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Research Article

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Assessment of the spatial suitability of urban expansion in the East of Baghdad governorate using modern technologies

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Abstract

Most of the cities and rural areas of Baghdad governorate have witnessed rapid urban growth, especially in the east of Baghdad governorate during recent years, which is sometimes random, spontaneous, and unorganized, as it has resulted in the emergence of multiple types of intertwined problems in various fields, including: the problem of urban expansion that exceeded technical capabilities And administrative decision-makers (**urban planning**) to face its effects.

These expansions became a clear threat to the fertile agricultural lands, and posed great and new challenges for decision-makers in the local governments of the eastern Baghdad governorate to confront. Here, there was an urgent need to take an appropriate decision, although it did not contribute to solving the entire problem, but it is somewhat characterized by solving a large part of it. By redirecting this expansion and organizing it towards the most suitable areas away from agricultural lands to secure the future of the coming generations.

Keywords: suitability spatial, multi-criteria suitability analysis, analytical hierarchy process.

1. Introduction

With the growth and expansion of cities, the complexity of life problems and the increase in human activity, the problem of urban expansion appeared in the vicinity of urban centers and rural areas in the east of Baghdad governorate, in the form of housing units (single or grouped), which grew and spread spontaneously, randomly and rapidly at the expense of agricultural lands, without organizing a plan or A study, as a result of the increasing population growth, and the social transformations that occurred within the cities and neighboring villages, the lack of investments in the residential sectors, and the accompanying rise in the income of families, which resulted in increased growth and urban expansion outside the planning controls at the expense of its rural back, and did not take Taking into account the suitability spatial (It is the process that includes the use of standards maps in their synthesis with the weights of these standards by subjecting them to the various processing units in a geographic information systems (GIS) environment to obtain the most appropriate land use classification and the proposed establishment for urban expansion, (**Alexander 2012**), It started day after day by grabbing fertile agricultural lands and switching their use to different unplanned land uses, including residential, industrial and commercial, in light of the weak preparation of plans, the absence of the rule of law, and the weakness of oversight and legislation that limit these abuses, especially after the events of 2003 AD.

Therefore, modern technologies have been relied on in studying and evaluating the spatial suitability of future urban expansion in order to give adequate indicators and a clear vision of determining the lands and the optimal future direction, and the most appropriate for urban expansion, by studying the factors affecting urban expansion and analyzing their spatial impact, through the application of appropriate analysis.Multi-criteria (**MULTI CRITERIA DECISION MAKING (MCDM**))(One of the techniques adopted in the various approaches to decision analysis, through which a comparison is made between the available acceptable options that achieve the final goal by defining multiple criteria of varying importance and evaluating the available options based on them),(**Eastman JR 1999**), according to criteria that have been carefully studied and deduced from the environment of the eastern province of Baghdad based on the Analyst Spatial approach based on geographic information systems (GIS) and using the analytical hierarchy process (AHP). **Therefore, we had to ask the following questions:**

1. What are the ideal locations for the eastward expansion of Baghdad Governorate?
2. Are there foundations and criteria for selecting suitable sites for urban expansion? Can GIS applications be used to identify suitable places for expansion according to specific criteria?

Hypotheses:

1. During urban expansion, there is the possibility of relying on the foundations and criteria for selecting sites
Occasion.
2. Using the spatial analysis tools found in the GIS environment, there is a possibility
Determine suitable places for urban expansion.

2. Methodology and materials

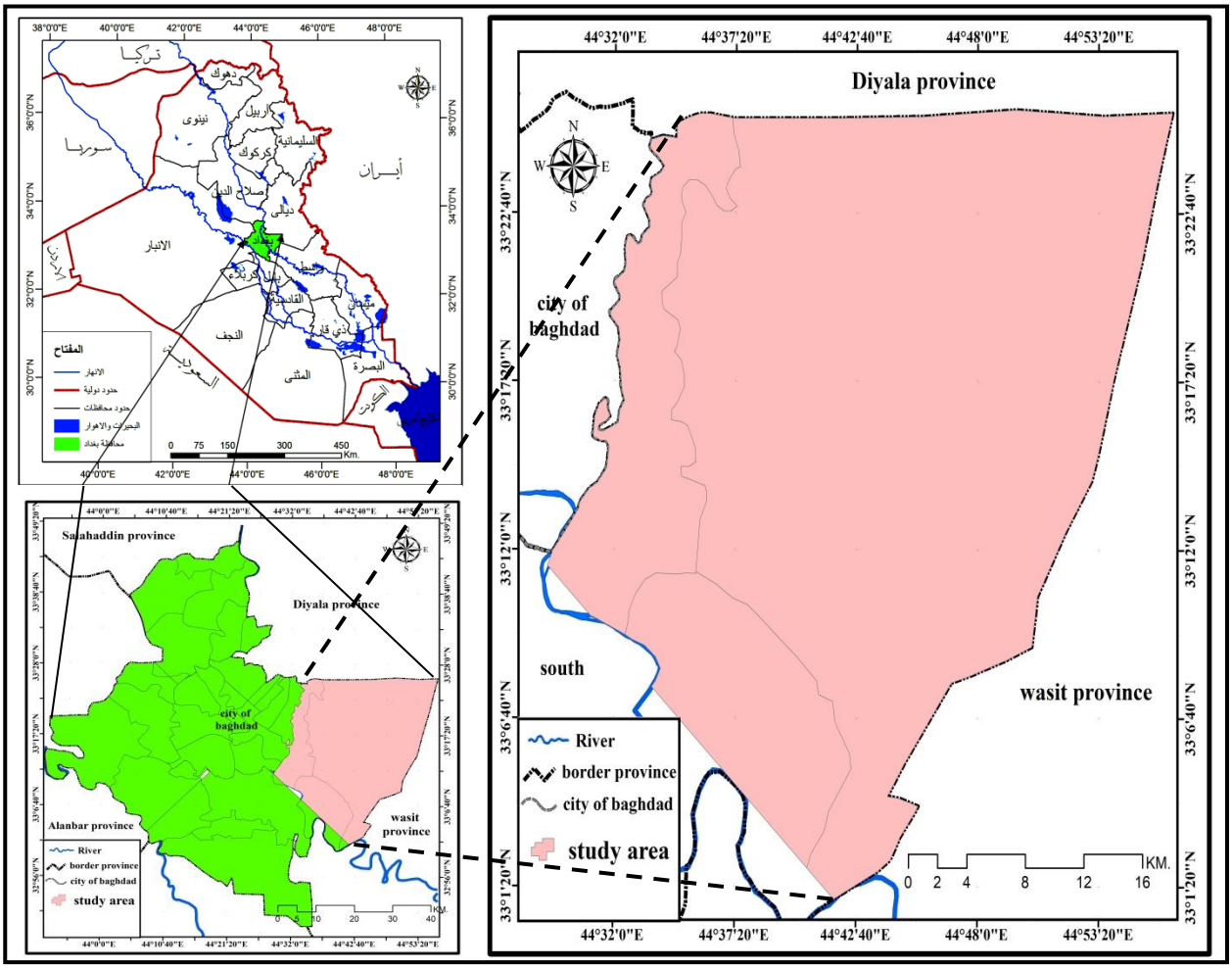
In this study, we relied on the descriptive analysis method by applying the Analysts Spatial available in the GIS environment and conducting the hierarchical analysis process (AHP) through

the Choice Expert program, in addition to conducting the Overlay Weighted process in Evaluate the spatial suitability and give the best suitable sites for future expansion.

