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The effect of urban sprawl on land cover changes in agricultural areas using geographic information systems

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Abstract:

The phenomenon of urban sprawl is considered one of the important phenomena or issues that most of countries in this world suffer from, as it affects agricultural lands and the sustainability of cities, which leads to shrinkage and contraction of agricultural areas, the importance of the research lies in knowing the changes that occurred in the vegetation cover during that time period and determining the extent to which they were affected, This paper deals with the development of the phenomenon in the region between the period (2000--2020) in the city of Baghdad, GIS is used, where satellite visualizations of the region were used from the (Land sat) satellite from the US Geological Survey (USGS) website for the years (2000--2010--2020), and then classification operations depending on (NDVI,NDBI) indexs , data analysis and processing were carried out, as well as calculations were made for the process of creeping that occurred during that period within the study area in order to reach quantitative results, as it was concluded that this region has witnessed unbalanced and unsustainable growth at the expense of agricultural lands, which It affected the sustainability and development of the city.

key words Urban Sprawl ,Agricultural Lands ,Urban grouth ,Geographic Information Systems.

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تأثير الزحف العمراني على التغيرات في الغطاء الأرضي في المناطق الزراعية باستخدام نظم المعلومات الجغرافية.

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جامعة بغداد / التخطيط الحضري والاقليمي للدراسات العليا

الملخص: ظاهرة الزحف العمراني تُعتبر واحدة من الظواهر أو المشاكل المهمة التي تعاني منها البلدان في هذا العالم، حيث تؤثر على الأراضي الزراعية واستدامة المدن، مما يؤدي إلى انكماش وتقلص المناطق الزراعية. تكمن أهمية البحث في معرفة التغييرات التي حدثت في تغطية النباتات خلال تلك الفترة الزمنية وتحديد مدى تأثيرها . يتناول هذا البحث تطور الظاهرة في المنطقة خلال الفترة (2000-2020) في مدينة بغداد، حيث تم استخدام نظم المعلومات الجغرافية(GIS) ، من خلال استخدام صور الأقمار الصناعية للمنطقة من القمر الصناعي (Land sat) من موقع المسح الجيولوجي الأمريكي (USGS) للسنوات (2000-2010-2020)، ومن ثم تمت عمليات التصنيف اعتمادًا على مؤشرات(NDVI, NDBI) ، وتمت عمليات تحليل ومعالجة البيانات، بالإضافة إلى إجراء الحسابات لعملية الزحف التي حدثت خلال تلك الفترة داخل منطقة الدراسة من أجل الوصول إلى نتائج كمية. واستنتج أن هذه المنطقة شهدت نموًا غير متوازن وغير مستدام على حساب الأراضي الزراعية، مما أثر على استدامة وتطور المدينة.

الكلمات المفتاحية: الزحف العمراني، الأراضي الزراعية، النمو الحضري، نظم المعلومات الجغرافية.

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1- The introduction

The phenomenon of urban sprawl on agricultural lands is considered one of the problems that most countries of this world suffer from, Especially those characterized by rapid population growth, and this phenomenon has occurred environmental, economic, social and urban impacts .The research briefly dealt with the concept of the phenomenon of urban sprawl, and then the location of the study area was defined in detail. After that, the method of classifying the visuals used in the research that pertained to the study area was presented, and the indicators and the programs that helped achieve the research results have been identified. This study aims to evaluate the phenomenon of urban encroachment on agricultural lands using GIS technology and using analysis methods for this phenomenon. The study area is an agricultural area that originally contained orchards and farms. Due to the urban sprawl that occurred in it, it turned into a residential area with some agricultural areas remaining. At the Earth Summit in Brazil in 1992, the international community adopted the term sustainable development," which means meeting the needs of the current generation without wasting the rights of future generations to live at a level no less than the level at which we live" (Nada Khalifa, 2017, p4).

2-The concept of urban sprawl

It can be defined as the increase in the area of the city, and this increase includes a change in the land surrounding the city, which had previously been used (Al-Muzaffar and Abd al-Mahdi Salim, 1996, p.

