spatial factors. Regulatory factors involve the organization and coordination of institutions responsible for the zones' implementation, while economic factors focus on elements that affect the zone’s performance and its broader economic impact. Physical or spatial factors primarily address the location of the EPZ and the supporting infrastructure both within and around the zone. The most successful EPZs leverage existing strengths, such as transportation networks and trade infrastructure, to enhance local and international connectivity [12]. However, relying on these pre-existing advantages does not always guarantee success if the infrastructure is not sufficient or advanced enough to meet the needs of the industries targeted by the zone.

The allocation of EPZs should not be based on political considerations but on economic and technical grounds. EPZs that leverage pre-existing advantages, such as transport and trade-related infrastructure that provide local and international connectivity, are more likely to be successful. If the industries within EPZs are not aligned in any way with the country’s competitive advantages, strategic location, or proximity to input suppliers and markets, the zone is highly expected to fail in achieving its goals [13].

2.1 The importance of spatial and urban factors

Recent research indicates that EPZs are partly based on the simplicity and effectiveness of tax exemption arrangements for companies. When searching for a new project location, investors begin by conducting research across multiple countries and hundreds of sites to determine the optimal place for business operations. It has been observed that tax exemptions within EPZs have become less significant in the site selection process, while other aspects of the operating environment have gained importance, such as selecting locations with regional geographic advantages, providing infrastructure, skilled labor, and efficient market access. Successful EPZs adopt a holistic or partial approach, where strategic site selection with sound infrastructure is fundamental [1]. Nearly all successful zones worldwide, which are characterized by intense competition, rely on high-quality infrastructure, market size, and geographic excellence. To act as catalysts for structural transformation, these zones must be connected to ports, railways, and highways with good logistics and facilities tailored to meet business needs [1, 14].

The authors emphasize that while some literature suggests that the success of EPZs increasingly depends on spatial and urban factors, with a decline in the importance of economic incentives, this decline does not mean the complete elimination of the importance of incentives. Instead, it highlights the need for integration between economic incentives and spatial and urban planning. Incentives can complement spatial factors in attracting investors, especially in areas lacking developed infrastructure. Therefore, the success of these zones requires the adoption of a comprehensive approach.

2.2 Key spatial and urban factors for successful EPZs

There is no global standard formula for measuring the success of EPZs, but it is generally determined by whether they meet the objectives set at their establishment (typically over a period of 10 to 15 years); these objectives are usually linked to quantitative measures of economic development outcomes such as investment, employment, foreign exchange earnings, or export generation, they are also related to economic and political reforms and urban development [1]. Therefore, it is acknowledged that there are no one-size-fits-all factors for the allocating and development of EPZs, however, there are several key success factors that governments, operators, and investors can implement when allocating, designing, and implementing these zones [4]. The following section provides a more detailed explanation of the spatial and urban factors based on a series of previous studies and global experiences.

2.2.1 Geographic location

Global experience has shown that a strategic location near major infrastructure hubs, large markets, and labor pools is essential to attract investors to the area [15]. The strategic geographic location is one of the most important factors for the success of EPZs, for example, the Chinese experience clearly demonstrates the advantage of geographic location, as most Chinese EPZs are located in coastal areas, major urban cities, or their vicinity, or in cities with a history of foreign trade. These locations benefit from good access to key infrastructure such as ports, airports, and railways, and have excellent connectivity to the international market, these characteristics have allowed Chinese cities like Shenzhen, Dongguan, and Huizhou to rapidly emerge as major manufacturing bases in the world. An analytical study of 321 Chinese cities between 1987 and 2008 (aimed at evaluating China's experience in EPZs showed that EPZs in these cities increased foreign direct investment by 21.7% and the growth rate of foreign direct investment by 6.9% [16].

The experience of Morocco also demonstrated the significant contribution of geographic location to the success of EPZs, such as the Tanger Med Zone located 14 km from Spain in the Strait of Gibraltar. This location provides access to shipping routes to Africa, Asia, Europe, North America, and South America, with the Port of Tangier and a network of roads and railways connecting various hubs in the region [15]. In addition, analysis of the Southern African experience shows that when EPZs sites are selected based on political rather than commercial or economic considerations, authorities often overlook infrastructure connectivity, workforce skills, and access to supplies; as a result, most Foreign Direct Investment avoids these sites in favor of locations with better infrastructure and labor markets [12].

The authors argue that geographic location plays a crucial role in the success of EPZs, but relying solely on location may not be sufficient, as seen in the case of South Africa, choosing sites based on political considerations can lead to overlooking critical factors like infrastructure and workforce. Therefore, it is essential to integrate geographic factors with strategic planning to ensure sustainable success for these zones.

2.2.2 Urban centers

Many studies have shown that proximity to large cities is likely to stimulate the dynamics of an area more than remote locations. Similarly, EPZs located in densely populated urban centers tend to be more successful in achieving their goals, in developing countries with one or very few major urban agglomerations, distance to the largest city is negatively correlated with the region's performance. Cities and urban centers offer a range of crucial benefits for the development of EPZs, including skilled labor, diverse markets, capital, easy access to supporting companies, and facilitating the movement of people and goods. Additionally, an EPZ can benefit from the connectivity and integration enjoyed by urban areas within global supply chains [15]. For example, the continuous economic development of a group of Chinese cities has led to the emergence of an urban agglomeration in the central areas of the Yangtze River, with the acceleration of development, urbanization, and industrialization in China, this urban agglomeration has become significantly important, emphasizing industrial links and urban interactions [17].