2.1 **Study area:** It is located astronomically east of Baghdad Governorate, between two latitudes (48¯ 32^{O} and 46¯ 33^{O}) in the east and longitudes (51¯ 43^{O} and 56¯ 44^{O}) east From the north, northeast and east, Diyala Governorate, from the southeast, Wasit Governorate, from the south, Babil Governorate, and from the west it is bordered by the city of Baghdad, as in the map (1), and includes the administrative units (Al-Jisr, Al-Wahda, Al-Madain, Nahrawan), As for the temporal boundaries of the study area, it includes the year (**2018 AD**).

2.2 Steps for assessing suitability spatial: The spatial adequacy of urban expansion to the four geographical directions of the province of Baghdad was carried out on a set of steps that were carefully and carefully developed, as follows:

Map (1) eastern Baghdad province



Source: From the researcher's work based on: 1- The Ministry of Water Resources, the General Authority for Survey, the Map Production Division, the administrative map of Iraq, at a scale of 1: 1000000, for the year 2010. 2- The Ministry of Water Resources, the General Authority for

Survey, a map of the administrative Baghdad governorate, at a scale of 1 : 500,000, for the year 2010 AD.

A: Estimating the expected future population of the eastern Baghdad governorate for the target year 2038 AD:

The estimation of the future population is of great importance in geographical research and studies, especially the geography of cities, as it is the basis and the important indicator on which any future development planning trends are based. Because it plays an important role in predicting their basic requirements of various public services and arriving at an estimate of the cities' needs for areas of land use in the future, and thus contributes to drawing future trends in a way that does not create economic and planning confusion (**Yahya 2016**).

The population numbers for the east of Baghdad governorate were predicted based on the growth rate for the previous years (2009-2018 AD), and the population numbers were predicted up to the target year (2018-2038 AD) by using the compound growth equation (1)(**Taha1988**):

(1): Pr=Po×(1+r)^n

Pr: future population, **Po:** current population, r: growth rate, **N:** the difference in the number of years for the present and the future. Selected for every (10) years.

that is, with a period of time (20 years), which is a sufficient period to complete future predictions, because if it extends for a longer period of time. This will reduce its usefulness to a large extent, due to the many possibilities of error and thus the extent of confidence in it will decrease (**Fathi 1968**). This is because growth variables are of a dynamic and flexible nature, they change rapidly, so the estimated period (10-20) years is sufficient to meet the requirements of human development and its future strategies (**Abd 1986**), the growth rate has been calculated decreasing at a rate of (0.01) for every 10 years, according to United Nations estimates. Table (1) shows the future prediction of the population of the east direction.

Table (1) Estimates of the future population of the eastern Baghdad governorate for the target year 2038 AD

Trend	Current Population 2018 AD		Future Population 2028 AD	Future Population 2038 AD	
	Population numbers	Population growth rate %	Population numbers	Population numbers	Population growth rate%
East		1.9	554870	669781	1,9

The source is from the researcher's work based on: 1. The Ministry of Planning, the Central Bureau of Statistics, population projections for the year 2018, unpublished data, 2. The compound growth equation.

We note from the above table that the population numbers and their growth rates will increase continuously during the above-mentioned period to reach the year 2038 AD, To the east, (669,781 people) with a growth rate of 1.9%, in the event that the demographic conditions and the current conditions continue as they are, but the most likely will change It varies from one trend to another depending on the circumstances it is exposed to and which are subject to change over time.

B: Estimating the future area of land that must be provided to cover the expected population increase in the eastern Baghdad governorate for the target year 2038:

Estimating the future area represents a correct and important planning step to reveal the spatial requirements resulting from population increases in the main cities and their countryside, and this would give appropriate data on the direction of the urban space that it will take during its future expansion, and there is a close relationship between the increase in population and the amount of demand for land, As the population increases, the demand for lands with all their uses increases, which results in the expansion of these lands in the direction occupied by their residents.

Since land uses are in constant growth as a result of changes in population numbers and economic and social developments, so they need continuous policies to regulate this growth, or else its growth will be random (**Ahmed 1988**), and from these policies this expansion is directed towards the most suitable lands for different uses in proportion to the increase projected future population.

For the purpose of identifying the area required to accommodate the future population increase in the eastern province of Baghdad, the housing deficit using equation (2) (**Al-Janabi1987**):

(2) 1.Extracting the number of houses to be provided = population / average family size.

2. The housing deficit = the number of housing units that exist – the number of housing units to be provided

was extracted by relying on the average family size of (6.9/units) according to the enumeration and numbering data for the year (2009) and the average share of one person, which amounted to (60 m 2 / individual) according to the planning standards approved by the Urban Planning Authority for Iraqi cities, and it is within the acceptable rate of horizontal housing in small cities, and the quota standard for one person has been reduced in line with recent studies that emphasize reducing these standards in order to preserve energy sources, and to prevent the expansion of cities horizontally at the expense of agricultural land, and according to the principles of urban sustainability, As well as taking into account the number of invalid housing units at a rate of (10%) according to modern planning studies, in addition to that, the horizontal pattern was relied upon because it is prevalent in the province of Baghdad, and the area of the future need of the land that must be provided for every 10 years until the target year was extracted 2038 AD, as shown in Table (2). using equation (3) (**Al-Janabi1987**):

(3): **The area of the future need was extracted based on the equation:** the number of units required ✖ the average (current) family size x th✖ share of the space per person.