It can also be said that it is the expansion of the geographical scope of the city, which is characterized by low-density housing projects, in which lands are divided

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for individual use, and an increase in reliance on private cars in the transportation process, as the reason for urban sprawl is to accommodate the population increase in urban areas in addition to the desire to increase urban space and other residential facilities in urban areas (Rafferty, J, 2020,p10).

From the foregoing, it has become possible to say that urban sprawl means the low-density horizontal expansion of the city, which results from the large unplanned population growth, which constitutes a direct threat to the natural environment surrounding the city and causes an imbalance in the environmental balance, The urbanization a non-positive example of human modification of land uses, as causes a radical change in the surface properties and in turn affects the thermal and radiative air properties.the process of urbanization associated with changes in the surface creates a modification in the climate elements, both the earth surface and the contacted layer of air with it which represents the lowest part of the atmosphere layers(Yousry Kazem,2022,p5074).

2.1- Location of the study area

The study area is located in Jisr Diyala sub-district affiliated to Al-Madaen district within the boundaries of the city of Baghdad. It is located to the southeast of the city of Baghdad. It is bordered to the north by Al-Khafaji district, to the south by the Baghdad-Wasit road, to the east by the borders of Al-Nahrawan sub-district, and to the west by the Diyala River as in the map.the following:-

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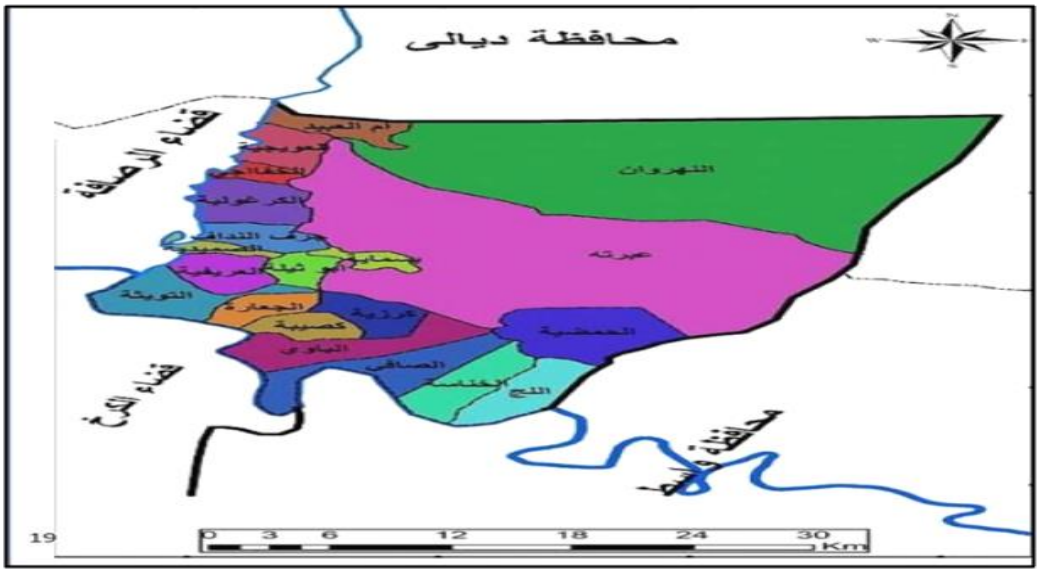

It is located between longitudes 33-44-44-11 towards the east and between latitudes 31-10-33-29. It is an area of agricultural use that contains orchards and farms. As a result of the phenomenon of urban sprawl that occurred in it, it turned into a residential area with some agricultural areas remaining. This area is considered within the green belt surrounding the city of Baghdad, according to the master plan of Paul Service. The number of residential units, as its area reached about 38 km2 in 2022, and it can be increased.