Similarly, in the Philippines, PEZA zones are often located in retail complexes, mixed-use developments, and high-density cities, there are also several zones situated in major regional centers and urban conglomerations [8].

The importance of urban centers is evident in the experience of the Aqaba zone in Jordan (which is a combination of an EPZ and a Free Trade Zone), This zone is located within the boundaries of the city of Aqaba and extends to the surrounding areas, the city of Aqaba is considered a regional hub for multimodal transportation and a major urban center that contributes to accessing a broader base of international and regional markets, skilled labor, concentrated services, and good connectivity to surrounding areas, in addition to the Aqaba ports (the main, middle, and industrial) and the international airport ,These factors have contributed to the effectiveness of the Aqaba zone, reflected in a 20% increase in FDI investments, a 25% growth in the local economy the creation of approximately 40,000 job opportunities in around 400 establishments, and attracted foreign investments amounting to about $400 billion from its establishment in 2001 until 2017 [4].

This section focuses on the importance of proximity to urban centers and major cities, while acknowledging other potential challenges, such as the lack of available land for future expansion, the negative impacts of urban growth, such as overcrowding, pressure on infrastructure, and environmental pressures.

2.2.3 Public and regional services

Studies have shown that concentrating essential public services in cities hosting EPZs enhances labor mobility within the region, significantly supporting the free movement of capital, technology, information, and other production factors. This also helps improve institutional arrangements for labor supply [18]. Furthermore, EPZs can achieve industrial development more efficiently and effectively when there is an agglomeration of public services in a specific geographic area, especially with the presence of a population cluster or residential block directed toward specific industries [16].

According to the field survey conducted by the UNDP in SEZs in Sierra Leone in 2023, decision-makers emphasized that physical structures such as residential buildings, office spaces, hotels, and shopping centers are the most critical for establishing EPZs, followed by non-physical administrative and operational structures. When discussing the development and operation of these zones, they stressed the importance of considering educational institutions, healthcare facilities, and services specifically designed for investors [14].

2.2.4 High-quality infrastructure networks

Successful EPZs worldwide, such as those in Singapore, China, Malaysia, Korea, and UAE, are characterized by high-quality infrastructure networks (water, electricity, gas, sanitation, and communications), making these zones highly attractive to investors [1]. And the development of good infrastructure networks has a significant impact on the performance of the zone [19]. Conversely, the primary reason for the inactivity of some EPZs in Zambia, Zimbabwe, Namibia, and Tanzania is the lack of required infrastructure networks. For instance, providing infrastructure networks in Tanzanian (EPZs) has been a major challenge, although the (EPZ) system was legally initiated in Tanzania in 2002 and 14 (EPZs) were announced in 2018, only 4 of these zones were operational by 2020, with the remaining zones still in development, these zones suffer from shortages of water, electricity, and sanitation, both on-site and off-site. This has negatively affected investment growth due to the limited number of operational zones. Additionally, weak infrastructure networks and poor operational performance have reduced the competitiveness of companies, even in the operational Tanzanian (EPZs) [12]. Similarly, the Lusaka East zone in Zambia had to reject many investors due to severe power shortages. Therefore, providing adequate infrastructure before opening an EPZ to investors is crucial for its success. In other words, a system that ensures the establishment of necessary infrastructure before attracting investors is more likely to succeed. Conversely, a system that declares an EPZ without prioritizing infrastructure availability before licensing investors is likely to fail [12]. Many governments and developers worldwide are turning to Public-Private Partnerships (PPP) to address these constraints and support the provision of high-quality infrastructure. Therefore, successful (EPZs) are no longer limited to establishing effective regulatory and administrative systems but also ensure good infrastructure networks for the zones [18].

2.2.5 Regional roads and railways

Connectivity and accessibility have contributed to the success of some regions in many countries such as Morocco, Singapore, Pakistan, the UAE, and Malaysia. In contrast, establishing a good network of roads and railways has posed a challenge to the effective operation of the Lekki Zone in Nigeria due to the need for substantial budgets to create these roads and railways that would connect the area to the nearest port and airport [4]. For investors to connect economically and financially with local and international markets, proximity to transportation is crucial. To reduce transportation costs, industrial facilities tend to cluster in specific areas with the best access to markets [18]. The importance of connectivity between individuals, institutions, countries, and EPZs increases as a key factor in achieving competitiveness and economic growth, for regions to act as catalysts for structural transformation, they must have or be connected to railways and highways [1]. For example, the creation of the China-Pakistan Economic Corridor has been essential in enhancing EPZs in Pakistan by linking the country to China and Asian and European markets through a global trade network of roads and railways, thereby helping to attract more foreign investment [20].

2.2.6 Seaports and airports

An analysis of spatial characteristics found that, like many global trends, EPZs were typically located near key port and airport infrastructure hubs. Some of the most successful zones were those situated either within or adjacent to ports, as seaports play a crucial role in facilitating international trade and domestic market exchanges. They also provide services to various industrial sectors. Analysis of several zones revealed that proximity to a port influences the nature of activities in the area, especially when the port includes storage warehouses and focuses on logistics and re-exportation. It's noted that the economic performance of zones depends not only on proximity to ports but also on the ports' capacity to handle adequate shipping volumes. Functions such as storage, warehousing, and distribution are equally important for ports to effectively serve and support economic activities, furthermore, proximity to airports is another key success factor for zones worldwide. Airports not only provide links to local and international markets but also serve as hubs for global supplier networks. The presence of basic transportation infrastructure such as airports and seaports enhance the attractiveness of business in the region, making it more competitive [4].

