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Building a Cartographic Model to Select the Best Sites for Urban Development in Al-Qantara Sharq City

Shyma Khaled Hassan*

* Department of Geography and Geographic Information Systems, Faculty of Arts, Port Said University, Egypt; shymaa.khaled@arts.psu.edu.eg

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ABSTRACT

This section of the study focuses on introducing a methodology and approach for utilizing cartographic modeling in the context of urban development. Furthermore, it proposes the creation of a cartographic model that can be adjusted based on spatial and temporal variables. In this regard, the model aims to generate a map indicating the most suitable locations for urban development. This is achieved by applying a set of criteria and standards to assess the suitability of the land for urban growth. The ultimate goal is to effectively manage and control the urban growth within the defined boundaries of Al-Qantara Sharq city.

Keywords: Cartographic Model,Geographic Information Systems,Urbanization, urban development, Al-Qantara Sharq city.

Introduction

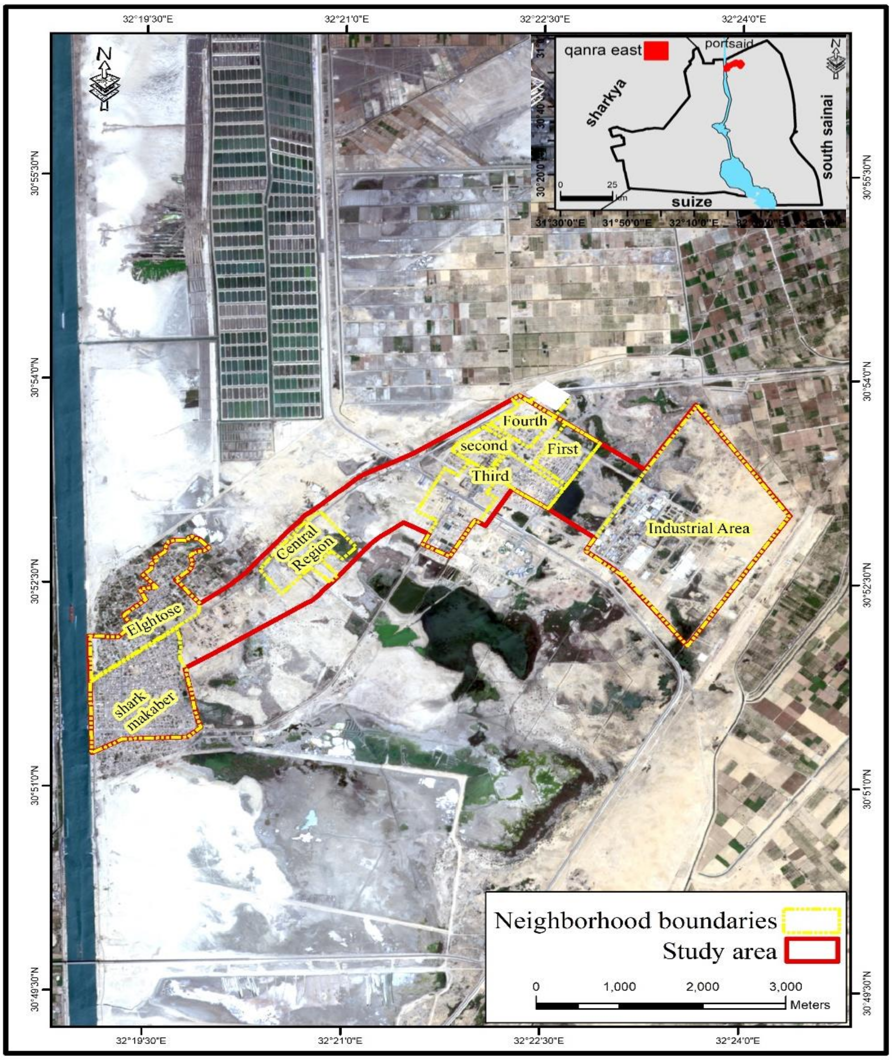
Urbanization represents the spatial domain in which humans reside, conduct their activities, and fulfill their various needs. With significant population growth rates, urban areas have expanded both within and beyond the boundaries of cities at rates surpassing development rates. This has led to the complexity of existing urban problems and the emergence of new issues, resulting in the deterioration of urban conditions. Hence, the importance of urban modeling arises as an attempt to simulate urban reality through clear criteria and indicators. Urban simulation aims to predict future urban growth trends in order to avoid the problems associated with it and assist decision-makers in developing solutions and regulations that address these challenges.

1) Study Area

The city of Qantara sharq is located east-northwest of the center of Qantara sharq, and is 26 km away from the city of Ismailia, as the Suez Canal divides the city into two parts: the old city (the original) -- the urban extension represents the second part and it has been called the new Qantara sharq or The new city, and the truth of the matter is that it is an urban expansion that can be considered a new neighborhood, and Qantara sharq is 80 km away from the southern border of Ismailia Governorate, where the city of Qantara sharq is located between longitudes 0 20 320 and 30 23 320 east and between latitudes 50 50 300, as shown in Figure (1).

2) Objective of the Study

- Studying the spatial and temporal developments of urban growth in the city.
- Identifying the obstacles to urban growth within the city.
- Deducing the areas where urban growth is expected by creating a simulation model in light of the incentives and obstacles to determine the areas most suitable for city growth



Source: From the researcher's work based on data from the City Council Information Center 2021, and MAXAR satellite visualization, 2023.

Figure 1. Location of the Study Area

3) Previous Studies

The city of Qantara sharq did not receive an independent geographical study, and the student relied on some of the previous geographical studies, including: studies that dealt with the subject of the study and studies that dealt with the city within the framework of the Suez Canal Region, which are as follows:

1-Studies specific to the subject of the study:

A - Jihan Abdel Moneim Ali Abdel Gawad, entitled Ain Shams Neighborhood, a study in urban geography, which was concerned with studying the astronomical and geographical location of the neighborhood, and the factors, both natural and human, affecting urban growth and studying the urban areas of the neighborhood and the distribution of its population, 2013.

B- Muhammad Ali Muhammad Abd al-Rahim, entitled The City of Dayrut: A Study in Urban Geography Using Geographic Information Systems. It was concerned with studying the natural characteristics of the city of Dayrut, then the city's origins, development, and functional structure, with an interest in studying the population, monitoring the city's problems, and proposing some solutions, 2014.

C- Medhat Saleh Abdel Halim Muhammad, entitled Sustainable urban development in the city of Mahalla al-Kubra using geographic information systems and remote sensing, where the study explained the morphological developments of the city of Mahalla al-Kubra, the natural factors affecting sustainable urban development, the role of the population in the sustainable development of the city, land uses, and the problems it suffers from. The city and its proposed solutions, 2020.