In this study, Landsat satellite images from the USGS website were usedUSGS as in the following table:

Table no.1 Landsat satellite images information

Parameters	2000	2010	2020
Spacecraft identifier	Land sat 5	Land sat 7	Land sat 8
Collection category	TI	T I	TI
Date type	TM-LITP	TM-LITP	OLI-TIRS-LITP

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Sensor identifier	TM	TM	OLI-TIRS
Map projection	UTM	UTM	UTM
Utm zone	38	38	38
Datum	WGS84	WGS84	WGS84
Date	2000/1/4	2010/3/28	2020/1/3
Resolution	30m	30m	30m

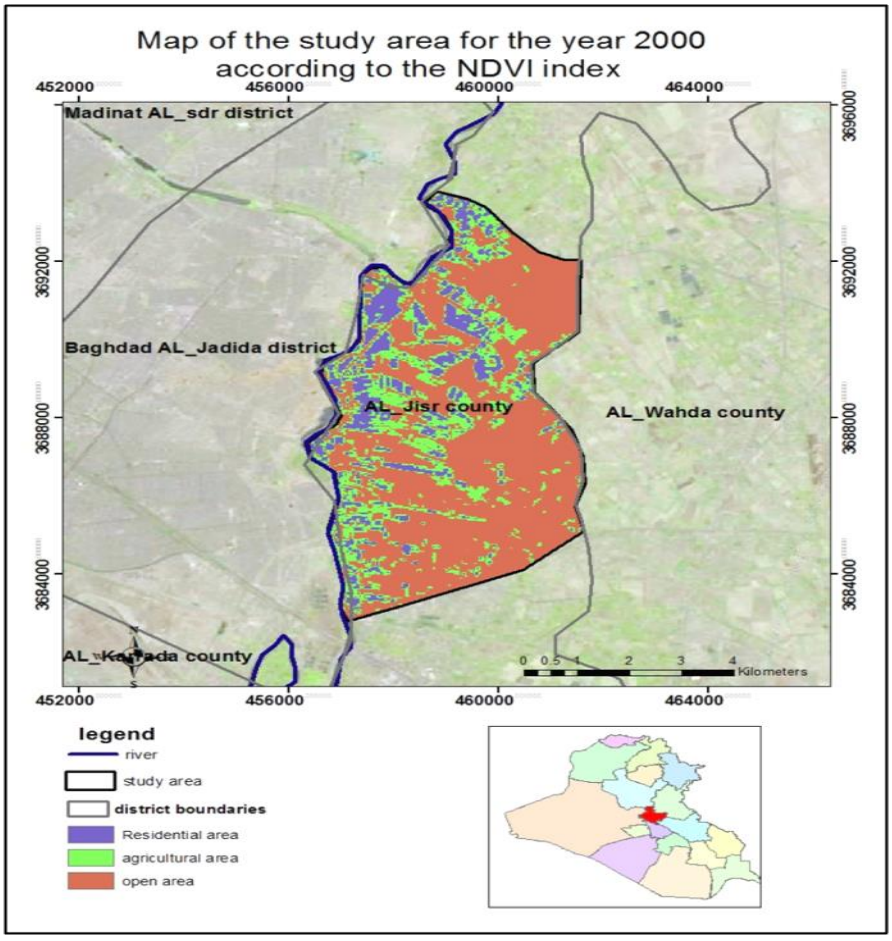

Figure No. 1 Map of the study area for the year 2000 according to the vegetation cover index