For example, the Shenzhen Port is considered one of the key factors in the success of the Shenzhen Export Processing Zone in China. As the fourth largest container port in the world, its coastal location and the presence of this port have contributed to transforming Shenzhen into one of the largest EPZs worldwide, with its GDP growing from $4 million in 1980 to $114.47 billion in 2008, and then to $338 billion in 2017 [15]. In addition, the Penang Zone in Malaysia has achieved significant success due to its strategic location near Penang Port, one of the country's most important ports. The presence of this port facilitated the import of raw materials and the export of manufactured goods, attracting substantial investments and contributing to the development of the area as one of Malaysia's key industrial hubs [4].

The authors argue that the importance of ports and airports in the success of EPZs requires noting that the effectiveness of these zones can be significantly affected by the level of development of the nearby port or airport. As the capacity of the port or airport to accommodate commercial activity varies, the level of industrial activity in the area changes, which in turn impacts the investment attractiveness and economic performance of the region.

Based on the previous literature, it is clear that the success of EPZs primarily depends on a set of spatial and urban factors. These factors contribute to enhancing the zone's ability to attract investments and stimulate economic growth. However, the authors emphasize that these factors alone cannot ensure the sustainable success of EPZs, as effective coordination between local and international economic and regulatory policies is required.

3. METHOD

The method followed in this research consists of a series of integrated steps, starting with the identification of factors influencing spatial and urban readiness through a review of previous studies and experiences. These factors were then converted into measurable indicators to be applied to the Egyptian cities under study, which were selected based on criteria also derived from literature and previous experiences. The necessary data was collected through official reports, bulletins, and statistics, which served as the primary source of data related to the cities. These indicators were analyzed using statistical methods such as factor and cluster analysis to assess the spatial and urban readiness of the cities. The following provides a detailed explanation of the methodological steps followed in this research.

3.1 City selection for assessment

Out of a total of 238 Egyptian cities (according to 2017 census data, which is the most recent census in Egypt to date), 76 cities were selected for assessment based on having at least one of the following indicators:

- Population size: Considering the population size as an indicator of labor availability, diversity, availability of public and regional services, and markets. Urban agglomerations with a population of 100,000 or more, classified as 'cities' according to the World Bank's urban cluster degree of urbanization [21] were chosen.
- Port cities: Considering port and airport cities as locations distinguished for allocating EPZs, as mentioned earlier.
- Industrial cities: For their existing industrial infrastructure and supportive environment for industrial activities.

3.2 Indicators selection

A set of 17 Spatial and Urban indicators was identified based on a combination of methodological and practical reasons. First, these indicators were derived from the spatial and urban factors identified through a review of previous studies and research, ensuring their close connection to the factors influencing the spatial and urban readiness of the targeted areas. Second, these indicators were chosen for their relevance to the context of developing countries like Egypt. Additionally, these indicators are measurable, as data related to them is available from official sources within Egypt, such as statistical reports and government publications, making it easier to collect and analyze the necessary data to assess the readiness of these cities for allocating EPZs. These indicators were grouped into five main groups as follows:

The first group: The level of urbanization of the city, which includes the indicators (population size - centralization of regional services - economic function).

The second group: Connectivity and gateway cities, which includes the indicators (having a direct connectivity with, commercial seaports, air cargo ports and dry ports – the connectivity of regional and national roads - availability of railway stations for cargo transport).

The third group: Availability of industrial facilities and supporting establishments, which includes the indicators (presence of: industrial zones - free zones and special economic zones - investment zones - logistics zones).

The fourth group: Infrastructure networks, which includes the indicators (the percentage of buildings connected to electricity, sanitary sewer, drinking water, and natural gas networks).

The fifth group: Availability of development-ready lands, including the indicator (availability of development-ready lands for further expansion inside their Urban Growth Boundaries UGB in the periphery of the city). Table 1 illustrates these indicators and their calculation method.

3.3 Standardizing indicator values

The index number method was used to standardize the values of different indicators (both quantitative and qualitative) onto a unified scale, facilitating comparison and statistical analysis between the various indicators that may have different units of measurement. The highest value for each indicator was chosen as the base value (100), and index numbers for all other values were calculated by dividing each value by this base value and multiplying the result by 100. This transformation ensures that the base value (the highest value) is considered 100, while the other values show their relative percentage compared to this base value. The index number is calculated as follows:

$$\text{Index Number} = (\text{Current Value} / \text{Base Value}) \times 100$$

By setting the highest value for each indicator as 100, the remaining values become relative to this base value. Any value less than 100 indicates lower performance compared to the base value.

3.4 Measuring indicator suitability using the Kaiser-Meyer-Olkin (KMO) method for factor analysis

The suitability of indicators for factor analysis was assessed using the Kaiser-Meyer-Olkin (KMO) measure, which evaluates the variance among variables. Factor analysis was conducted using SPSS software to identify the most influential indicators related to spatial and urban readiness of the Egyptian cities. It helps reduce the number of indicators and identifies the main factors affecting cities classifications.

3.5 Classifying Egyptian cities using cluster analysis

Based on the results of the factor analysis, cluster analysis was then performed using the SPSS software. Cluster analysis is a statistical method used to group cities into homogeneous clusters based on the standardized indicator values. This method groups cities that share similar characteristics based on the indicators derived from the factor analysis. As a result, cities can be classified according to their readiness levels for hosting EPZs in a more precise manner.