D-Howaida Hamed Ahmed Mahmoud, entitled The City of Tahta, A Study in Urban Geography Using Geographic Information Systems, which focused on studying the location and spatial relationships of the city of Tahta, the historical and urban development of the city, the composition of its population, and the uses of land in the city of Tahta, then monitoring the problems that the city suffers from, and estimating the future needs of the city, 2019.

2- Studies within the Suez Canal Region:

A - Ahmed Mohamed Ragab Ibrahim, entitled Growth and Urban Development of Port Said Governorate as a Model for Cities in Congested Locations. It focused on studying the city, the Suez Canal, its location in the global navigation network, the city's entrances and crossings, and arterial roads, in addition to economic growth, the development of land uses, the development of population dimensions, urban growth, and the quality of life therein, 2010.

B- Warda Ahmed Al-Sayed, entitled Development in Port Said Governorate, a geographical study, which dealt with natural, human and social factors in addition to agricultural and industrial development, livestock, population and tourism development, 2010.

C-Muhammad Mustafa Jamal Sheta, entitled Atlas of Development in Ismailia Governorate, concerned with studying the natural and human geographical components of the governorate and its historical and cultural heritage and studying the components of tourism, economic and infrastructure development while developing a future map for the governorate, 2014.

D-Warda Ahmed Al-Sayed, entitled The City of Ismailia, a study in urban geography, dealt with the location, location and spatial relations of the city, the origin and development of the city, urban growth and its population, then land uses, infrastructure, and urban planning of the city, 2014.

E-Marwa Abdel Fattah Siddiq, entitled Urban Growth and Its Impact on Land Use Patterns in the City of Suez, focused on studying the changes that occurred in the urban mass and the use of land there as a result of historical development in addition to studying the population and functions performed by the city, 2016.

4) Study Curricula and Methods

The method is the path or method that the researcher takes to address the research topics in order to reach his desired goal through a set of pre-determined steps and scientific methods. Urban geography topics require the intersection of many curricula, paths and approaches and the use of many processing methods that are needed by the aspects of the study depending on the nature of the data and the scientific material available. In accordance with the objectives set by the study and the questions and hypotheses it raised, and according to the diversity of research and study topics in the field of urban growth of cities, this study adopted a number of approaches and used some methods and approaches within the study paths in urban geography, each of which serves A purpose in the study the subject of study and research as follows:

A) Study curricula:

1-Historical approach: This approach was used to study the origin of the city and monitor its historical, administrative and urban development according to a set of maps for varying years.

2- The regional approach: This approach is used to highlight the geographical character of the city, especially since it is among the cities of the Suez Canal region.

3- The descriptive analytical approach: This approach was used to study the form of the urban plan and to study the urban structure and use of land in the city.

b) Study methods:

1- Quantitative and statistical method: to create statistical tables, draw graphs, and create some equations through the EXCEL 2010 program.

2- Geographic Information Systems Method: By creating a geographic database for the cities of El Qantara through inputs from maps and information using the ARC GIS V10.5 program to draw maps and analyze them spatially, and the ENVY 5.3 program to correct satellite visualizations, improve and classify these visualizations, then monitor the change and transform. The results of classifications are converted to Raster to Vector to achieve the possibility of spatial distinction between urban and non-urban spaces.

3- Field study method: through which exploratory visits and field surveys were carried out, as well as personal interviews.

5) Study Sources

- A database of digital maps from the Urban Planning Information and Departments Center, Qantara City Council and the Ismailia Governorate Building, in addition to data from the Central Authority.
- The field study that confirmed the official data and enabled the researcher to collect data and photos for the field study.
- Personal interviews with officials in the Ismailia Governorate building and the two city councils.
- Using the ARC GIS program to create the spatial database for the cities of El Qantara.

The research studied the following:

First: Stages of urban growth in the city of Qantara Sharq from its inception until 2020.
Second: Spatial analysis of urban growth trends in the city of Qantara Sharq during the period of 1943-2020.
Third: Building a cartographic model to choose the most suitable sites for urban development in the city of Qantara Sharq.

First: Stages of Urban Growth in the City of Qantara Sharq from its Inception until 2020

The study of the urban growth of the city of Qantara Sharq is not limited to the current geographical conditions, but rather takes within it the historical dimension and development of it over time, which gives the city's character great clarity, and even shows its impact on future urban growth through it being the administrative capital of its center, which led to the concentration of many Its services are exclusive to other neighboring villages. When a city grows, it affects the areas near and adjacent to it.

In order to trace the built urban mass that makes up the city from its inception until 2020 AD, the urban growth of the city and its growth axes were monitored during 4 periods, and each stage was studied separately according to the available satellite maps and visuals, which clearly show the built urban mass of the city.

The initial nucleus of the city's built-up urban mass was determined during historical periods, and the areas were calculated according to the main and subsidiary geographical trends, as shown in Table (1) and Figure (2). It should be noted that the approved administrative division of the city has been confirmed for the year 2020 AD. In order to facilitate the comparison process, the periods are as follows:

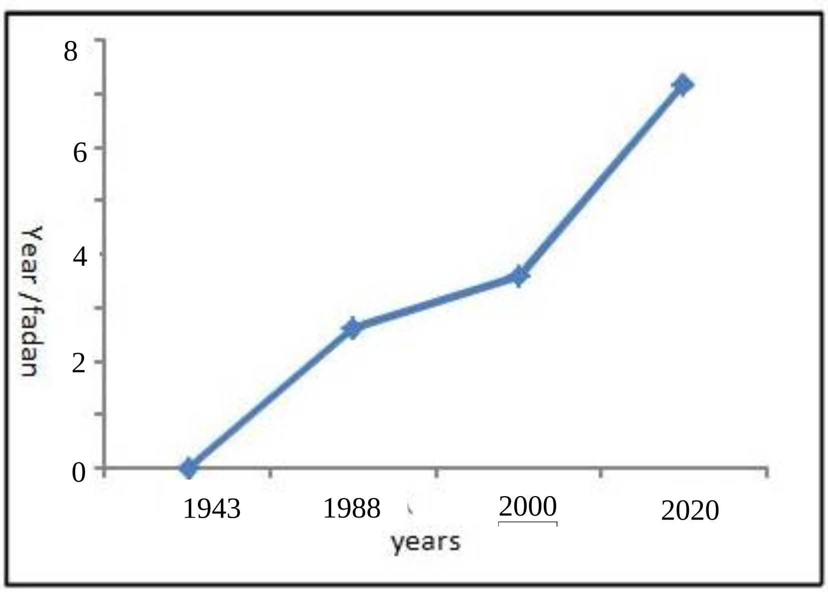
1- The first stage in 1943:

In its inception, the city of Qantara Sharq was closely linked to the establishment of the Suez Canal. The city suffered from the scourge of war and the displacement of the population. The first nucleus of the urban bloc built for the city was the Border Police Department, in order to secure Egypt's eastern borders with respect to the city of Qantara Sharq, as the urban area of the city of Qantara Sharq extended. In that period, between two main axes: the north and the northeast, the area of the built-up urban mass of the city of Qantara Sharq reached 287.53 acres. The urban mass of the city was not characterized by compactness and connectivity in that period, as it was characterized by an abundance of vacant lands, as shown in Figure (3) and the table. (1).