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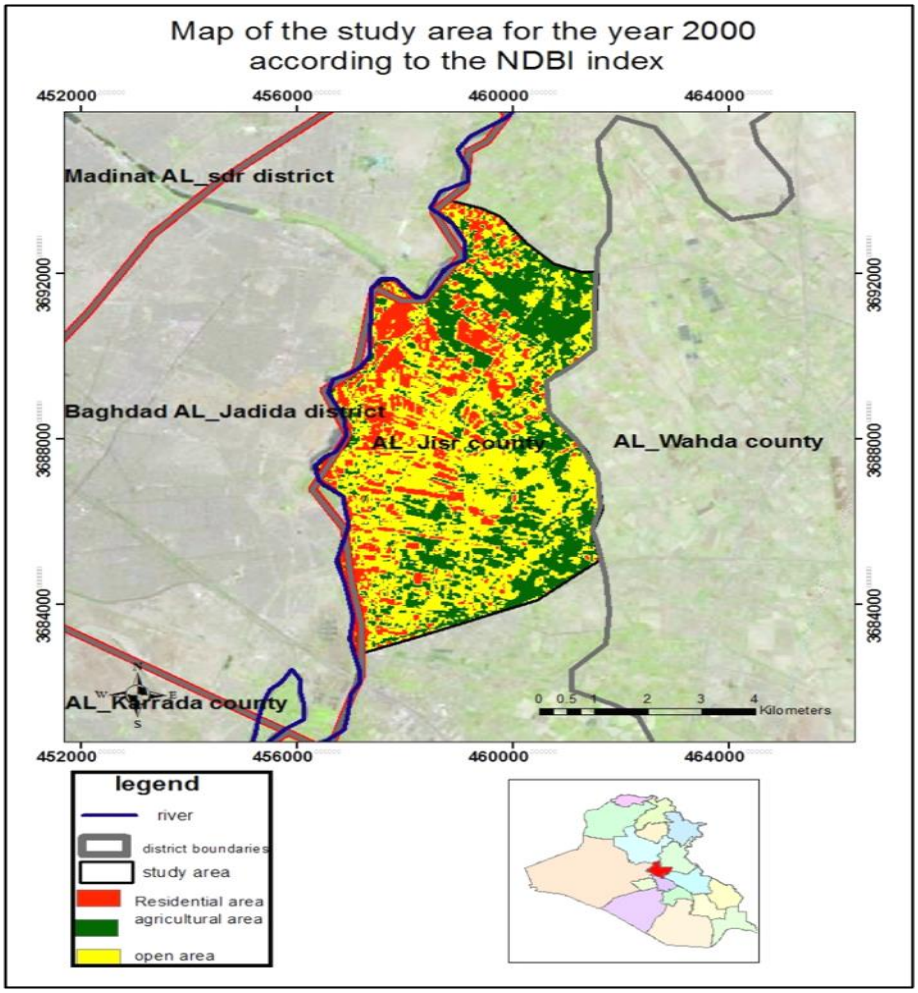

Figure 2 shows the study area according to the urban area indicator

Classification of satellite visuals: 2.2

(The general goal of digital (automatic) classification of visuals is to make all image elements (pixels) in the classification of land uses automatically or in classes called (classes), and multi-spectral data is usually used to accomplish this classification. The digital classification process is an important basis in the study of land uses and land cover, and the process of classifying the visible according to the numerical values of several ranges is based on two types of classification (Saleh 7102)) "Classification Supervised and non-directed classification

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Supervised (Classification Un) In each method, there is a special method in training, which is the process by which the computer operates with classification controls such as the number of items and statistical criteria for each item. The undirected classification method was adopted in this research. This method is used in the absence of training samples and the basis of its work depends on the fact that any type of items present in the scene is made up of visual units with values close to each other. This method includes mathematical calculations that test a large number of unknown formal units and divide them into groups based on the spectral value of each of these units(Hassan, 7104.)"

3- Indicators used in the study

3.1 Normal vegetative divergence indexNDVI

(Normalized Difference Vegetation Index)," was used to distinguish vegetation cover from other types of land cover and determine its density". It also allows identifying and visualizing vegetation areas on the map as well as detecting abnormal changes in the growth process Result in most plants having a green coloring (low reflection). A lot of green light is reaching human eye, because human eye sees a lot of plants 0.4 to 0.7 µm chlorophyll in plant leaves is usable for photosynthesis on the other side, the cell structure of the leaves gives plants a greater photosynthetic activity at a wavelength of 0.7 to 1.1 µm than at 1.0 µm. "Digital processing methods for satellite images in the presentation of vegetation cover is based on the fact that the plants exhibit high reflectivity in the wavelength range near infrared and low reflectivity wavelength range red" ,It represents the ratio of the difference between the spectral reflectance at the near infrared wavelength and the red wavelength of their total(Abeer N. Abdul-