Table (2) The future space to be provided for the eastern Baghdad governorate for the target year 2038 AD

Direction	Future area 2028 AD	Future area 2038 AD
	Area (km2)	Area (km2)
East	571	1261

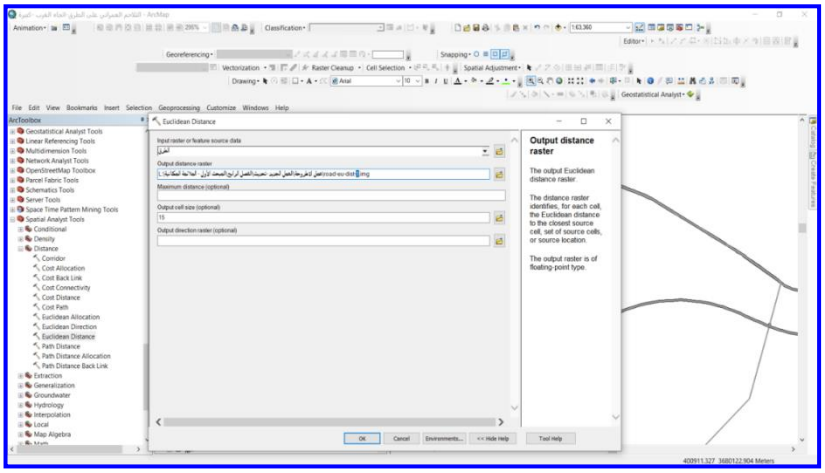
Source from the researcher's work based on 1. Ministry of Planning, Central Statistical Organization, population projections for 2018, unpublished data, 2. Baghdad Governorate, Urban Planning Directorate, urban planning standards, for the year 2009AD.

We note from the above table when estimating the future need until the target year 2038 AD, and based on the planning criterion (60 m^2 / person), To the east, it needed an estimated area (571 km2) to reach (1261 km2) until the target year 2038, and we conclude from this that the Baghdad governorate needs a large area of land to cover the future need, so this expansion must be redirected and organized towards the most suitable areas as far as possible from the fertile, high-density agricultural lands to secure the future of future generations.

2.3 Spatial data classification:

At this stage, the factors affecting the expansion were prepared as a criterion that enhances or detracts from the spatial suitability (**Jankowski 2003**), as the process took place within the environment of the Geographic Information Systems (GIS) program and for each geographical direction, as each factor was divided into (5) equal areas in terms of Distance from the influencing factor by using the (Distance (Euclidean) tool available within the Analyst Tools Spatial) and the (Multiple Ring Buffer) tool available within the (Analysis tools) within (ArcToolbox), and as in the picture (1).

Picture (1) The process of classifying data by using the (Distance (Euclidean) tool for the province of Baghdad



From the researcher's work, based on the (Arcmap)

2.4 Classification of the effect of factors affecting the urban expansion of the eastern Baghdad governorate:

1.The effect of proximity to water resources:. The east of Baghdad Governorate is characterized by a large water network of rivers, canals and streams, and despite its attraction for various uses, the land near it, the areas located close to it are considered unsuitable for urban expansion. Because in the planning of land use, it is necessary to define the rivers and their limits to ensure that the flood does not threaten the residential units on the one hand, and that the surface waters of the rivers are not polluted by urban areas and human activities on the other hand,(**Chen 2017**), and these limits should not be less than (100 metres).(**Iraqi Gazette 1987**), For the purpose of maintaining water quality, the limit reaches (150 meters) (**WHO 2004**), and based on this, an assessment of the water resources was given according to the spatial dimension. Water got the lowest rating (1). Table (3) and map (2) show the degree of classification of the spatial dimension of water resources:

Table (3) Classification of the degree of spatial dimension in relation to water resources

Rating score	Proximity to water resources (meters)
1	0 - 150
5	150 – 300
4	300 - 450
3	450 – 600
2	600 >

Source: From the researcher's work based on (Arcmap)

2.Effect of proximity to the road network:

Baghdad Governorate is characterized by a dense network of main and secondary transportation routes, which is reflected in its attraction to various uses of the land near it. , which required respecting road boundaries and preventing the development of cities and the construction of any housing units, buildings or facilities at a distance of (260 meters) for highways, (100 meters) for main roads (arterial and combined) and (60 meters) for secondary roads (secondary, rural and touristic) (Iraqi Gazette 1983), as for The second issue: When cities and residential areas are close to the main and secondary roads, they work on interconnection and develop relations, which affects the development of the economies of these cities.

Based on this, an assessment of the road network was given according to the spatial dimension, and in an accurate manner to take into account these two perspectives. The areas that are more than (260 meters) from the highways got the highest rating (5), which is far from (60 meters) for the secondary roads, while the areas Adjacent or close to the road network got the

lowest rating (1). Table (4) and map (3) show the degree of classification of the spatial dimension of the road network:

Table(4) classifies the degree of spatial dimension in relation to the road network

Classification degree	Proximity to the road network (meters)
1	0 - 100
4	100 – 200
5	200 - 300
3	300 – 400
2	400 >

Source: From the researcher's work based on (Arcmap)

3. The effect of proximity to the urban area:

The proximity to urban areas is of great importance, especially as it contributes to achieving urban coherence and harmony with areas of future expansion.

This factor should be considered from two perspectives: the first is that the proximity factor contributes to reducing the economic cost of establishing infrastructure services such as extending road, water and electricity networks, as well as reducing the factor of ease of access (time - distance) to most of the activities located in city centers. Due to the availability of modern means of transportation, which reduces the degree of importance of easy access, however, there is a desire among the residents to be near these centers for special reasons related to them in terms of work, shopping and reviewing official departments.

The second relates to the nature of this interdependence and homogeneity, as the merging of these areas with cities leads to a real increase in the population of these cities, and that the increase in population activity leads to increased pressure on them and high rates of social unemployment, which will result in an increase in economic problems cities in the end. Therefore, lands with a distance of more than 1.5 km are considered the best suitable areas for future expansions.

Based on this, an assessment was given to the urban areas according to the spatial dimension and in an accurate manner, taking into account what was previously mentioned. The areas that are more than (1,5 km^2) got the highest rating (5), while the areas near and adjacent to urban centers got the lowest rating (1) Table (5) and map (4) show the degree of classification of the spatial dimension from urban areas:

Table(5 Classification of the degree of spatial dimension for the urban area

Classification score	Proximity to urban area (meters)
3	0 - 1500
5	1500 – 3000
4	3000 - 4500
2	4500 – 6000
1	6000 >

Source: From the researcher's work based on (Arcmap)

4.Soil effect

The most important goal in soil studies in urban planning is to study the agricultural and material potentials and mechanical properties of the soil (**Smidt,2018**), Soils in Baghdad Governorate vary in terms of the degree of their bearing the pressure created on them and their suitability for cultivation, as there is no type in them that cannot be built on top of, but some treatments can be found to be suitable for construction, which necessitates the use of salt-resistant cement in all foundation works to ensure that they do not slip or fall, and here It must also be pointed out to the nature of the soil in terms of its fertility, so it is preferable not to nominate areas with fertile soil suitable for agriculture in urban expansion.