Table 1. The indicators and their calculation method

Key Indicator Groups	Indicators	Indicator Calculation Method
Level of urbanization	Population size	Number of populations of the city (1)
	Centralization of Regional Services (2)	It is calculated by (site factor calculation for each service * number of service units per city) The site factor = 100 / total number of service units across all cities
	Industrial function of cities (1)	It is calculated by computing the value of location quotient for labor and industrial activities Location quotient = Percentage of labor or industrial establishments in the city / Percentage of labor or industrial establishments in total cities
Connectivity and gateway cities	Port Cities	Egyptian Ports Classification (Major ports- Minor Ports) (3) Volume of cargo and containers traded (4) Port hinterland (5)
	Airport Cities	The regular international and national movement of national airlines for passengers and goods (6) Airport impact zone (7)
	Dry Ports	The number of dry ports in every City (8)
	Road connectivity (2)	It is calculated based on the total number of regional and national roads and railways passing through the city according to their classification
	Railway stations	Number of railway stations (8)
Availability of industrial facilities and supporting establishments	Industrial zones	The number of industrial zones in the city (9)
	Free zones and special economic zones	The number of free zones and special economic zones in the city (10)
	Investments zones	The number of investment zones in the city (9)
	Logistics zones	The number of logistics zones in the city (8)
Infrastructure networks	Electricity	The percentage of buildings connected to electricity networks (1)
	Sanitary sewer	The percentage of buildings connected to sanitary sewer networks (1)
	Drinking water	The percentage of buildings connected to drinking water networks (1)
	Natural gas	The percentage of buildings connected to natural gas networks (1)
Availability of development-ready lands	Availability of development-ready lands for further expansion inside the Urban Growth Boundaries UGB in the periphery of the city (3)	

Source: The authors based on: (1) [22] (2) [23] (3) [24] (4) [25] (5) [26] (6) [27] (7) [28] (8) [29] (9) [30]

4. RESULTS

When measuring the suitability of the data using KMO, the value obtained was 0.766, and high significant value (0.000) indicating good suitability of the data as shown in Table 2.

Table 2. KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		**.766**
Bartlett's Test of Sphericity	Approx. Chi-Square	745.555
	df	136
	Sig.	.000

Source: The authors based on the SPSS analysis

Factor analysis identified the most influential indicators by analyzing the shared variance between them. This method is based on extracting latent factors that explain the largest portion of the total variance in the data. In this context, variance refers to the differences or diversities in the values across the data points. The analysis revealed that population size, port cities (with direct connectivity to seaports), road connectivity, industrial function, availability of development-ready lands, and the percentage of buildings connected to electricity and natural gas networks were among the most influential indicators due to their high factor loadings, as shown in Table 3. These seven indicators were selected from a total of 17 indicators analyzed. The indicators were grouped into six components, which together explained 75.6% of the total variance, the variance was explained as follows: the first component accounted for 21.38%, the second for 14.38%, the third for 11.84%, the fourth for 10.67%, the fifth for 9.63%, and the sixth for 7.72%, as shown in Table 4.

Table 3. The most influential indicators

Communalities	Initial	Extraction
A (Population Size)	**1.000**	**.908**
B (Road Connectivity)	**1.000**	**.851**
C (Regional Service)	1.000	.765
D (Industrial Cities)	1.000	.646
E (Free Zones)	1.000	.729
F (Investment Zones)	1.000	.662
G (Industrial Zones)	**1.000**	**.815**
H (Cities with Developable Land)	**1.000**	**.813**
I (Port Cities)	**1.000**	**.881**
J (Railway Cities)	1.000	.735
K (Electricity Network Connected Buildings)	**1.000**	**.808**
L (Drinking Water Network Connected Buildings)	1.000	.707
M (Sanitary Sewer Network Connected Buildings)	1.000	.653
N (Natural Gas Network Connected Buildings)	**1.000**	**.806**
O (Airport Cities)	1.000	.682
P (Logistics Zones)	1.000	.730
Q (Dry Ports)	1.000	.493

Source: The authors based on the SPSS analysis

Table 4. Total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.931	29.007	29.007	4.931	29.007	29.007	3.635	21.384	21.384
2	2.658	15.637	44.645	2.658	15.637	44.645	2.274	14.375	34.759
3	1.465	8.618	53.263	1.465	8.618	53.263	2.013	11.840	46.599
4	1.340	7.885	61.148	1.340	7.885	61.148	1.814	10.673	57.271
5	1.290	7.588	68.736	1.290	7.588	68.736	1.638	9.633	66.905
6	1.001	5.887	74.623	1.001	5.887	74.623	1.312	7.719	**75.623**

Source: The authors based on the SPSS analysis, Extraction Method: Principal Component Analysis