Table 1. Development of urban growth areas of the city of Qantara Sharq during the period (1943-2020)

Time Period	Built-up urban area (acres)	The time period between each stage	Built-up urban area (acres)	Annual urban growth rate (acres/year)
Before 1943	287.53	-	-	-
1943-1988	530.3	45	242.77	1.31
1988-2000	658.8	12	128.5	1.80
2000-2020	309.57	20	349.23	3.60

Source: From the researcher work based on the measurements from Figure (7) and the areas calculated in the Attribute Table for the layers of the built-up urban mass of the city of Qantara Sharq in the geographical database during the study period using the Arc gis 10.5 program.

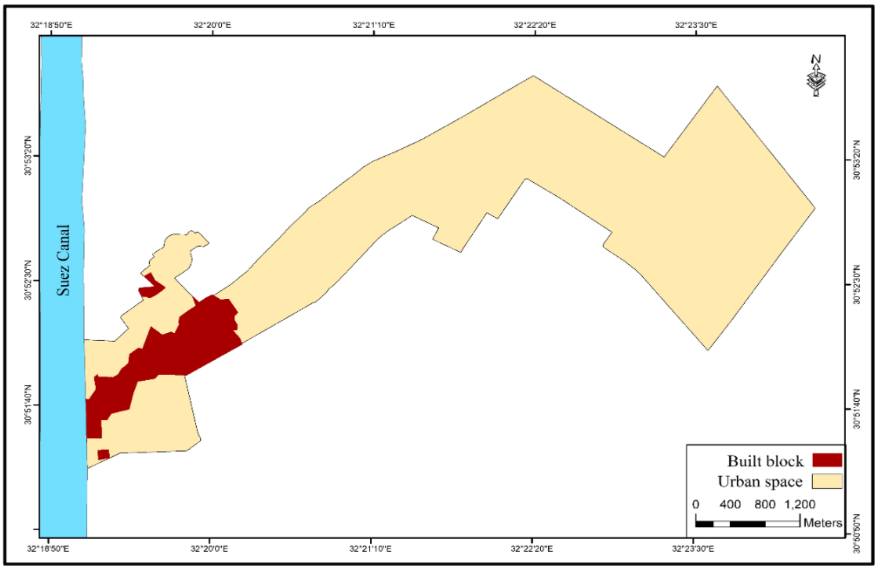


Source: From the researcher's work based on Table 1

Figure 2. Urban growth of the city of Qantara 1943-2020

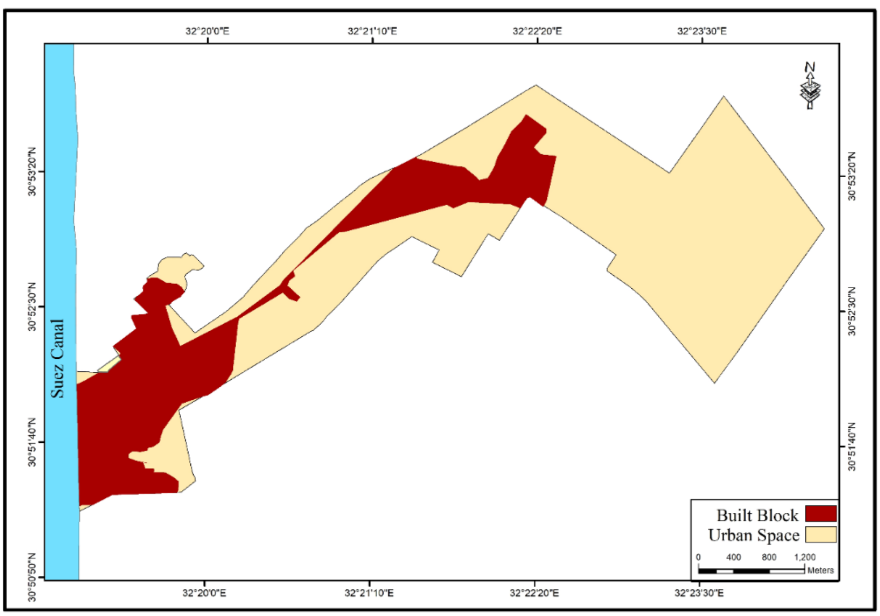
2- The second stage during the period (1943-1988):

The built-up area of Qantara East City reached 530.3 acres, an addition of 242.77 acres over the previous period and a growth rate of 1.31 acres/year, as shown in Table (1) and Figure (4).



Source: The researcher work based on topographic maps, scale 25,000:1, from the Egyptian Survey Authority, using the Arc gis program.

Figure 3. The built urban mass of the city of Qantara Sharq in 1943

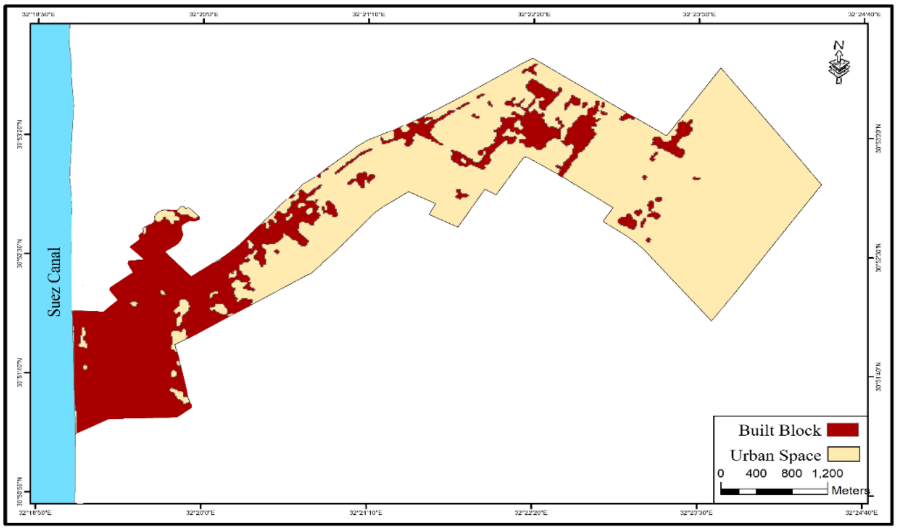


Source: Worked by the researcher based on topographic maps, scale 25,000:1, Egyptian Survey Authority, using the Arc gis program.

Figure 4. The built urban mass of the city of Qantara Sharq in 1988.

