Analysis the effect of economic conditions on the vegetative change in Baghdad using GIS and remote sensing techniques

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Abstract

   The study of vegetative change of cities is one of the most important studies related to human life because of its direct correlation with the temporal conditions that occur. These include the economic problems that force people to move and look for job opportunities in the city, which leads to an increase in the population density of cities, especially for cities with an important economic and administrative location as in the capital city of Baghdad. In this study, the effect of the increasing in population density was analyzed on the urban planning of Baghdad city. The decreasing in vegetation was due to the increasing of urban areas on the outskirts of the city, which led to an increase in its area. Moreover, urban cities increased the amount of randomization; this problem has not good consequences on the environmental and health level and attached services.

   This study was carried out by finding the Normalized Difference Vegetation Index (NDVI) of the study area through the using of two satellite image from the Landsat7 satellite for two different dates (2002 and 20017) after being uploaded from the US Geological Survey site. The third and fourth bands were used to calculate the Normalized Difference Vegetation Index (NDVI) by using Arc-GIS Techniques.

تحليل تأثير الظروف الاقتصادية على تغيرات الغطاء النباتي في بغداد باستخدام نظم المعلومات الجغرافية وتقنيات التحسس النائي

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الخلاصة

   دراسة تغير الغطاء النباتي للمدن من الدراسات المهمة المرتبطة بحياة البشر بسبب العلاقة المباشرة مع الظروف التي تحدث. وهذه تتضمن المشاكل الاقتصادية التي تواجه السكان، والتي تقود الى زيادة كثافة التلوث للمدن خاصة للمدن التي لها موقع اقتصادي وتجاري مهم مثل العاصمة بغداد. تم تحليل تأثير زيادة كثافة التلوث على الخطط السكانية في مدينة بغداد في هذة الدراسة. نقصان الغطاء النباتي ناتج عن زيادة المساحة السكانية للمدن، والتي تؤدي الى زيادة كمية العشوائية وهذة المشكلة تؤثر على الخدمات والمستوى الصحي.

   في هذه الدراسة تم حساب معامل التغير النباتي باستخدام صورتين للاقمار الاصطناعية للسنوات (2002 و 2017) للحزم الطيفية الثالثة والرابعة.

- **Purpose of the study**

This study aimed to achieve the following:

1- Draw, analyze and evaluate the change in vegetation cover Baghdad City during the period from 2002 to 2017 using the visuals from the satellite (Landsat7).

2- The impact of economic and security problems in the urban change of the study area and change in vegetation cover in the study area during different time periods.

Theoretical concepts

Baghdad is located on latitude 33 and longitude 44 on the Tigris River, in the central region of Iraq, between the main cities to the north and south. Basra is 445 km to the south, Mosul is 350 km and Arbil is 320 km. Baghdad is the largest city in Iraq and also one of the largest cities in the Middle East and the second largest contemporary Arab city after Cairo in Egypt. The center of the capital is divided into two branches. Karkh on the western side of the Tigris River and Rusafa on the eastern side of the river. In both parts, modern buildings are located. On the Rusafa side is the Karrada area with narrow streets and many shops.

The population of Baghdad has soared to the total population of Iraq in very few decades. This large increase in population has also been reflected in overcrowded overcrowding in many residential areas of Baghdad, particularly in the center of Baghdad. The population density of the city of Al- (Sadr City) has exceeded the highest population density recorded in the region. This rapid phenomenon coincided with an unprecedented period of unrest in the modern history of Iraq. A severe housing crisis erupted in Baghdad and began to show traffic jams and widespread shortages of essential services for the lives of Baghdad citizens, such as the lack of

drinking water supply and the lack of power supplies and communications services [2].

The following Table 1 shows the approximate population of Baghdad from 1935 to 2010 [3].

Table 1: The approximate population of Baghdad from 1935 to 2010.

year	population
1935	287000
1947	352000
1957	490496
1965	1523300
1977	2888000
1981	3300000
1987	3841205
1995	4478000
2004	5258000
2010	7600000

The rapid growth, development and security problems in Iraq over the past years have led to increased demand for land, especially in the outskirts of the capital Baghdad, and consumed vast tracts of agricultural land and open spaces during the bulldozing and burying of agricultural areas around the capital Baghdad for use in housing projects. The nature of land uses, especially in urban expansion and urbanization, have changed to accommodate the increase in population numbers.

The extraction of information on land cover from remote sensing data is an essential and essential part of the collection.

A variety of applications including land-use mapping and monitoring of variables [4].

During the last years, powerful and versatile geostatistical tools have been developed for geosciences applications. Geostatistics is a methodology for incorporating the spatial and temporal coordinates of observations in data processing. The applications of geostatistics have spread from the original metal mining

topics to more diverse fields such as soil science, oceanography, hydrogeology, agriculture, and environmental science.