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Hammed,2022,p1395),This means that the plant shows high reflectivity in the near infrared wavelength (0.63–0.69). µm wavelength (0.76–0.90) (Gilabert)µm

Band (NIR) + Band (RED) / Band (NIR)−Band (RED) = NDVI

Band5 + Band4 / NDVI = Band 5 - Band 4

that values(NDVI) has a range from (+1 to -1) and in general, if the result is positive, then it is an indication that the cell has a vegetation cover, and the higher the resulting positive value, this indicates the greenness and density of the plant. "The opposite is true for negative values denoting surface features that are not green".

3.2 Normalized Differences Built-up Index (NDBI).

It is an indicator used to characterize urban or densely built-up areas, and it is the difference between the spectral reflections at the infra-red wavelength. µm (1.55 - 1.75) , and the lengthµm (0.76 - 0.90) for the near infrared sub wavelength on their sum and according to the following equation: (MIR)+Band (NIR) Band Band / (MIR) - Band (NIR) NDBI =Band

Band 6 + Band 5 / NDBI = Band 6 - Band 5

It is based on the distinct spectral response of built-up lands that +have high reflectivity at the mid-infrared wavelength and a lower reflectivity at the near-infrared wavelength,(Abd Rahman Sandi, 2016).

4-Urban grouth

The city's response to changes in the development of its social, economic and political relations pushed the population to migrate from the countryside to the city, which made the city face the emergence of the phenomenon of rapid

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urbanization and urban growth as a type of spatial mobility and an indicator of spatial interaction between the city and its surroundings, that interaction that contributes to the formation of the urban system, to accommodate This increase and control over, the growth of cities and directing it according to the basic plans. The volume of spatial interaction is affected by the distance between cities, as the closer the cities are, the greater the volume of interaction and vice versa. The size of the city and its function also have an important impact on the volume of spatial interaction. The greater the city's population, the greater the possibility of population movement to other cities. Functional specialization also contributes to increasing interaction between cities, (Al-Kinani,2016,p31), The concept of urban growth means an increase in the population of various cities, which results in an increase in the area of land occupied by the city to provide services and activities resulting from that increase, which requires an expansion in the size of the city. It also means the movement of people from rural areas to urban areas with the intention of permanent residence. It also means preoccupation. People without agriculture(Heba Abdul Hussein,2020,p17)