Based on this, an evaluation was given to the impact of the soil according to the degree of its resistance to urban construction and its fertility. Soils are more suitable for urban expansion and are not suitable for agriculture, they obtained the highest rating (5), while the least suitable and suitable for agriculture, they obtained the lowest rating (1), and the table (6) shows 10) and map (5), the degree of classification of suitability of soils:

Table(6) Classification of the degree of spatial dimension for agricultural land

Classification degree	Proximity to soil (meters)
4	shoulders of rivers
5	muddy river basins
3	gypsum pebble
2	immersion patrol
4	basin depressions
3	valley bottom soil
3	Soils of the ancient river plains buried in silt
3	ancient plains riverine pebbly soil
1	mixed gypsum desert lands

Source: From the researcher's work based on (Arcmap)

5. The effect of proximity to agricultural land

The most important goal in urban planning studies for expansions, is to determine the quantitative and qualitative characteristics and the agricultural and material capabilities of agricultural lands (**Misra 2015**), and that the governorate of Baghdad, as mentioned previously, which suffered from abuses of all kinds on agricultural lands, and the transformation of its use from agricultural use to different land uses, including Residential, industrial, commercial, and service in the absence of legislation and lawlessness, especially after 2003.

Therefore, it is necessary to classify these lands and determine the degree of their fertility. The high-density and most fertile agricultural lands will take priority in the current and future expansions in order to preserve them and ensure the sustainability of natural resources in them to secure the future of future generations, while the barren and less fertile lands direct the expansions towards them.

Based on this, an assessment was given to the impact of agricultural lands according to the degree of their fertility. The most fertile lands received the lowest evaluation (1) to ensure that no expansion at their expense, while the less fertile lands received the highest evaluation (5), and the table (7) shows, and the map (6), the degree of classification of agricultural lands according to their fertility:

Table (7) Classification of the degree of spatial dimension for agricultural lands

Classification degree	Proximity to agricultural land (meters)
1	high density agricultural
4	uncultivated agricultural
5	barren

Source: From the researcher's work based on (Arcmap)

6. Effect of proximity to industrial areas, military sites and airport

Factories and industrial areas play a role in expanding the size of cities, and charting their future trends by signing various industrial activities and events, and despite their prominent role in the concentration of the population around them, the adjacent and adjacent areas are not suitable for urban expansion, because they play an important role in noise Air, soil and water pollution in areas under their influence.

The appropriate distance should be monitored, which must be respected for urban development, and at a minimum a distance of (500 meters) from industrial areas should be established (**Martinat 2016**), and expansion near military and security sites and airports should also be taken into account.

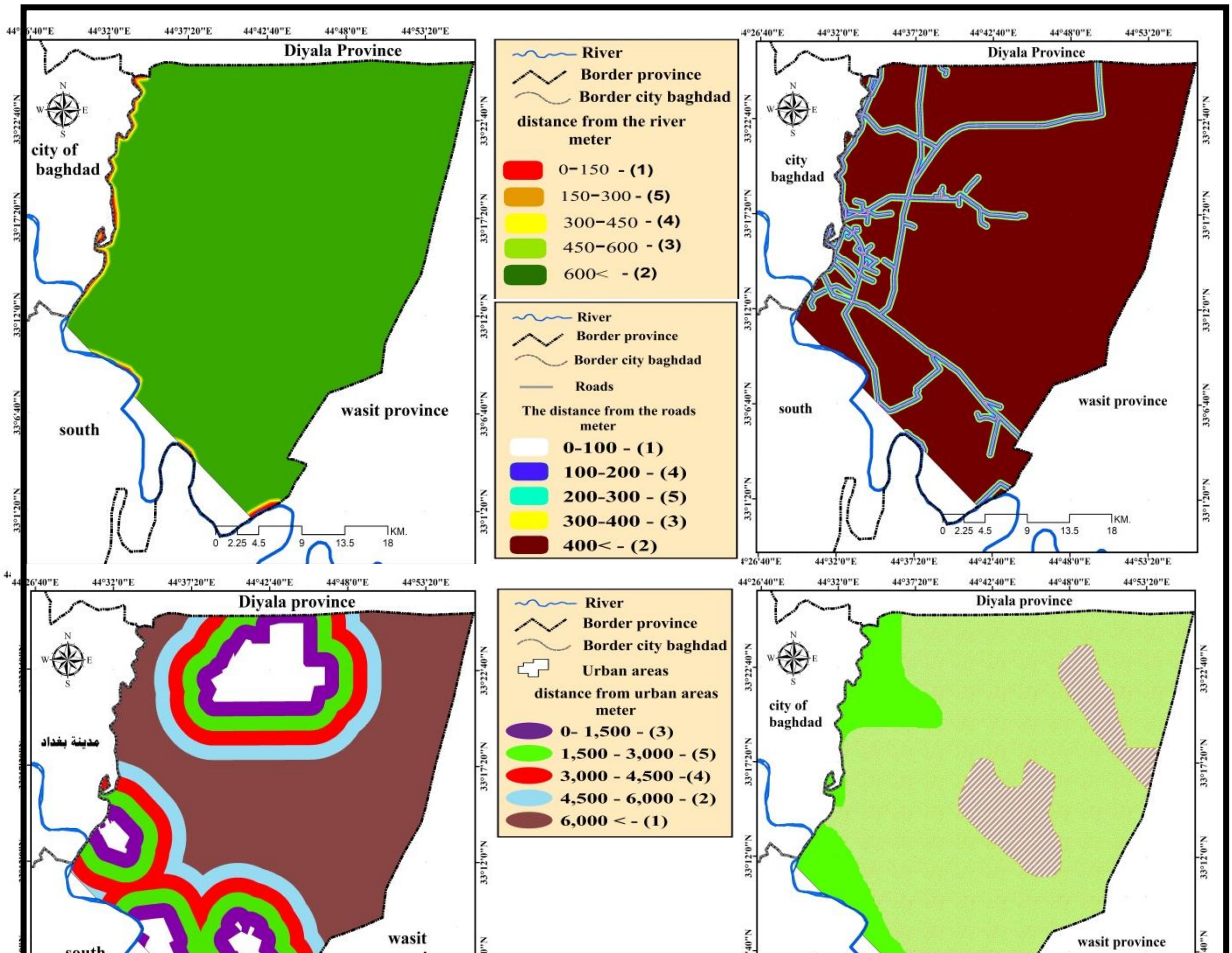
Baghdad governorate is characterized by the diversity of factories and industrial areas in it, so an assessment of the impact of industrial areas was given according to the spatial dimension and in an accurate manner, taking into account what was previously mentioned. The highest rating (5), as for the military sites, the areas near them got the lowest rating (1), while the areas far from them got the highest (5), while the areas near the airport and at a distance of less than (2 km^2)((**ICAO, 2001**) obtained the lowest rating (1), while the remote areas received the highest rating (5). Table (8) and map (7) show the degree of classification of the spatial dimension of industrial areas and military sites:

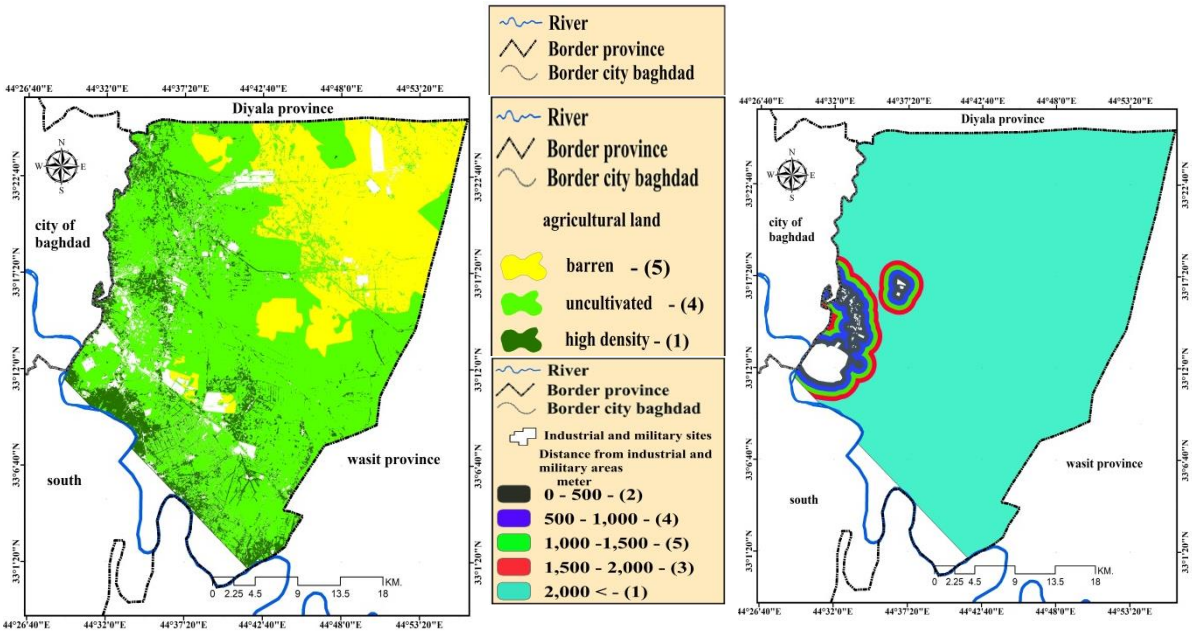
Table (8) Classification of the degree of spatial dimension of industrial areas, military sites and the airport

rating degree	Proximity to the airport (meters)	Classification degree	Proximity to industrial and military sites (meters)
1	0 - 2000	2	0 - 500
3	2000- 4000	4	500 – 1000
4	4000 - 6000	5	1000 - 1500
5	6000-8000	3	1500 – 2000
2	8000>	1	2000 >

Source: From the researcher's work based on (Arcmap)

Maps (2-3-4-5-6-7) classifying the degree of spatial dimension of the influencing factors for eastern Baghdad governorate





Source: From the researcher's work based on (Arcmap)

2.5 Determining the weights of the factors (layers) using the analytic hierarchy process (AHP):

One of the most important components of the multi-criteria decision-making analysis (MCDM) based on geographic information systems, is to assign weights to all factor maps, (**Ibrahim 2011**) as the purpose of weighing in this process is to express the importance or preference of each factor in relation to the impact of another factor on the expansion areas But the most exciting problem in analyzing multiple criteria decisions is how to construct weights for a group of factors in order of importance (**Zhang et al., 2013**).

Therefore, the Analytical Hierarchy Process (AHP) is a comprehensive and logical process that allows for better understanding of complex decisions by solving the problem in a hierarchical structure by simplifying the complex choices in a series of comparison between pairs to produce outputs, and it has a valuable method in choosing alternatives as well as for testing To ensure that the evaluation made by the decision maker is consistent (**Saaty, T.L., (1980**).

Adopting this method is not necessary to take complex decisions, because its mechanism of action allows comparison of individual criteria or pairs of variables (**Asakereh 2014**), so the method of wise pair comparison (**PAIR WISE COMPARISONS METHOD**) was relied on to obtain the weights, as the method of wise pair comparisons was developed by (Saaty 1980) in the context of the Analytical Hierarchy Process (AHP), and this method includes wise comparisons of the main factors with each other and the sub-factors with each other and results in relative weights,

and this process is carried out according to the scale of preferences Consists of (9 degrees)(**Saaty, 2012**).

As in Table (9), the highest value in scale (9) indicates the highest importance, while the lowest value (1) indicates equal importance. Once the comparison is made between the two spouses and the weight of the factor is determined, the consistency ratio is calculated (CR)) which refers to identifying inconsistencies and developing the best weights in the complete pairwise comparison matrix and to check the reliability of the relative weights (Bunruamkaew 2011), when the value of the consistency ratio (CR) is less than (0,1) and does not exceed (10%), the contradiction is satisfactory But when the value of (CR) is greater than (0,1) and exceeds (10%), the discrepancy is not satisfactory, so the decision must be reconsidered (**Romano 2015**).

Table (9) shows the baseline scale used in the pair-wise comparison

Qualitative identification	شدة الأهمية
Equal importance	1
Just as much or a little more important	2
A little more important	3
Few to more important	4
much more important	5
Much more important	6
much more important	7
Much more important to more important	8
very important	9

The source is from the researcher's work based on the preference scale by (Saaty 1980)

Most researchers sometimes reach results and appropriateness for expansion that do not match the actual reality of urban growth, which necessitates the administrative and planning authorities not to implement them, because they are not applicable in practice due to the inaccuracy of the weights of the factors affecting them, their failure to observe the planning controls and the difficulty of implementing them on the ground, so We see the necessity of applying one of the modern scientific techniques in this field, which is the Delphi technique (It is a set of questions to obtain the opinions of a number of experts. This method is used in the processes of forecasting and future planning, based on the collective participation of scientists and specialists, and not the subjective opinions of the researcher. to the influencing factors)(Dalkey 1963), Experts with different specializations in studies of cities and urban centers were selected in order to give weights (1-9) to the factors with high accuracy according to priority and importance in line with the nature of the factors and their impact on urban expansion, and for the purpose of reaching a more realistic and feasible spatial suitability On the ground in the future.