Table 5. The names of the cities in each group

The Cities with Excellent Readiness	The Cities with Good Readiness	The Cities with Moderate Readiness	The Cities with Low Readiness	The Cities with the Lowest Readiness
Cairo	Al oubour	El Fayoum	Meinouf	Belqas
Alexandria	New Borg El Arab	Toor Sainai	Zeifta	Al Manzala
Suez	Bani Swaif	Kafr Al Dawwar	Deisouq	Al Senbelaween
10th of Ramadan	Luxour	Damanhour	Al Mataria	Abo Kebeer
6th of October	Dumitta	Shubra El Khyma	Qaluoub	Kerdasa
Port said	Ismailia	Al Mahalla	Samanoud	Ashmoon
	Giza	Meet Ghamr	Akhmeem	Al Borollos
	Banha	Al Zaqazeeq	Belbies	Manfallout
	Marsa Matrouh	Rosetta	El Aresh	
	Aswan	Al Warraq	Sennoras	
	Al Sadat	Kafr Al Sheikh	Samalout	
	Sohag	Nuweiba	Shebben Al Qnater	
	Qena	Gerga	Al Hawamdya	
	Safaga	Edfo	Al Khousous	
	Assuit	Al Khanka	Maghagha	
	Al Mansoura	Kafr Al Bateekh	AlBadrasheen	
	Minya	Eddko	Nasser	
	Shebeen Al Koum	Tahta	Faqous	
	Tanta	New Cairo	Abo El Nomros	
	Badr	Kafr Saad		
	15-May	Mallawy		
	Hurghada			

Source: The authors

Cluster analysis classified the cities into five homogeneous groups based on the indicators and results derived from factor analysis. While the most influential indicators play a significant role in the classification process, cluster analysis considers the values of all 17 indicators to ensure a comprehensive and accurate classification. The resulting five groups reflect the varying levels of readiness among cities for allocating EPZs:

Group 1: the cities with excellent spatial and urban readiness, which includes 6 cities, which are currently qualified to allocate EPZs.

Group 2: the cities with good spatial and urban readiness, which includes 22 cities, they are the cities with the least spatial and urban readiness from the previous group, and they are also suitable for allocating EPZs, but they have lower readiness compared to the first group.

Group 3: the cities with moderate spatial and urban readiness, which includes 21 cities.

Group 4: the cities with low spatial and urban readiness, which includes 19 cities.

Group 5: the cities with the lowest spatial and urban readiness, which includes 8 cities.

Figure 1 illustrates a map showing the spatial distribution of Egyptian cities according to their spatial and urban readiness for allocating EPZs and the names of the cities in each group are shown in Table 5.

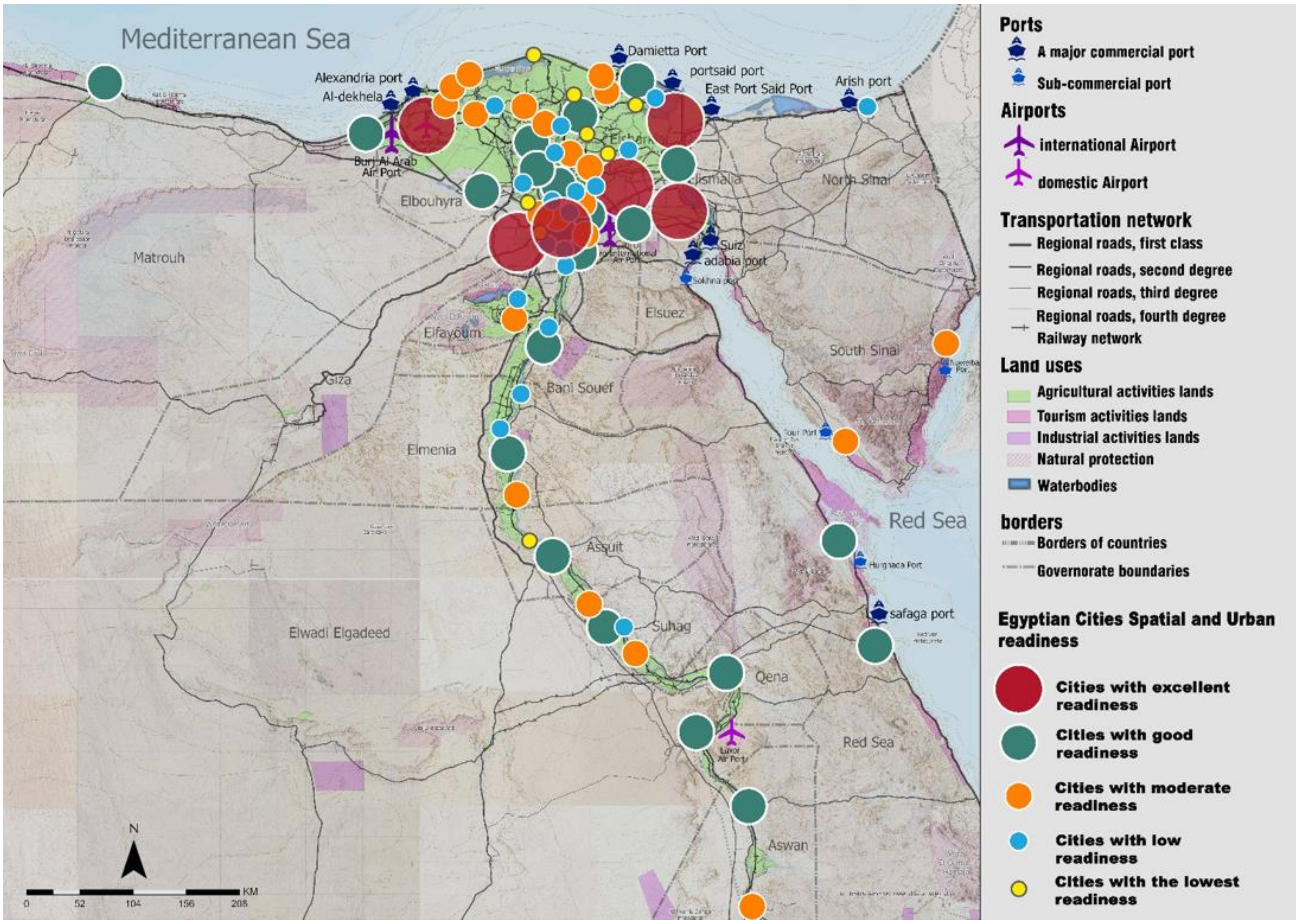

Figure 1. The spatial distribution of Egyptian cities according to their spatial and urban readiness
Source: The authors

5. DISCUSSION

This section will review the detailed characteristics of each city group identified in the results and explore how these results align with the theoretical literature.