Recently GIS has emerged as an innovative and important component of many projects; the Geostatistical Analyst represents a major step in bridging the gap between GIS and geostatistics. ArcGIS Geostatistical Analyst is an extension to ArcGIS Desktop (ArcInfo, ArcEditor, and ArcView) that provides a variety of tools for spatial data exploration, anomaly identification, optimum prediction, uncertainty evaluation, and surface creation. ArcGIS Geostatistical Analyst is a complete package for spatial data preprocessing, geostatistical analysis, contouring, and post-processing. It also includes interactive graphical tools with robust parameters for default models to help newcomers to create prediction and standard errors. In the present study, the NDVI predicting was accomplished by the ArcGIS Geostatistical Analyst model. Geostatistical Analyst model can generate optimal surfaces from sample data and evaluate predictions for better decision making [3].

Landsat data acquired from the USGS Global Visualization Viewer as in the tutorial "Acquiring Landsat Data" has been terrain radiometrically and geographically corrected, but has been formatted to fit in an 8-bit number (ranges from 0-255). Data in such a format is referred to as "digital number," or DN data. Before it can be used to calculate vegetation indices, the data must be converted to reflectance, a physical measurement.

In addition, if one is interested in calculating the tasseled cap brightness, greenness, and wetness indices, further transformation is needed. The tasseled cap coefficients for the Landsat 5 TM data were developed for both DN format data and for surface reflectance data. Reflectance calculated from Landsat data are a so-called "top of atmosphere" (TOA) measurement, however, so the tasseled cap coefficients calculated in the two papers from the 1980s are not applicable to Landsat data unless atmospheric correction is applied, a process that may introduce considerable error. Tasseled cap coefficients are calculated for the TOA reflectance data from the Landsat 7 ETM+ sensor. These coefficients are directly applicable for Landsat 7 ETM+ TOA reflectance data, and can be used with Landsat 5 TM data using a further transformation [5].

Calculate NDVI

Out of the various vegetation indices available, NDVI is very widely used as it minimizes the effect of change in illumination condition and surface topography. The NDVI is defined as the ratio of difference between the near infrared and red reflectance to their sum. The NDVI algorithm subtracts the red reflectance values from the near-infrared and divides it by the sum of near-infrared and red bands [6].

With TOA reflectance calculated for each band, one can now calculate vegetation indices. NDVI is given by

$$NDVI = (band\ 4 - band\ 3) / (band\ 4 + band\ 3) \tag{1}$$

where the TOA reflectance are used for each band. Use Raster Calculator to calculate the index [5].

- **Experimental work**

Includes the following steps

1- Download satellite video date (2002) for the study area of the site of the US Geological Agency of satellite landSat7. Figs. 1 and 2 shows the third and fourth band were introduced as being included in the account (NDVI).
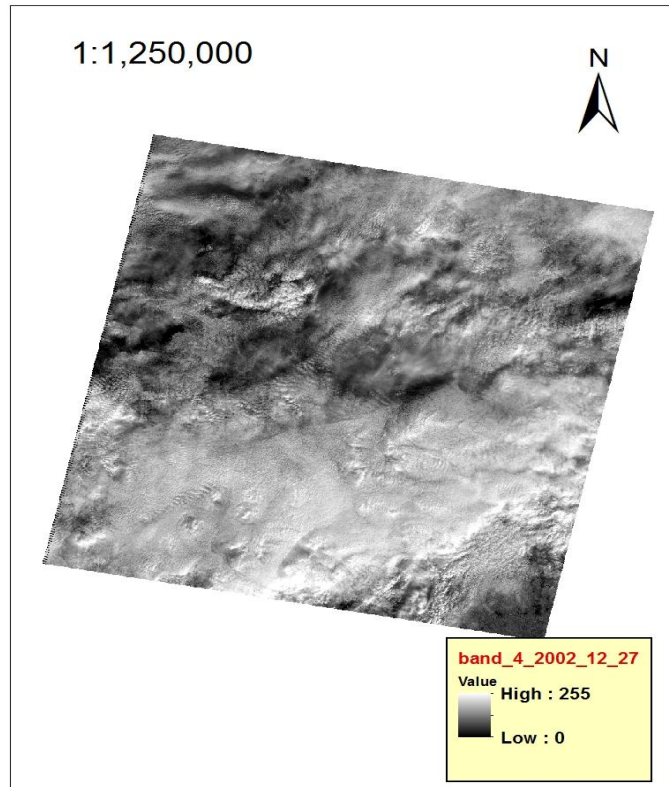
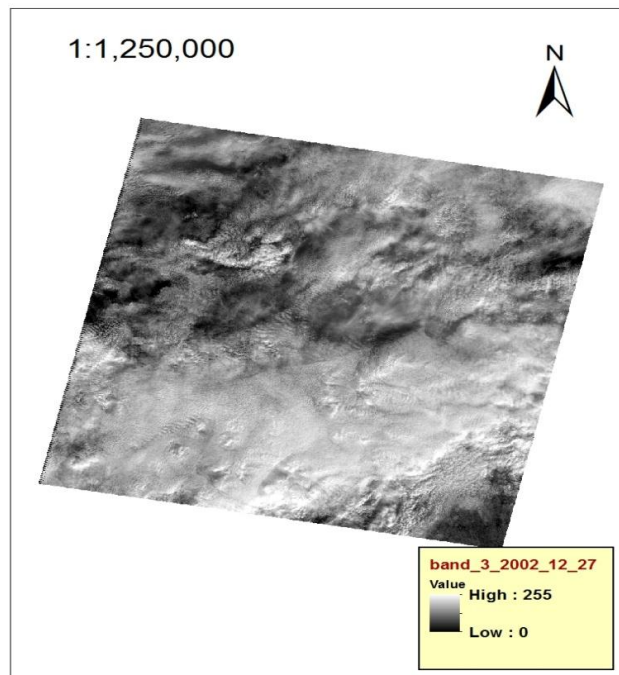*Fig.1: Show image of band (4) for study area in date (27/12/2002).*