The results of the experts were relied on in determining the weights according to priority and importance and as in the above-mentioned table, and since there are multiple decision-makers (experts), so the geometric mean(It is a type of average or average that measures the central tendency or the typical value of a set of data, and it was extracted according to the equation:(3)(**Matt Friehauf 2018**)

(3): $G = \sqrt[n]{x_1 \times x_2 \times x_3 \times \dots \times x_n}$ So, n: the number of values, x: the values

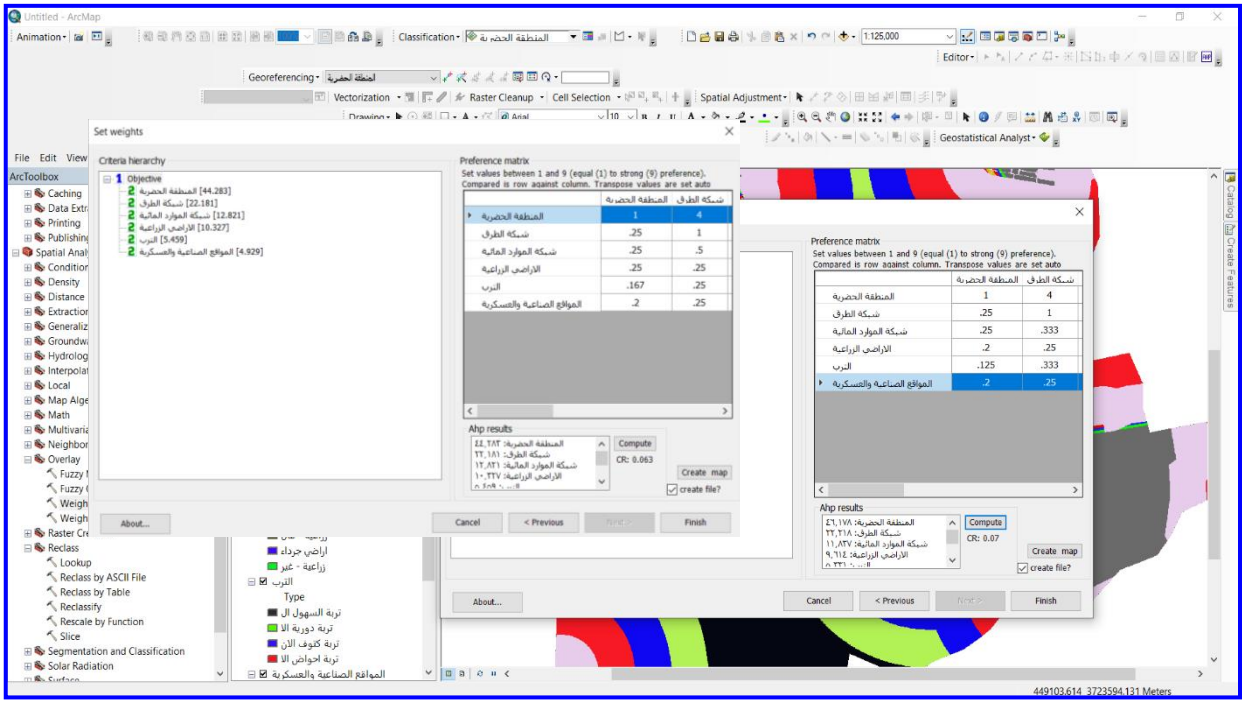
of the priorities was calculated to obtain the final weights (**Asmaa 2004**), and as in Table (10), and these weights were applied within the (AHP) tool that was added within the Arcmap environment) to perform the pairwise comparison process and the weights were extracted, as gradual weights appeared to us according to importance, and the value of the consistency index (CR) was calculated according to the extracted weights, as it reached The value = (0.06), which is less than (0,1) according to the hourly index in the hierarchical level of the process (AHP), and this indicates that the process of distributing weights between the influencing factors indicates a high level of accuracy and that its results are acceptable and shows good consistency in the nature of the judgment. and as in the picture (2),

Table (10) Binary Comparison Matrix - Results of Weights Test for Influencing Factors for Eastern Baghdad Governorate

The weights of the influencing factors						Factors	ت
Industrial and military sites	Soil	Agricultural land	Water Resources Network	Road network	Urban area		
5,000	6,000	4,000	4,000	4,000	1,000	Urban area	1
4,000	4,000	4,000	2,000	1,000	0,250	Road network	2
3,000	4,000	1,000	1,000	0,500	0,250	Water Resources Network	3
2,000	3,000	1,000	1,000	0,250	0,250	Agricultural land	4
2,000	1,000	0,333	0,250	0,250	0,167	Soil	5
1,000	0,500	0,500	0,333	0,250	0,200	Industrial and military sites	6
0,050	0,054	0,105	0,133	0,221	0,437	Weights	
Consistency Index (CR) = 0.063							

Source: From the researcher's work, depending on the field study, the expert results questionnaire form, using the Delphi method, by relying on the (Arcmap) program.

Picture (2) Results of choosing weights for the influencing factors to determine the best weight using the AHP . method



Source: From the researcher, depending on the results of experts and using the (Arcmap) program.

2.6 Evaluation of the degree of spatial suitability of urban expansion in relation to the influencing factors:

After clarifying the impact of the factors affecting the urban expansion of Baghdad governorate, at this stage, the weights obtained from the results of the hierarchical analysis (AHP) will be relied on in order to carry out the process of evaluating the spatial suitability, as the weights were given to each factor according to the given relative importance and as in Table (11), by performing a calculation using the Overlay_Weighted tool available within the GIS environment in the Analysis_Tools within (ArcToolbox).