3-The third stage during the period (1988-2000):

The area of the built urban mass in the city of Qantara Sharq was 658.8 acres, an addition of 128.5 acres, and the growth rate of the built urban mass in that period was 1.80 acres/year, which means that the growth rate of the built mass in that period was greater than its counterpart in the previous period, which is shown in the table (1) Figure (5).

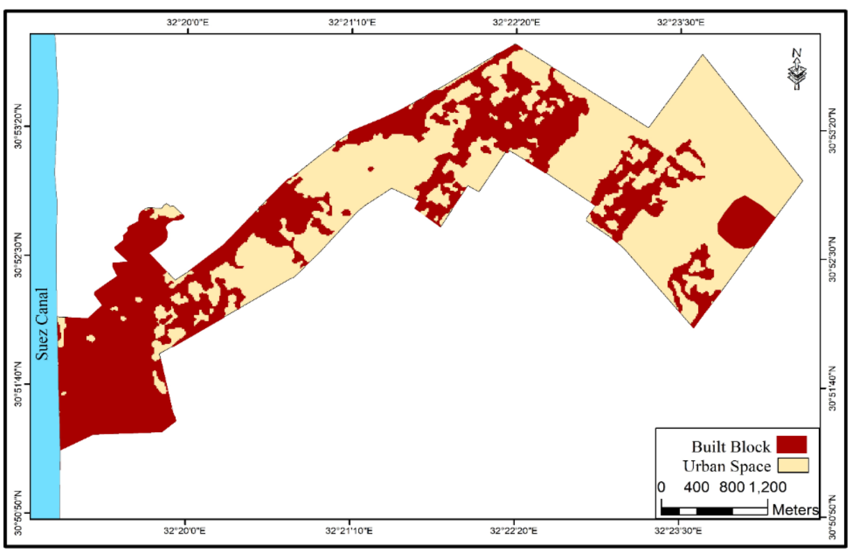


Source: The researcher work based on the ETM+ satellite visual classification for the year 2000 using the ENVI 5.3 program and the ARC GIS program.

Figure 5. The built urban mass of the city of Qantara Sharq in 2000

4- The fourth stage during the period (2000-2020):

The area of the built-up mass in the city of Qantara Sharq was 309.57 acres, as shown in Table (1) and Figure (6), an increase of 349.23 acres, but the built-up urban mass increased during that period at a growth rate that reached 3.60 acres/year.



Source: The researcher work, based on the OLI satellite visual classification for the year 2020, using the ENVI 5.3 program and the ARC GIS 10.5 program.

Figure 6. The built urban mass of the city of Qantara Sharq in 2020

From the previous presentation and Figure (7), it is clear that the built urban mass of the city of Qantara sharq was increasing throughout the study periods, as the city of Qantara sharq had the highest urban growth rate in the period from 2000-2020 at a rate of 3.60 acres / year

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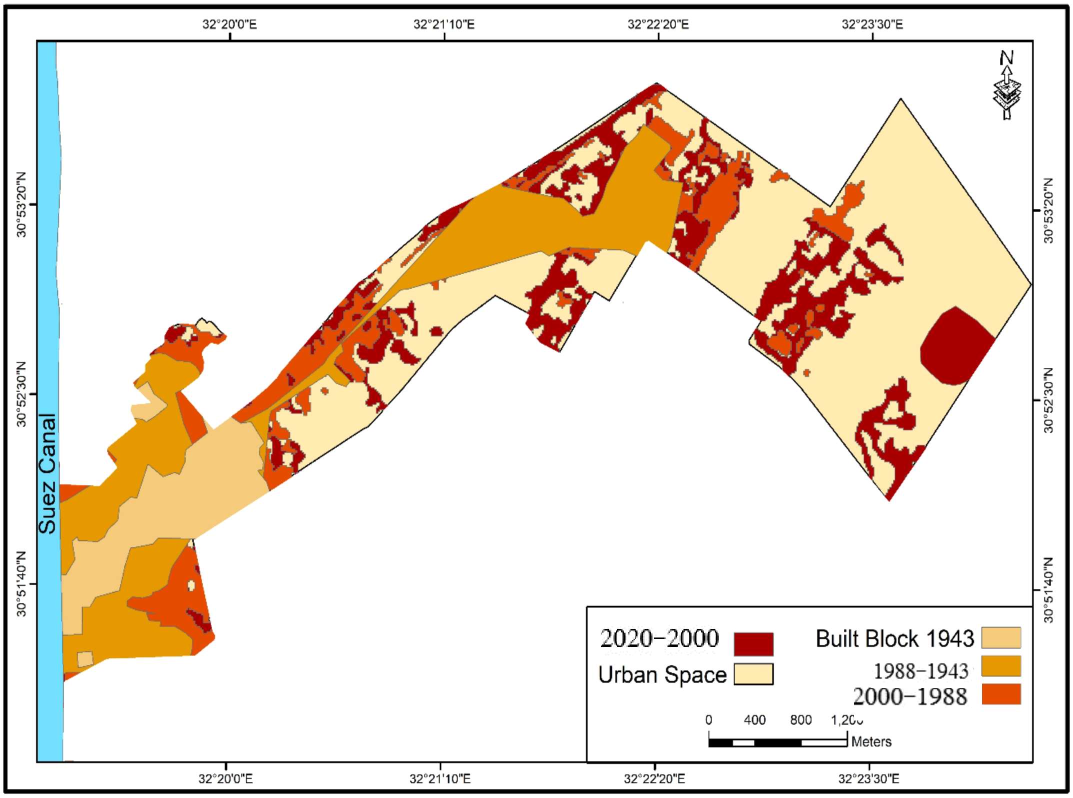


Source: The researcher work based on topographic maps at a scale of 25,000:1 for the years 1943 and 1988, and the Landsat 8 (Oli) satellite visual classification for the years 2000 and 2020 using the ENVI and ARC programs.

Figure 7. Urban growth of the city of Qantara Sharq in the period from 1943-2020

Second: Spatial analysis of urban growth trends in the city of Qantara Sharq in the period 1943-2020:

Tracking the urban growth trends of the built-up mass in the city is the ultimate goal of the process of monitoring its growth in different time periods. In this context, urban growth rates varied along a group of geographical directional axes, which reflects the extent to which urban growth favored one direction over another in the city, and then appeared Preferred directional axes for horizontal urban expansion processes and others that urban growth relatively neglected in stages and not others. From Tables (2 and 3) and Figures (8, 9, 10 and 11), the following is clear:

Table 2. Horizontal urban growth trends in the city of Qantara sharq in acres in the period 1943-2020

Direction / years	north	North east	east	South east	south	South west	west	North west
1943	16.53	244.2	5.23	4.22	6.30	4.50	2.25	4.30
Total	**5.75**	**84.93**	**1.82**	**1.47**	**2.19**	**1.57**	**0.78**	**1.50**
1988	352.52	450.80	72.72	20.16	12.29	3.25	3.3	37.96
Total	**36.99**	**47.30**	**7.63**	**2.12**	**1.29**	**0.34**	**0.35**	3.98
2000	512.06	633.63	165.4	62.80	60.33	5.08	5.59	82.87
Total	**33.52**	**41.47**	**10.83**	**4.11**	**3.95**	**0.33**	**0.37**	5.42
2020	134.77	1500	331.68	181	55.5	30.98	3.78	2.92
Total	**6.01**	**66.95**	**14.80**	**8.08**	**2.48**	**1.38**	**0.17**	0.13

Source: From The researcher work based on the measurements from Figure (7), considering the base point for measurement as the Border Police Department, the first to be built in the city.