Fig. 2: Show image of band (3) for study area in date (27/12/2002).

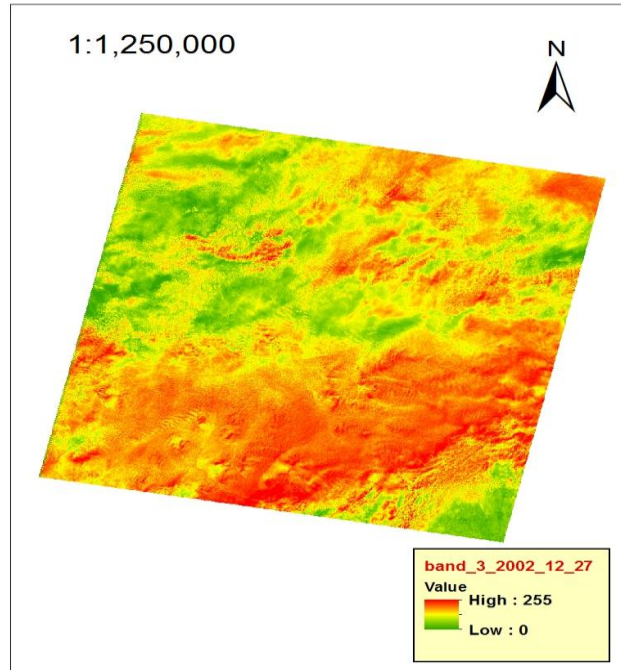The bands 3 and 4 for landsat7 can be classify two band as in Figs.3 and 4.

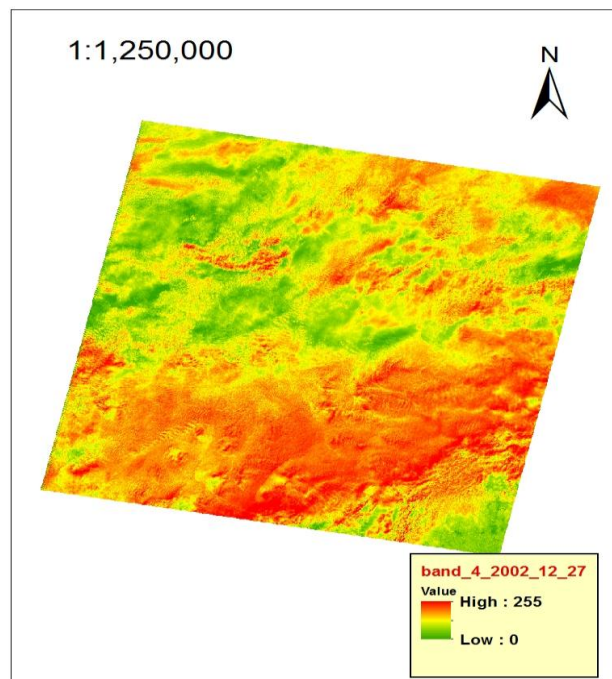***Fig.3: Show image classification of band (3) for study area in date (27/12/2002).***

Fig.4: Show image classification of band (4) for study area in date (27/12/2002).