Table (11) Binary Comparison Matrix - Results of Weights Test for Influencing Factors for Eastern Baghdad Governorate

Importance ratios - %	Factor affecting urban expansion Importance ratios
43,7%	Urban area
22,1%	Road network

13,3%	**Water Resources Network**
10,5%	**Agricultural land**
5,4%	**Soil**
5%	**Industrial and military sites**
100%	**Total**

Source: From the researcher's work based on the field study - expert results questionnaire form And using Delphi style by relying on hierarchical analysis ((AHP) within the program (Arcmap

And after performing the weighted match procedure, according to the methodology and method that was followed in the analysis, the result of the spatial suitability shows us (3) classifications of land types according to the degree of their suitability for urban expansion and through the map ( ), and after the inspection it was shown We have the following:

First: Suitability areas: The areas of spatial suitability for urban expansion vary, in terms of their distribution and area on the four geographical directions, and when comparing these areas with the maps of the influencing factors that were prepared in advance, we note that their location has several advantages that qualify them to attract the population towards them:

1. Strengthening and strengthening the interconnection of the region's kinetic and economic axes with its neighboring cities, as a result of its good location along the main and secondary transport and connectors, as it is located along the main road axis (**Baghdad-Hilla**) in the east direction, as well as the secondary road network that branches within it.
2. Achieving interdependence, local integration and social homogeneity between urban centers because they are a gradual extension of the neighboring areas and not a jump. A kind of disconnection and distance occurs, which opens the way for the development of the region into a nucleus of major population attraction and the transformation of the high population concentration around urban and rural centers within agricultural lands and in the city of Baghdad It accumulated over many years and for many reasons towards it, especially to attract low-income citizens, employees and workers, benefiting from the geographical location in terms of accessibility factor (distance - time), and from providing job opportunities in terms of proximity to city centers and services.
3. Most of its lands are almost flat and do not require high costs to extend basic service networks, as they are located within uncultivated agricultural lands and barren lands, which are characterized by good conditions suitable for construction in them, and this enhances their role in preserving high-density agricultural lands from urban expansion Random.
4. Its proximity to the archaeological areas and hills within them, and integrating with the open green areas nearby, has a strong impact on strengthening the economic base of the population on the one hand, and on the other hand, the growth of the tourist and recreational areas will form an outlet for its residents and provide services in a way that enhances the attraction and stability of the population in the region.

5. The alignment of some of its areas to rivers, water channels and streams, which can be used to exploit the river fronts and exploit the site's special potentials related to the nature of the river path in the region, as the nature and shape of agricultural lands confined to the movement of the river path in the region encourages the proposal of a basic nucleus for the establishment and establishment of projects Service stations, such as water purification stations to provide the region with potable water, and tourism projects in the region, which will contribute significantly and effectively to turning it into a nucleus of attraction for the population as areas of stability.
6. Its proximity to the industrial areas in some parts, which contributes to attracting manpower to the area, especially with the provision of housing for workers close to the work areas, which leads to turning it into a nucleus of attraction for the population as areas of stability.
7. Investing the potentials of the surrounding area in terms of soil fertility and water availability by strengthening the agricultural sector and what this sector holds of great importance due to the link between its development and strengthening with the development of all basic sectors in the region.

We note from the table ( ) that the total area of land suitable for the east direction is about (395 km2), and this area occupies only about (69%) of the area of the future need for the year (2028) amounting to (571 km2), and to reach (31%) in the target year (2038).) from the area of the future need of (1261) km2, We conclude from this that the balance of this area is not sufficient to meet the areas of future need, and thus the high-density agricultural lands remain a confirmed urban reserve balance for future expansions.

In this regard, and similarly to that, it is noted through Table (12) that the suitable land area is a confirmed reserve balance for the expected urban expansions for the year 2038 AD, amounting to (92 km2). Future squatter urbanization on agricultural lands, preventing the transformation of high-density and uncultivated agricultural lands in the province of Baghdad into barren, barren lands, and preserving them and ensuring the sustainability of natural resources in them to secure the future of generations during the next twenty years.

Table(12) Areas of areas suitable for urban expansion in eastern Baghdad governorate

Expected urban area km^2		Percentage of coverage for future need 2038 AD	Area of future need 2038 AD	Percentage of coverage for future need 2028 AD	Area of future need 2028 AD	Suitable areas	Trend
years 2038	year 2028	Percentage	Area (km^2)	Percentage	Area (km^2)	Area (km^2)	
132	103	31%	1261	69%	571	395	East

Source: From the researcher's work based on the results of spatial adequacy through the use of the program (Arcmap).

Second: Suitable medium areas: The spatial suitable medium areas for urban expansion vary, in terms of their distribution and area on the four geographical directions, and when comparing these areas with the maps of the influencing factors that were prepared in advance, we note that their location is characterized by some of the pros and cons, which reflect their effects on the polarization of the population towards them, and the most important Positives:

1. These areas occupied a wide area and extension of land compared to other areas, parts of which can be invested in construction and urbanization.
2. Some of its parts penetrate a good network of main and secondary transportation and communication routes.
3. The presence of some villages in the form of small nuclei of the population spread over large areas of them.
4. The proximity of parts of it to the water resources network, which can be used in the establishment of service projects such as filtering stations to provide their areas with potable water, and tourism projects such as exploiting their riverfronts for recreational areas.

Despite these advantages that characterized the regions, they are not without negatives, whose effects were reflected in the failure to achieve the required level of spatial adequacy to direct urban expansion towards them, except for some parts of them, and these negatives include:

1. Some parts of its lands and large areas are a homogeneous mixture of mixed agricultural lands (high-density - uncultivated), so it is imperative for them to implement development plans in them.
2. The distance of parts of these areas from the city centers, which results in the residents' unwillingness to head towards them, and the occurrence of administrative problems when expanding the boundaries of their municipalities, as well as the difficulty of implementing service projects in them in the future, because they require high capital to carry out their implementation.
3. Ownership of some lands within these areas to the population (agricultural contracts - and agricultural taboo) and for large areas, so it is necessary to provide large sums of money as a compensatory measure for their owners.
4. The presence of some human determinants within the areas it occupies and for large areas, most notably the location of atomic energy and industrial facilities.
5. The extension of some areas in a stripe pattern for long distances, results in a great fading of services, which forms a separation boundary between these areas and the city centers.

We note from Table (13) that its total area towards the east is about (530 km^2), and this area occupies only about (93%) of the area of the future need for the year (2028) amounting to (571 km^2), and to reach (42%) in the target year (2038) of the area of the future need amounting to (1261 km^2), and despite occupying large areas, it cannot be used as a balance to meet the future housing deficit, except for a few parts of it, especially the lands that fulfilled some criteria conditions and located within the uncultivated agricultural lands.

Table (13) Areas of medium-sized areas suitable for urban expansion
To the east of Baghdad Governorate

Percentage of coverage for future need 2038 AD	Area of future need 2038 AD	Percentage of coverage for future need 2028 AD	Area of future need 2028 AD	Suitable medium areas	Trend
Percentage	Area (km2)	Percentage	Area (km2)	Area (km2)	
42%	1261	93%	571	530	East

Source: From the researcher's work based on the results of spatial adequacy through the use of the program (Arcmap).