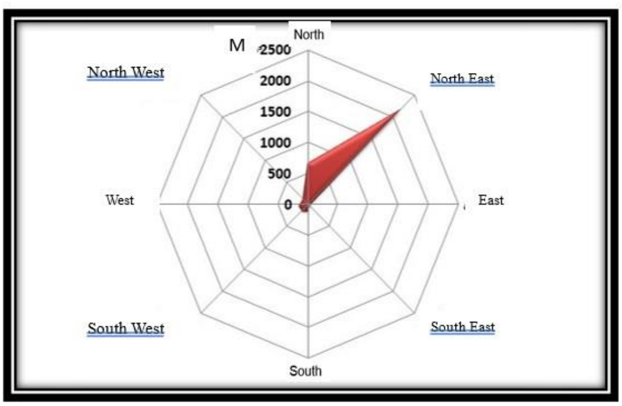
Table 3. Horizontal urban expansion trends of the city of Qantara Sharq in the period 1943-2020 (linear meters/year).

Direction / years	north	North east	east	South east	south	South west	west	North west
1943	674.1	2191	26.7	38.6	110	123	105	120
1988	1070	5124.5	701.7	670.2	391.5	165.9	232.9	236.3
2000	1871.6	5145.2	1598.2	810.8	873.3	216.7	264.1	306.5
2020	1916.6	5234.8	2168.2	810.8	828.3	215.7	206	156.7

Source: From The researcher work based on the measurements from Figure (7), considering the base point for measurement as the Border Police Department, the first to be built in the city.

1-Urban growth trends in 1943:

This stage is considered the beginning stage of the formation of the city. From its inception until 1943, the city of Qantara Sharq witnessed urban development in all major and secondary geographical directions, where the north-eastern direction in the city of Qantara Sharq came in the forefront of directions with a rate of 84.93% and an extension of 2191 meters/year and the least westward direction with a percentage. 0.78% and an extension of 105 meters/year, which is shown in Figure (8)

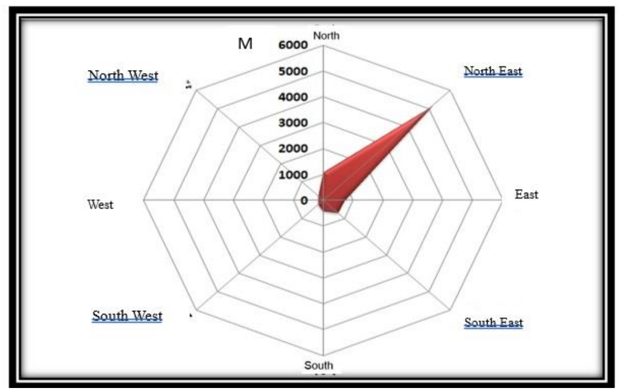


Source: From The researcher work based on the measurements from Figure (3).

Figure 8. The main and subsidiary axes of the city's built-up urban mass extensions

2-Urban growth trends during the period 1943-1988:

The urban growth of the city exceeded the previous stage, with the north-eastern direction continuing to maintain first place, at a rate of 47.30%, with an extension of 5145.5 meters/year, and the least developed direction was the southwest, with a rate of 0.34%, and an extension of 165.9 meters/year, as shown in the following figure (9).

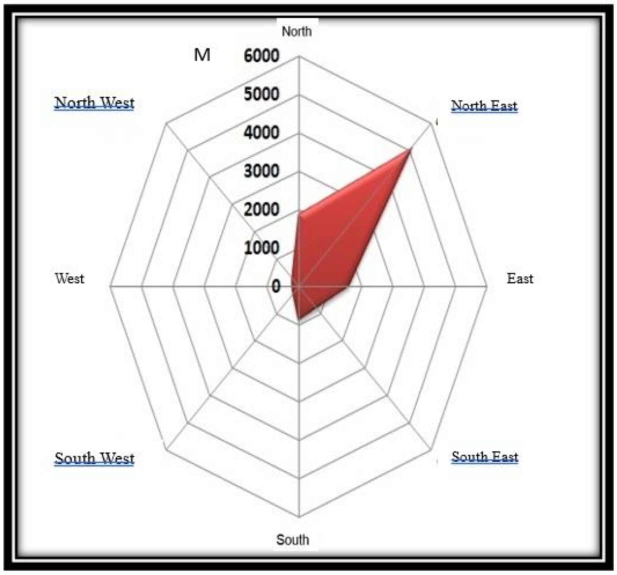


Source: From The researcher work based on the measurements from Figure (4).

Figure 9. The main and subsidiary axes of the extensions of the built urban mass of the city of Qantara in the period 1943 to 1988

3-Urban growth trends during the period (1988-2000):

The growth trends during this stage represent a reflection of the size of urban growth in the city, as the north-eastern direction occupied the forefront of the trends in the city in that period as well, as it is considered one of the trends stimulating growth in it, at a rate of 41.47% and an extension of 5145.2 meters/year, and the least direction (obstructing urban growth) was the trend. The southwest by 0.33% and with an extension of 216.7 meters/year, which is shown in Figure (10):

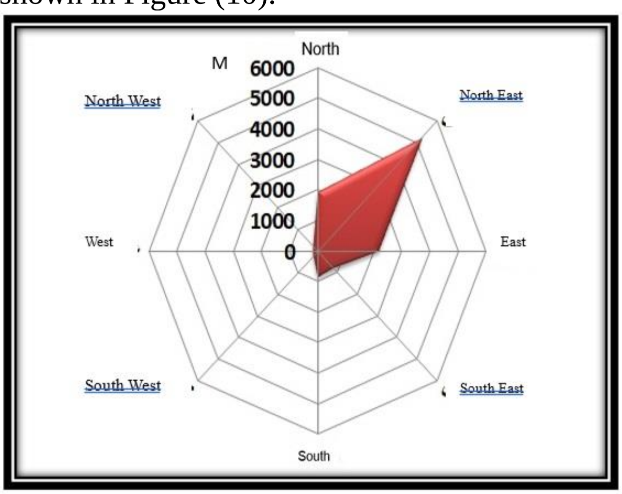


Source: From The researcher work based on the measurements from Figure (5).