For the cities in the **first group** (6 cities) with excellent readiness (Cairo, Alexandria, Suez, Port Said, 6th of October City, and 10th of Ramadan City), they share several key characteristics, including a large population size, strong connections with seaports and airports, availability of regional and public services, and robust infrastructure and industrial bases. Cairo is distinguished by its road and railway networks linking it to other governorates, while Alexandria serves as a strategic hub for commercial ports and airports. Suez and Port Said, located along the Suez Canal, feature several seaports and industrial zones. 6th of October City and 10th of Ramadan City offer significant opportunities for urban and industrial development, with free zones and investment areas attracting industrial projects. This aligns with the literature that emphasizes the importance of geographical location and connectivity in the success of EPZs. Egypt's unique geographic location, with proximity to major global trade routes, enhances the attractiveness of its cities to potential investors and helps stimulate global trade and exports. This mirrors China's experience, where coastal locations were a key factor in the success of its EPZs [9]. In line with Egypt's strategic vision, which includes 13 commercial ports, the presence of these ports is crucial for the performance and success of EPZs [4]. Thus, Egyptian cities with excellent readiness, particularly those located on the coast, naturally align with this global trend.

The literature also stresses the need for a dense labor force near export zones to facilitate worker movement and reduce transportation and housing costs [15]. Large Egyptian cities like Cairo and Alexandria meet these requirements due to their high population density, availability of public services, and strong road and transportation networks. This is supported by statistical analysis, which shows that cities with large populations are more likely to have the workforce and services necessary to support EPZs. Successful global experiences also highlight the importance of high-quality infrastructure networks, especially energy networks like natural gas and electricity, which are essential for the successful operation of EPZs [12].

For the cities in the **second group** with good readiness, which include 22 cities, they have lower readiness compared to the first group but are still suitable for allocating EPZs. These cities have smaller populations, less centrality in regional services, and fewer connections with seaports and airports compared to the first group. They include regional capitals and emerging metropolis cities, which are major centers for jobs and regional services. Examples of these cities include Safaga, Marsa Matrouh, and five new cities, such as the new industrial city of Borg El Arab. This aligns with the literature suggesting that cities with smaller populations and less centralized regional services may still offer potential for EPZ allocation, especially if they function as secondary urban centers or emerging cities. Although these cities may not have the same level of connectivity and infrastructure as larger cities, they possess characteristics that make them good candidates for EPZs, particularly if supported by proper development and planning [4, 9].

The cities in the **third group**, which includes 21 cities, exhibit moderate readiness. These cities have medium population density and show a relative decrease in regional service centrality compared to the previous two groups, with weak or nonexistent interactions with seaports. Most of these cities are connected to the main industrial centers, either within metropolitan areas or clustered around the main industrial center in their governorates.

Literature suggests that cities with medium population density and located far from seaports may face challenges in designating EPZs. This is because the availability of regional services and strong logistical facilities are crucial for the success of these zones [15]. While some of these cities may be industrial hubs, the weak connections with seaports and relatively weak public services make them moderate in readiness, especially compared to the first two groups. Global literature emphasizes that improving infrastructure, including energy and transport networks, is one of the key success factors for EPZs [12]. However, some cities in this group lack modern infrastructure, limiting their ability to fully support EPZs.

The **fourth group** consists of 19 cities that have low readiness. These cities lack logistical centers and dry ports, and there are no free zones or investment zones. In addition, they exhibit weak connectivity with commercial seaports and a low percentage of buildings connected to the natural gas network. Most of these cities are dependent on the main capital and industrial cities in their governorates to support industrial activities. Literature indicates that the absence of energy networks and basic infrastructure is a major threat to the success of EPZs. Countries that have successfully implemented EPZs have paid significant attention to infrastructure such as electricity and natural gas [12]. The lack of these networks in cities of Group 4 limits their potential to host EPZs. Moreover, weak connections to commercial seaports complicate the implementation of these zones, as global experiences emphasize the importance of access to seaports for ensuring the success of EPZs [4]. Additionally, these cities lack autonomy and rely heavily on the main industrial centers in their regions, which limits their ability to support EPZs independently. These cities represent weak links in the logistical production chains, contradicting the literature that emphasizes the need for strong infrastructure and central connections to operate EPZs successfully [1].

The cities in the **fifth group**, which consists of 8 cities, have the lowest level of spatial and urban readiness. These cities are characterized by small populations, weak regional service centrality, and a lack of industrial facilities and supporting infrastructure. They also lack buildings connected to the natural gas network, hindering industrial development. Literature suggests that EPZs require integrated infrastructure, including public services such as education, healthcare, and transport, to meet the needs of both workers and investors [15].