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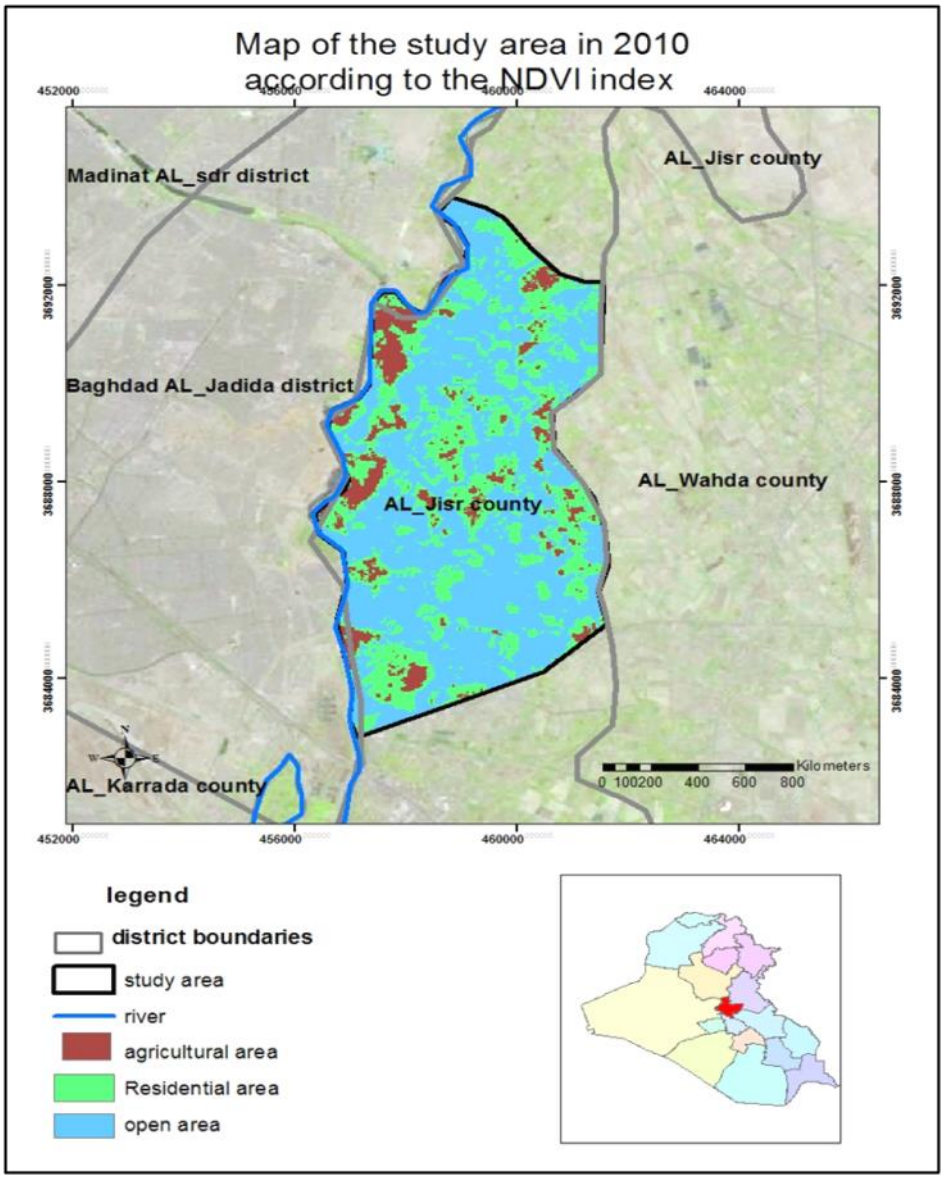

Figure 3 shows the study area according to the classification of the vegetation index