Figure 10. The main and subsidiary axes of the extensions of the built urban mass of the cities of Qantara in the period 1988 to 2000

4-Urban growth trends during the period (2000-2020):

We can call the trends of this stage the stage of urban completion or maturity, as the city grew along the main axes stimulating urban growth in each of them, where the northeast ranked first with a rate of 66.95% and an extension of 5234.8 meters/year, and the least direction was the northwest with a rate of 0.13% and an urban extension of 156.7 meters/year. General, as shown in Figure (10).



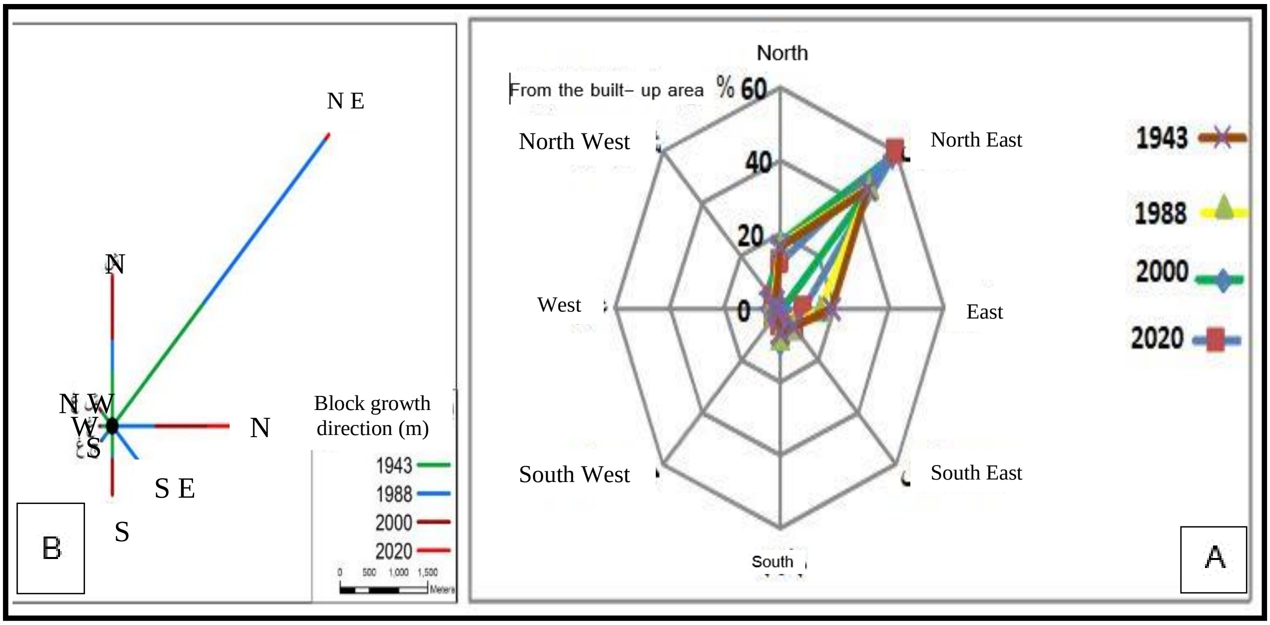
Source: From The researcher work based on the measurements from Figure (6).

Figure 11. The main and subsidiary axes of the extensions of the built urban mass of the cities of Qantara in the period 2000 to 2020

It is clear from the previous analysis and Figure (12) that the largest direction of increase in the built-up area and the longest expansion in the city of Qantara Sharq is the north-eastern direction, which is the preferred direction for the growth of the city. This is due to the increase in the land area in this direction, as there are no obstacles preventing growth, and the lands Surrounding it are desert lands, with the exception of the northern part, there are some agricultural reclamation lands, as well as the presence of the new city and the central region, so growth directions are available from all directions, in addition to the fact that neither of them needs to extend outside the approved urban space, as the two regions are not complete and still have lands planned for future uses. It meets the needs of the future city of Qantara Sharq, in addition to the presence of the industrial zone and attracting many workers to it.

The west and southwest direction is also considered one of the determinants of the city's growth, due to the presence of the waterway, which is the Suez Canal, and the residence of some of the army and police commanders and the city's personnel ferry.

Thus, it becomes clear that with the digging of the Suez Canal, the city appeared and its urbanization gradually expanded, especially with the decrease in population size in the early stages of the city's establishment, which began to grow with the development of the canal region, but in light of the period of political tensions, urban growth rates remained relatively low, especially with the 1956 aggression and forced displacement operations. For the population, but after a period of stabilization of the situation in the country, urban growth, construction and reconstruction began, as this period represented a stage of relative stability for the cordons of Egyptian cities in general.



Source: created by the researcher based on data calculated from Table (2 and 3) and Figure (7), using a program. ARCGIS

Figure 12. B. The development of the extensions of the built-up mass (m) of the city of Qantara Sharq in the main directions in the period 1943-2020.

Figure 12. A. Evolution of the built-up area ratio (%) of the city of Qantara Sharq in the main trends in the period 1943-2020

Third: Building a cartographic model to choose the most suitable sites for urban development in the city of Qantara Sharq:

This part of the study is concerned with presenting a method for using the cartographic modeling process, by proposing and building a cartographic model (that can be modified according to spatial and temporal variables). Through it, a map can be derived that shows the most suitable locations for urban development, which by applying a set of foundations and standards shows the suitability of the land for urban growth in an attempt to control growth in the city of Qantara Sharq, within the boundaries of the city's approved urban space, using the analytical environment provided by geographical information systems techniques in order to draw Strategy for urban growth And developing a map of urban sustainability in the city of El Qantara Sharq, based on the analysis and evaluation of the factors influencing urban growth and coordination between data and basic information regarding the capabilities of the city's location of different scales and informational nature, which were stored in a geographical database in the previous chapters of the study, as GIS technology has functions and analytical capabilities for information. Spatial highlights the extent of interaction between information, the nature of its locations, and its various environmental impacts.

The word "model" has been commonly used to refer to a mini-descriptive diagram of a phenomenon, which is usually larger in dimensions, with the aim of drawing a picture through which its general characteristics can be understood. Accordingly, "modeling" in its abstract sense is the stages of designing this model[1].

[1]) Hani Sami Abu El-Ela, 2011, Cartographic Modeling of Urban Hazards in Hurghada, Journal of the Faculty of Arts, Alexandria University, p. 62.

The use of the Cartographic Modeling method has made it possible to determine the suitability of a particular area for practicing a particular activity. This method will be used to determine the most suitable/best locations for urban development in the city of Qantara Sharq based on the MCE multi-criteria evaluation[2]. Applied locally and internationally within the Arc Gis modeling environment, in order to improve the process of spatial decision-making and making, which depends on a set of alternatives.