The absence of these basic services makes cities in Group 5 incapable of supporting EPZs. Furthermore, the lack of industrial facilities and weak interaction with seaports presents a major barrier to the establishment of these zones. Moreover, the small population sizes in these cities mean that the availability of a workforce is insufficient to meet the essential needs of large industrial projects. Literature emphasizes that the proximity of a dense workforce to EPZs is critical for the operation of these zones, which is missing in cities with small populations [15].

In the context of the primary objective of the research being to assist decision-makers and policymakers in selecting sites for EPZs, the authors proposed a set of policies customized for each group of cities according to their level of urban and spatial readiness:

(1) Cities with Excellent Readiness: These cities exhibit strong connectivity to regional infrastructure and ports, making them ideal regional export hubs. To maximize potential: enhance logistical infrastructure with warehouses and smart facilities, develop connected seaports and airports to support logistics and supply chains, strengthen digital and smart infrastructure for commercial and industrial activities, including e-commerce, increase free zones' efficiency to attract investments, allocate EPZs in areas allowing urban expansion without affecting existing urban or agricultural land, implement plans to transform these cities into export hubs using advanced technologies, and leverage global expertise in port and logistics management. Expanding logistics projects requires significant funding and time but offers opportunities to enhance efficiency and competitiveness. Public-private partnerships are recommended.

(2) Cities with Good Readiness: These cities have good potential but need additional support in skills and infrastructure. To enhance readiness: invest in technical education through specialized training centers for logistical and technological skills, improve industrial infrastructure and logistics by adopting new technologies, and enhance connectivity with cities of excellent readiness to facilitate

goods and services movement. These policies can boost goods movement and support development.

(3) Cities with Moderate Readiness: These cities offer growth potential if transport networks and services are improved. To enhance readiness: localize public services for investors, develop road and railway networks for better connectivity with ports and airports, improve connections with new cities, allocate small and medium EPZs as a start, partner with the private sector for infrastructure projects, ensure regional integration with major ports, airports, and economic zones, and provide incentives for zones. Implementation through infrastructure plans and government funding for logistics is recommended.

(4) Cities with Low Readiness: These cities need targeted interventions to improve basic infrastructure and ensure project sustainability. Government funding is key to: complete utility infrastructure for future projects, develop regional road and railway networks for goods and worker movement, direct investments to energy, water, and sanitation networks, and support vocational training programs to strengthen the local labor market.

(5) Cities with Lowest Readiness: While lacking readiness, these cities can improve long term by: expanding energy infrastructure, particularly natural gas for industrial zones, integrating into national plans with budgets for transport and energy networks, prioritizing investments in essential needs like roads and energy, and linking these cities with major industrial centers to attract investors. Significant investments are required, with diverse options and structured plans recommended.

These policies represent a blend of short- and long-term solutions tailored to the readiness level of each group of cities. They remain general proposals intended as an initial discussion, providing scalable solutions that require further in-depth studies and specialized evaluation before implementation.

The authors highlight differences in statistics across countries. Therefore, some indicators reflecting the same factors were used, with different measurement methods based on available Egyptian data. They also emphasize that the research results are tied to the time period of the indicators used. If the same evaluation is conducted using indicators from a different time period, the results may change. The research methodology can be applied to other countries because the factors and indicators used are derived from literature and global experiences, making them suitable for many countries, especially developing ones. The authors confirm that the requirements for allocating EPZs include a comprehensive set of factors (urban, spatial, economic, social, etc). While the research focused on spatial and urban factors, incorporating other factors would likely affect some findings.

6. CONCLUSIONS

This study is the first to assess the readiness of Egyptian cities for the allocation of EPZs based on spatial and urban factors, filling a significant gap in the literature, which often focuses on economic and administrative factors. The results show that only 49 out of 238 cities in Egypt have excellent to moderate readiness for EPZ allocation, highlighting the challenges in many cities. This study enhances understanding of the role of spatial and urban factors in EPZ allocation and provides a new assessment of Egyptian cities. It also emphasizes the importance of considering these factors in EPZ decisions. The study proposes general policies to improve city readiness. Future research could focus on other types of EPZs, such as Single Factory or Hybrid EPZs, and explore economic and social factors or a combination of factors. Additionally, future studies could examine the proposed policies in more detail.

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REFERENCES

[1] Zeng, D.Z. (2016). Special economic zones: Lessons from the global experience. PEDL Synthesis Paper Series, 1(1): 1-9.

[2] Przybyła, K., Kulczyk-Dynowska, A. (2018). The impact of global economic crisis on the functioning of special economic zones in Poland. In Consumer Behavior, Organizational Strategy and Financial Economics. Eurasian Studies in Business and Economics. Springer, Cham, pp. 255-263. https://doi.org/10.1007/978-3-319-76288-3_19

[3] Dubinina, E. (2023). Impact of special economic zones on domestic market: Evidence from Russia. Post-Communist Economies, 35(1): 82-99. https://doi.org/10.1080/14631377.2022.2138154

[4] COMCEC. (2017). Special economic zones in the OIC region: Learning from experience. https://www.comcec.org/wp-content/uploads/2021/07/10-TRD-AN.pdf.

[5] Government of Trinidad and Tobago. (2019). National special economic zones policy. https://tradeind.gov.tt/.