Third: Unsuitable areas: The areas unsuitable for urban expansion vary, in terms of their distribution and area on the four geographical directions, and when comparing these areas with the maps of the influencing factors that were prepared in advance, we note that their location cannot be used to meet the future housing deficit because it is not suitable to attract the population and direct urban expansion towards it. For several reasons, the most important of which are:

1. These areas occupied a small area of land compared to other areas, and most of their lands are located within high-density agricultural lands, so it is difficult to implement any development projects within their scope.

2. Weak traffic and economic movement, because some of its parts are far from the main and secondary transportation network.

3.The occurrence of large parts of them within the conditions of the standards (taboos) that were set in the process of preparing them in advance, especially their proximity to city centers, rivers, roads, and military and industrial sites.

4. The distance of parts of these areas from the city centers, which results in the residents' unwillingness to go towards them, as well as the occurrence of administrative problems when expanding the boundaries of their municipalities, as well as the difficulty of implementing service projects in them in the future, because they require high capital to carry out their implementation.

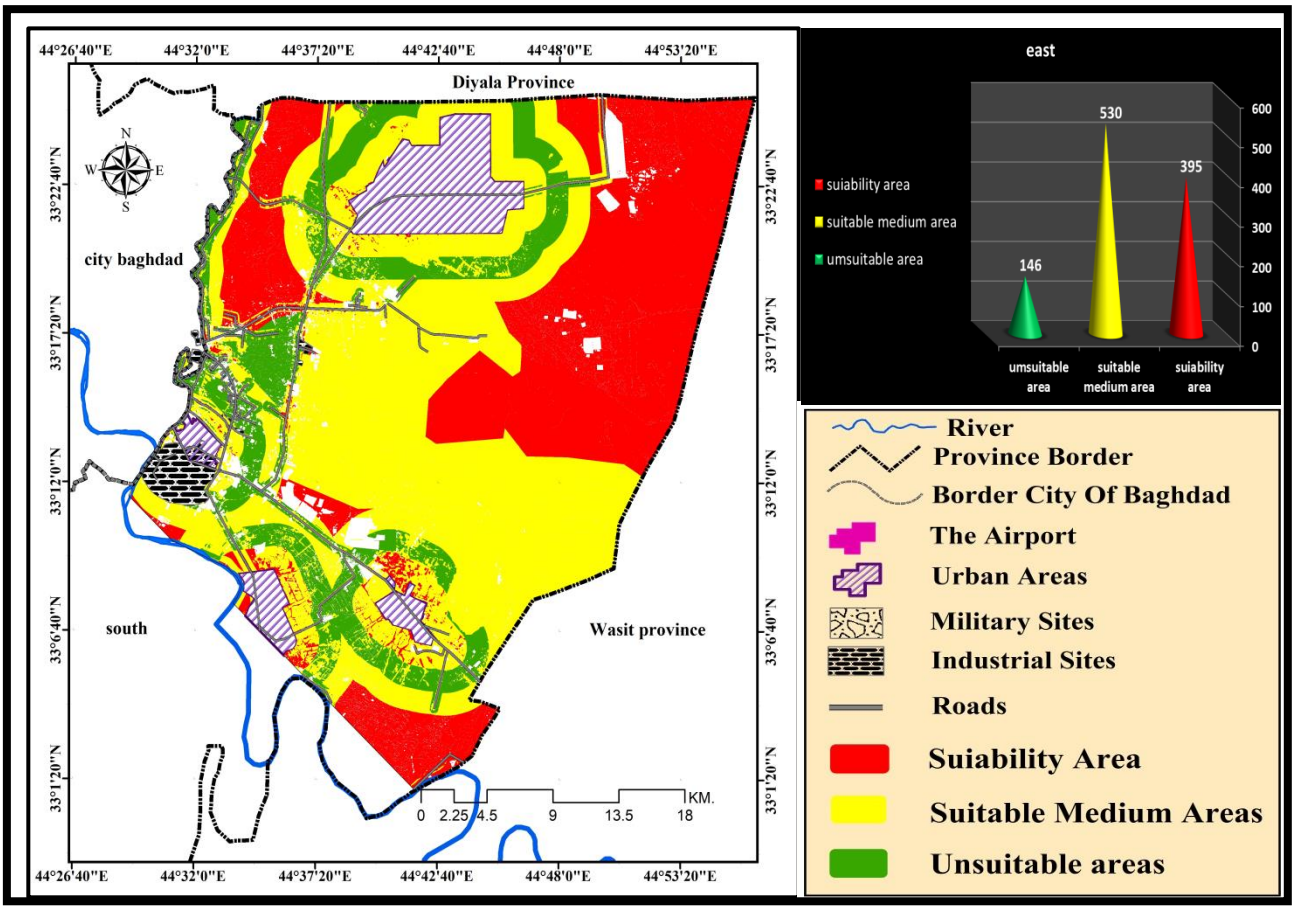
It was shown in Table (14), that its total area to the east was about (146 km^2), and this area occupies only about (26%), of the area of future need for the year (2028), which is (571 km2), and to reach (12%). In the target year (2038) of the future need area of (1261 km^2).

Table (14) Areas of areas unsuitable for urban expansion in eastern Baghdad governorate

Percentage of coverage for future need 2038 AD	Area of future need 2038 AD	Percentage of coverage for future need 2028 AD	Area of future need 2028 AD	Suitable medium areas	Trend
Percentage	Area (km2)	Percentage	Area (km2)	Area (km2)	
12%	1261	26%	571	146	East

Source: From the researcher's work based on the results of spatial adequacy through the use of the program (Arcmap).

Map (8) Spatial Adequacy of Urban Expansions by Overlay Weighted Process



Source: From the researcher's work through the use of the (Arcmap) program.

Conclusions

The study proved that the use of multi-criteria decision-making analysis, in combination with Delphi method (expert opinion), GIS tools and remote sensing, contributed significantly to providing realistic solutions to a large part of the current and future urban expansion problems, which are expected to reach an area of In the eastern province of Baghdad for the year 2038 AD (132 km^2).

The study concluded, according to the methodology used in the spatial analysis of spatial convenience, that the area of areas suitable for urban expansion in eastern Baghdad governorate amounted to (395 km^2), and that the best directions are suitable and the largest area, are the areas adjacent to the Diyala River extending from the side of the bridge towards the cities, so this

methodology contributed In solving the bulk of the problem of future random urban expansions on agricultural lands, preventing the transformation of high-density and uncultivated agricultural lands in the province of Baghdad into barren, barren lands, and preserving them and ensuring the sustainability of natural resources in them to secure the future of generations during the next twenty years.

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