• **Problematic stage[3]:** The question is how to know and choose the most suitable/best sites for future urban development based on the suitability of the land in the city of Qantara Sharq? Then, the evaluation criteria for the determinants and drivers of that growth are determined according to what has been studied of the factors influencing the urban growth of the city, in addition to the local and international standards followed in that regard. Some of these standards can also be met through previous studies or simulation models.

• **Design stage[4]:** Through which the model is designed and the importance of each factor and element of the determinants and drivers of growth is determined based on the rules of decision-making and decision-making and the priorities of the decision-maker.

• **The stage of choosing between alternatives:** Establishing a relative importance and weight for each layer that represents a determinant or incentive for urban growth, then applying the model and based on its results a choice is made between the alternatives.

It is worth noting that in order to choose the most appropriate sites for development, the student reviewed the standards set by the Urban Planning Authority, the Supreme Council for Planning and Urban Development, the standards of the Ministry of Housing and Utilities, and some standards found in the East Qantara City Council, in addition to reviewing some previous studies. Which dealt with the topics of choosing the most appropriate location and used digital cartographic modeling to produce the most appropriate site map.

• The suitability of the site in terms of topographic levels (not exceeding 200 m level).
• Suitability of the location in terms of inclination (flat areas where the inclination does not exceed 10 degrees).
• Soil suitability for foundation and construction.
• Validity of geological formations.
• Proximity to main roads.
• The distance from the Suez Canal campus is 400 metres.

Choosing these determinants, whether natural or human, does not mean that they are the only ones that influence the process of choosing urban development sites, since, as previously mentioned, they can be modified according to spatial and temporal variables, but they were chosen for their ease of representation in the mathematical model, as they are easy to represent on maps and appear clearly. In satellite images, which are the basic inputs to the system.

These criteria were based on the available capabilities in the region, such as soil, topography, etc., and the restrictions that hinder

(Multi Critria Evaluation method/technology is applied in the GIS software environment in order to determine the 2)suitability of a particular space for a specific use. This technology has been developed to improve spatial decision-making processes when a group of alternatives is needed. Which will be evaluated on the basis of conflicting and equivalent criteria that represent a set of qualitative and quantitative information. The cartographic modeling process using multiple criteria evaluation is concerned with how to combine data and information that represent the criteria in one model to form an indicator that determines the suitability of the place for a specific use, so that this indicator is composite and weighted by importance. Each of these criteria is through a logical grouping.

3) Sam Kito and Scott Thomas, 2011,Site selection Criteria and Evaluation Hand Book, Education Support Services Facilities, Department Of Education, State of Alaska, p 223.

4) Zegey cherente, 2014, Helawi sewent Building Ethiopia, Sustainability and Innovation in Architecture and Design, Africa p 177.

development in the region, which is the Suez Canal campus area, in which work is now underway to empty the existing urban areas, especially in the old block of Ezbet Al-Ghous and the East Cemetery area, and the presence of some swamps in the old and new block. These criteria were classified and arranged according to the Ranking Methode, and the final output model for lands suitable for development was classified based on their suitability into two categories (due to the small relative area of the city), and those areas were classified to:

• First-class suitable areas for development.
• Suitable second-class areas for development.
• Areas that are not suitable for development, namely swamps.
• These groups provide decision-makers and planners with an integrated approach and the basic needs for sustainable development in the region, based on the following steps:

1) The process of building a geodata base:
Creating a database is one of the stages that requires accuracy in the work, as it is the basis for the work of geographic information systems and includes data from various natural and human phenomena and characteristics of the study area in the form of digital spatial data, which means a set of maps that have been drawn in the form of data. Directional Vector Data, and the Raster Data set, and then I used digital maps drawn from different types of maps (geological - soil...) in addition to remote sensing data that was stored in the geographical database during the study of the previous chapters, The database shown in Figure (13) and Table (4) was used.

Table 4. Layers that were used in building the model.

Layer number	Layer name	scale	source
1	Dem	30m	Aster dem
2	Slop	30m	Aster dem
3	Soil	1:100000	Soil map, Ismailia Governorate
4	geology	1:500000	Geological Survey Authority
5	Main roads	1:50000, 30m	Topographic maps and satellite images
6	Buffer of suez canal	1:50000, 30m	Topographic maps and satellite images

Source: Based on Arc Gis V10.5 geodatabase.

2) Standard Euclidean Distance measurement or equal dimension ranges:
The mechanism of the distance finding tool is to calculate the distance from the center of each cell to the centers of its neighboring cells. The true Euclidean/standard distance is calculated theoretically according to the Pythagorean theorem for the right-angled triangle. This tool creates multiple buffers around criteria (layers). The model gave each zone a numerical value that expresses the suitability of the zone to the urban growth process based on the ability of the zone to enhance communication between marginal and central areas fairly, such as (the digital elevation - slope - Suez Canal campus model).

3) Converting data from vector format to Polygon to Raster format:
Building the model was based on converting the data of some layers from the vector data format to the rater data format, such as the soil and geology layer, through the Conversation Tool, where the phenomena are represented in the form of cells/squares. Each pixel/cell records a value that expresses A specific phenomenon (this step is a type of modeling), which is what was done with the soil layer and the geology layer.

4) Reclassification process:
This step is useful in determining the spatial scopes for the model to work and assigning them to categories from 1-9 to standardize the scale (where the criteria are reclassified according to

that scale and the most suitable cells are given the value 1 and the least suitable cells are given the value 9 or vice versa, taking into account the positive or negative dimension with varying degrees of suitability between them. Between them, this process results in a new layer for each criterion added to the geographic database. The weighted overlay process requires that it be uniform in scale, which enables logical calculations to be performed on it when used as criteria within the model, thus ensuring the validity or accuracy of the matching process. It has also been done Conducting the reclassification process for all classes representing the criteria being evaluated and not for specific classes.

5) Weighted Overlay Process:

It is a process in which the layers that were prepared in the previous two steps are arranged and their importance is determined according to the established criteria mentioned above, then the importance of each layer is determined separately, and the total degree of importance of the layers is equal to 100%, as there are two layers of raster and an importance degree has been assigned. For each layer, the first layer has a degree of importance of 75% and the second layer has a degree of importance of 25%. By performing statistical operations on the two layers, the final output is the required Raster layer, which varies according to its purpose.

There are many different approaches used to allocate weights to these criteria according to their importance, including, for example: the Ranking Method, which is the simplest and most widely followed method and method of weighting to evaluate the importance of weights, as it depends on the vision of researchers, makers, and decision makers in determining the preference of one criterion over another ([5]), which is the method that It was followed to weight the criteria of the model used in the study. Table (5) shows the importance and weight of each layer of criteria used as inputs in the study model, where the weight value reflects the relative preference for each criterion, and it was done on all layers resulting from the reclassification process.