[6] Alansary, O.S.A., Al-Ansari, T. (2023). Defining 'free zones': A systematic review of literature. Heliyon, 9(4): e15344. https://doi.org/10.1016/j.heliyon.2023.e15344

[7] Arnold, D. (2017). Export processing zones. In International Encyclopedia of Geography: People, the Earth, Environment, and Technology. John Wiley & Sons, USA. https://doi.org/10.1002/9781118786352.wbieg0249

[8] Ortega, A.A., Acielo, J.M.A.E., Hermida, M.C.H. (2015). Mega-regions in the Philippines: Accounting for special economic zones and global-local dynamics. Cities, 48: 130-139. https://doi.org/10.1016/j.cities.2015.07.002

[9] Yuan, Y.M. (2017). Studies on China's Special Economic Zones 2. Springer Singapore, Singapore. https://doi.org/10.1007/978-981-13-6675-8

[10] Adu-Gyamfi, R., Asongu, S., Mmusi, T., Wamalwa, H., Mangori, M. (2020). A comparative study of export processing zones in the wake of sustainable development goals: Cases of Botswana, Kenya, Tanzania and Zimbabwe. MPRA Paper 103227, University Library of Munich, Germany.

[11] Mitrofanova, I.V., Melnikova, N.S., Yalmaev, R.A., Yalmaeva, M.A. (2019). Creation and functioning of special economic zones in Russia: Tendencies problems and perspectives. In The Future of the Global Financial

System: Downfall or Harmony 6. Springer International Publishing, USA, pp. 708-717. https://doi.org/10.1007/978-3-030-00102-5_74
[12] Dube, C., Matsika, W., Chiwunze, G. (2020). Special economic zones in Southern Africa: Is success influenced by design attributes? WIDER Working Paper. https://doi.org/10.35188/UNU-WIDER/2020/818-4
[13] Bendell, J., Miller, A., Weber, J., Zhan, J. (2015). Enhancing the contribution of export processing zones to sustainable development goals: An analysis of 100 EPZs and a framework for sustainable economic zones. United Nations, New York & Geneva. https://insight.cumbria.ac.uk/id/eprint/2175.
[14] UNDP. (2023). Promoting productive transformation through special economic zones (SEZs) in Sierra Leone 2023 Report. https://www.undp.org/sites/g/files/zskgke326/files/2023-09/undp_sl_sez_report_final_for_web_0.pdf.
[15] UNCTAD. (2020). Special economic zones and urbanization: Discussion paper. https://unhabitat.org/sites/default/files/2020/06/special_economic_zones_and_urbanization_discussion_paper.pdf.
[16] Zeng, D.Z. (2015). Global experiences with special economic zones: Focus on China and Africa. World Bank Policy Research Working Paper, WPS7240. http://documents1.worldbank.org/curated/en/810281468186872492/pdf/WPS7240.pdf.
[17] Hu, X., Tan, T. (2017). Gray correlation degree study on Changsha-Zhuzhou-Xiangtan urban construction land structure and economic development. In Proceedings of the 20th International Symposium on Advancement of Construction Management and Real Estate, Zhejiang, China, pp. 159-168. https://doi.org/10.1007/978-981-10-0855-9_14
[18] Yuan, Y.M. (2020). Studies on China's Special Economic Zones 3. Springer Singapore, Singapore. https://doi.org/10.1007/978-981-13-9841-4
[19] Zheng, L. (2021). Job creation or job relocation? Identifying the impact of China's special economic zones on local employment and industrial agglomeration. China Economic Review, 69: 101651. https://doi.org/10.1016/j.chieco.2021.101651
[20] Ranjan, A. (2015). The China-Pakistan economic corridor: India's options. Institute of Chinese Studies, 10(1): 1-25. https://www.icsin.org/uploads/2015/06/05/31e217cf46cab5bd9f15930569843895.pdf.
[21] Taylor, G. (2013). Urban Geography: A Study of Site, Evolution, Patern and Classification in Villages, Towns and Cities. Routledge, UK, pp. 1-264. https://doi.org/10.4324/9780203716250
[22] Central Agency for Public Mobilization and Statistics. (2017). Egypt Population, Housing, and Establishments Census 2017. https://ghdx.healthdata.org/record/egypt-population-housing-and-establishments-census-2017, accessed on Mar. 8, 2024.
[23] Ministry of Housing, Utilities, and Urban Communities, Egypt & General Organization for Physical Planning. (2021). National Urban Policies (NUPs). https://gopp.gov.eg/.
[24] Ministry of Housing, Utilities, and Urban Communities, Egypt & General Organization for Physical Planning. (2016). Egypt's Comprehensive Strategic Vision 2052. https://gopp.gov.eg/.
[25] Ministry of Transport, Egypt, Maritime Transport & Logistics Sector (MTLS). (2024). http://www.mts.gov.eg/ar, accessed on Jun. 19, 2024.
[26] Notteboom, T., Pallis, A., Rodrigue, J.P. (2022). Port Economics, Management and Policy. Routledge, UK, pp.1-690. https://doi.org/10.4324/9780429318184
[27] Central Agency for Public Mobilization and Statistics. (2021). Annual Bulletin of Air Transport Statistics: 2020/2021. CAPMAS, Cairo, Egypt, pp. 14-18. Retrieved from: http://www.capmas.gov.eg.
[28] Gibbons, S., Wu, W. (2020). Airports, access and local economic performance: Evidence from China. Journal of Economic Geography, 20(4): 903-937. https://doi.org/10.1093/jeg/lbz021
[29] Ministry of Transport, Land and Dry Ports Authority. (2024). https://ldp.gov.eg, accessed on May 19, 2024.
[30] General Authority for Investment and Free Zones. (2023). http://www.gafi.gov.eg, accessed on Apr. 8, 2023.