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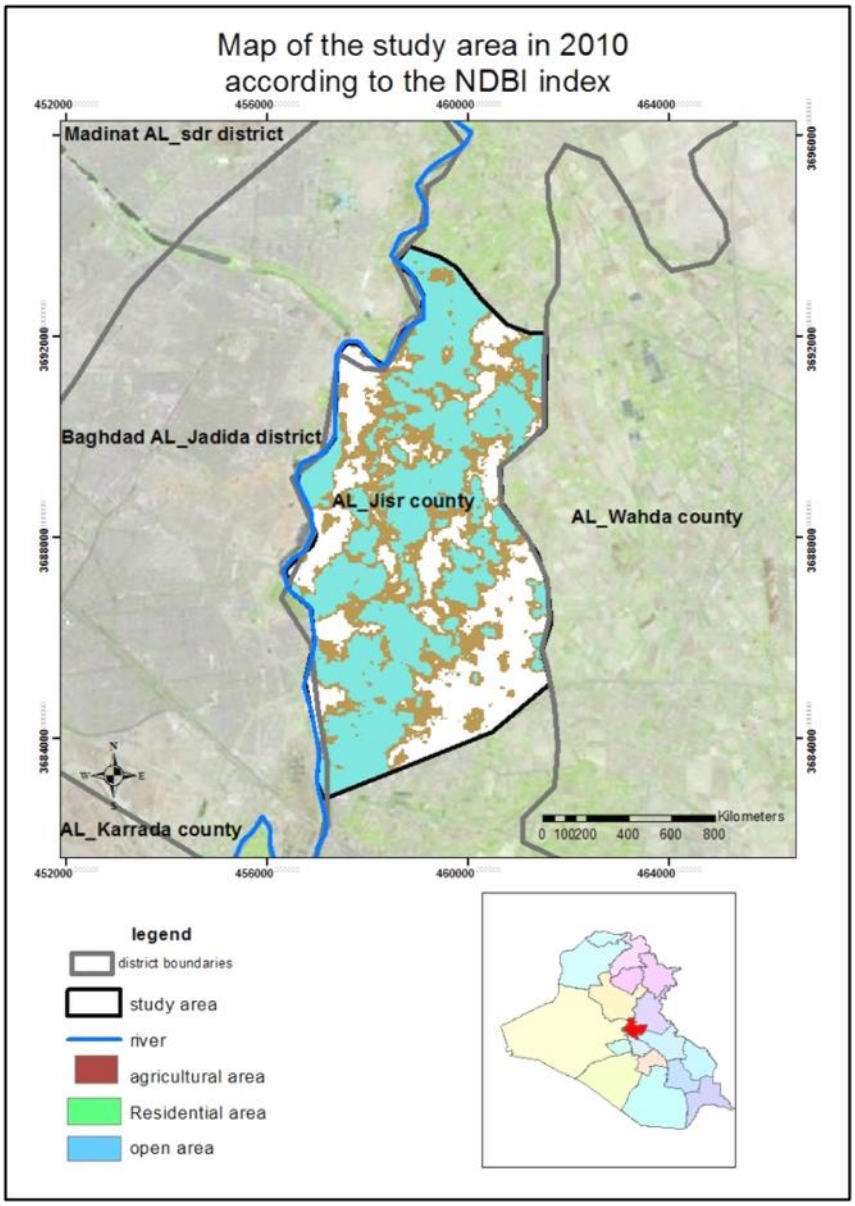

Figure No. (4) shows the study area according to the urban or built-up area cover indicator classification

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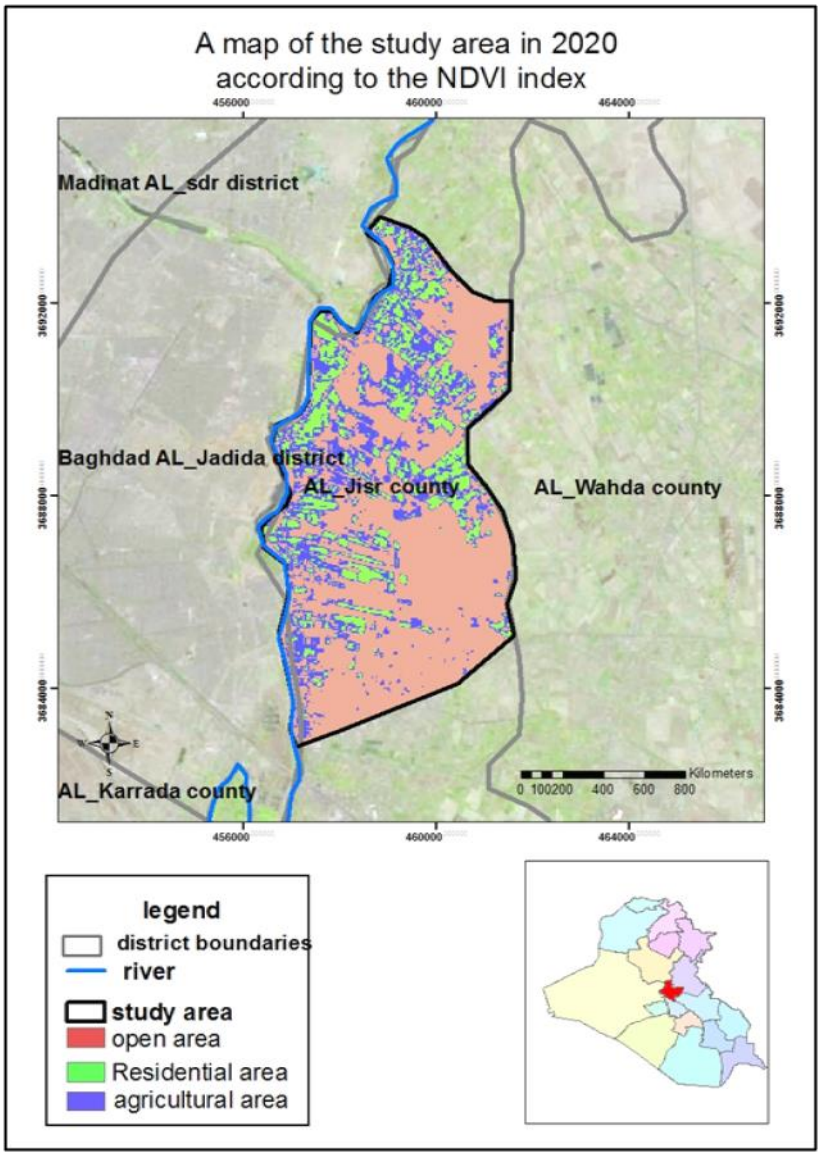