Table 5. Order and weight of the criteria that represent the inputs of the proposed cartographic model.

Layer name	Rank or The importance of class (r)	Weight (w)*	Relative weight%**
Dem	2	5	24
Slop	1	6	28
Soil	4	3	14
geology	3	4	19
Main roads	5	2	10
Buffer of suez canal	6	1	5
total	**-**	21	100

Source: Arrangement of standards from the researcher's point of view.

* The weight of the layers was determined based on the equation: W = (N - R) + 1, where (N) is the number of standards (6 layers).

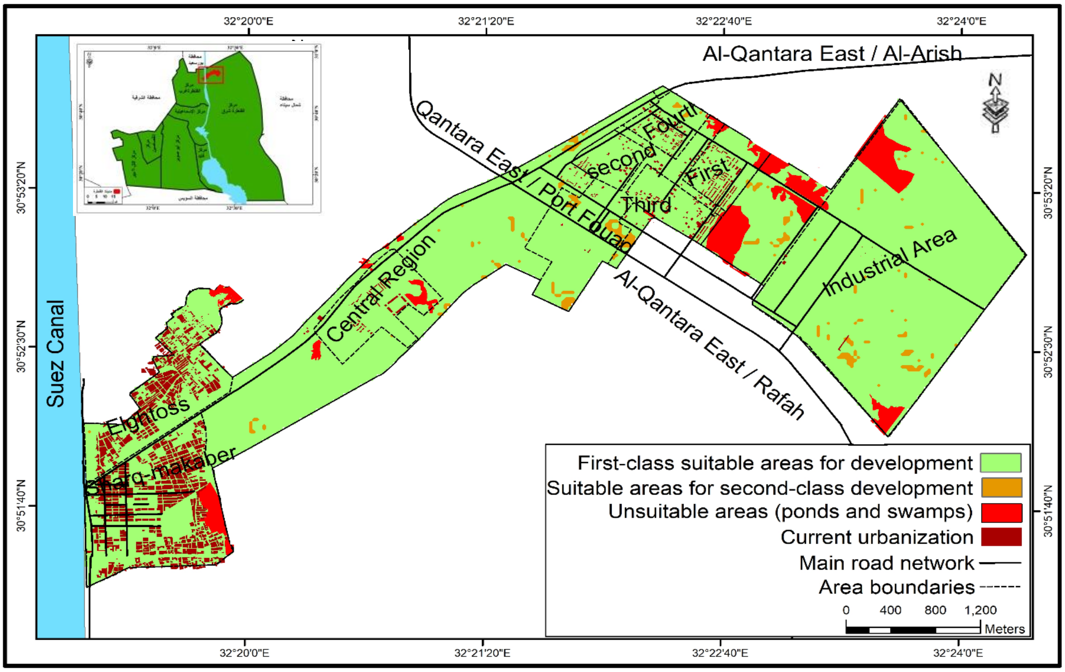
** Calculate the relative weight based on the equation: % = f/mg and x 100, where mg and (the sum of the weights of the 21 layers).

6) Results:

After performing the weighted matching process, the product is a map showing the development indicators mentioned previously. It is classified into two areas suitable for urban development and an unsuitable area, which is the swampy area surrounding the city, as shown in Figure (13) and Table (6), which shows the area of each area and the extent of its suitability.

[5]) Jianquan cheng, 2005, Modelling Spatial and Temporal Urban Growth, Faculty of Geographical Sciences Utrecht University, Netherlands p 257.

For comprehensive urban development in the city of Qantara Sharq.



Source: The student's work based on Table (5) using the ArcGis program.

Figure 13. The best locations for future urban development in the city of Qantara Sharq.

Table 6. Areas suitable for urban growth in the city of Qantara Sharq.

Region	Suitable first-class areas for urban development (acre)	Suitable second-class areas for urban development (acre)	Ponds and swamps (acre)	Urbanism (acre)
Elghtoss	275.6	-	6.6	117.8
Sharq-makaber	284	-	3.7	94.3
Central Region	93.1	-	12.4	6.5
First neighbourhood	59.7	-	31.2	9.1
Second neighbourhood	68.1	-	-	11.9
Third neighbourhood	38.8	17	38.6	10.6
Fourth neighbourhood	61.3	1.5	6.5	28.9
Industrial Area	444	15.8	48.3	0.9
Total	1324.6	34.3	147.3	280

Source: Worked by the researcher based on measurements of the digital spatial suitability map of the city of Qantara Sharq.

The results of this study showed that there are suitable lands available for future urban growth in the city of Qantara East, and these areas vary from one area to another within the city, as the industrial zone ranked first with an area of 444 acres of suitable first-class areas and an area of 15.8 acres of suitable second-class areas, where The study recommends the establishment and completion of the industrial zone in terms of establishing a factory for sand, cement and bricks used in construction, establishing a center for logistics services as the city is located on the maritime channel, and creating a complex for postal and communications services in the area. Then the East Cemetery area, with an area of 284 acres, was among the areas suitable for urban development First-class, and therefore the study recommends establishing a general central hospital to serve the old block, establishing a center for girls for handicrafts, and financing small projects. Then came Izbat al-Ghtous, with an area of 275.6 acres, of first-class suitable areas as well, in which the study proposes establishing a center for the elderly and a center for caring for orphaned and homeless children. As for the rest in the city areas, it is proposed to establish some primary, middle, secondary, and hotel high schools in order to encourage residents to live in the city of Qantara Sharq and remove concerns related to the desert environment and the inefficiency and lack of services there.

Fourth: Study results:

-The built-up area of the city of Qantara Sharq reached 309.57 acres in 2020, an increase of 349.23 acres.

- The northeast direction is considered the preferred growth direction for urbanization in the city of Qantara Sharq, especially after the establishment of the industrial zone.

- The study proposed creating a cartographic model for future urban development in the city of Qantara Sharq, which can be modified according to temporal and spatial variables and in accordance with the local environment of the city of Qantara Sharq.

Fifth: Recommendations:

- Reconsidering the current building laws with the aim of trying to reach an idea that fulfills the requirements of a distinct urban environment with cultural and aesthetic values, while emphasizing the importance of having a distinctive architectural character that is compatible with the cultural identity of each of the existing cities.
- Develop programs and plans for the development, upgrading and development of the urban fabric in the two cities so that they are compatible with all available capabilities.
- It is necessary for urban development plans to focus on paying attention to visual study in terms of working to achieve visual enrichment of all distinct architectural elements that can be perceived as an attempt to improve the urban environment of the city.
- Supporting administrative and financial decentralization and activating the role of popular participation in the development planning process.
- Encouraging more new investments and increasing the participation of the private sector and civil society.

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