Figure No. (5) shows the vegetation cover index for the year 2020

Figure No. (6) shows the index of the urban area for the year 2020

5- Programs used in the study:

Use GIS software 1.Map10 Arc in correcting reflectance values for satellite visuals (Chander et al, 2009; Baigab et al., applying special mathematical equations (OLI 9 and TM 4 probes) to calculate the spectral reflectivity, and with the same program, the values of the indicators were calculated using the Raster

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Calculator tool located within Tools Analyses Spatial, where this tool calculates the spectral reflectance between selected wavelengths from within the range of wavelengths available in the space visual by means of a mathematical relationship specific to each indicator (Al-Ghariani, 2017).

6- Random change of land use(Importance and necessity)

Land use change is a natural state of the universe, it is the basis for the dynamic change of social and technological aspects of human control, provided that this change has the effect of lessons learned and the changes in land use are studied on the multimedia of the plan, i.e. other grounds of use to be changed. In other words, it should be the future that affects human comfort because planning aims to achieve human happiness and well-being. The state's policy of controlling clear uses has a major role in two prohibitions, excluding some people from using the land according to their desire and preferring it to the highest possible choice by determining its capabilities and potential (Mustafa Abdel Jalil, 2018, p. 247), and thus lies the necessity and importance of research and Its purpose is to demonstrate and prove the direct impact of ill-considered and unplanned change in land use, which is one of the main causes of the deterioration of cities and sustainability.

7- Results and discussion

Table no.2 the result of analysis

Rate the change	open spaces (Agricultural the origin)	Rate the change	Residential spaces	Rate the change	agricultural spaces km2	the year
8%	25	33%	9	55%	9	2000

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	23		12		4	2010
0	23	-8%	11	-25%	5	2020

From the above table , we note that there are clear and significant changes in the nature of the uses of the region, and these changes were monitored in the period between (2000-2020) and through the use of the geographic information systems program (ArkMap - Geographic Information Systems) and were reached through the classification of indicators (Vegetation Cover Index (NDVI) and (Built-up Area Index (NDBI)) and these changes have a clear and clear impact on the city and its sustainability, as we note that the area of agricultural land in the base year (2000) was (9) square kilometers and decreased to (4) Square kilometers in the year (2010), where the rate of change was 55% in agricultural lands. After that, the area of agricultural lands increased in the year (2020) to (5) square kilometers. This is in relation to the results of agricultural lands, as for residential or urban lands. In the region, in the base year (2000) it was about (9) square kilometers and it increased to (12) square kilometers in the year (2010) with a change rate of 33%. This justifies the decrease in the area of agricultural land, as the increase in the area of residential land is the justification. The only reason for the decrease in the area of agricultural land in that region, and also for the following year (2020). From above discussion , it became clear the impact of the phenomenon of urban sprawl in the region and on the nature of land uses therein.

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