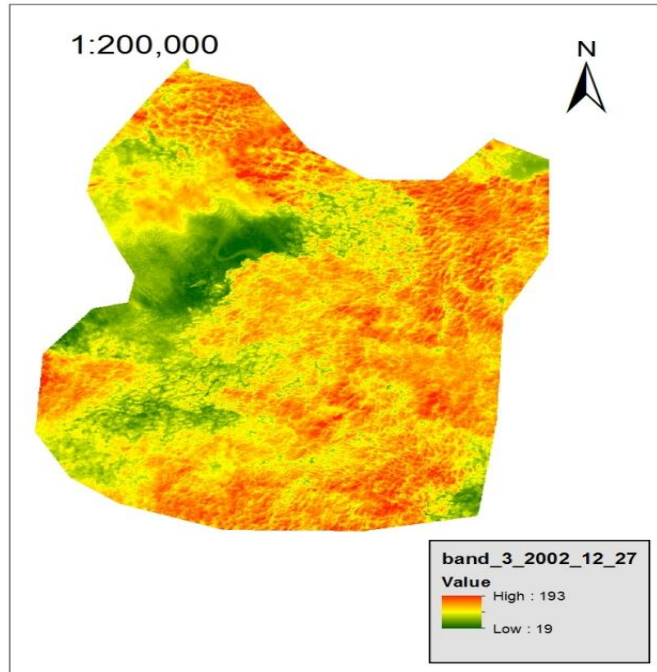Cut the study area for each band (third and fourth) of each image. Figs.5 and 6.

Fig.5: Show image extraction of band (3) for study area in date (27/12/2002).
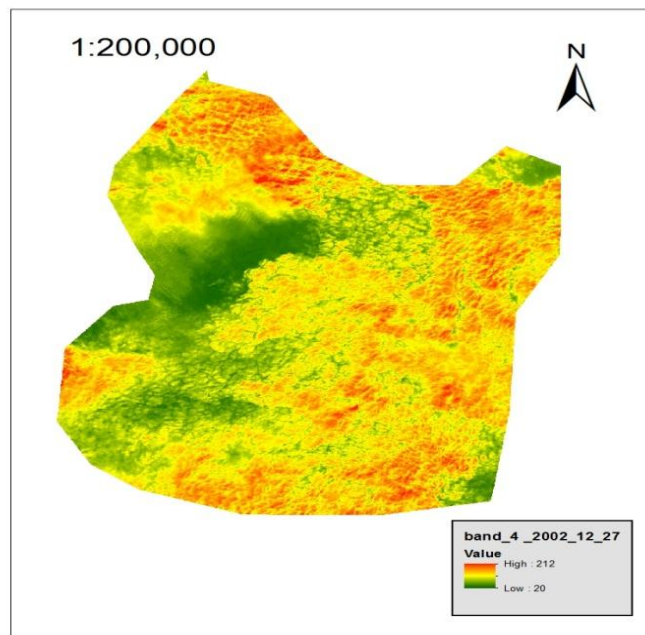
Fig.6: Show image extraction of band (4) for study area in date (27/12/2002).

1- Calculate the value of (NDVI) for study area by using the tool (raster calculator) in Arcmap program through applying the Eq.(1) and The result show in Fig.7.
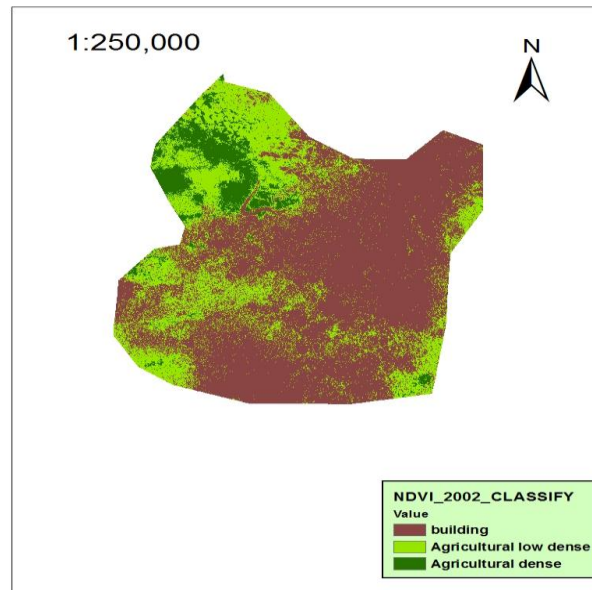
Fig.7: Show NDVI image for study area in date (27/12/2002).

2- Calculate areas of agriculture area

To calculate the area of the areas classified in Map (NDVI), the map has reclassify. Using the ArcMap program techniques, the area was calculated and added to the final map to calculate the value of (NDVI) in 2002 date for study area as in Fig.8.
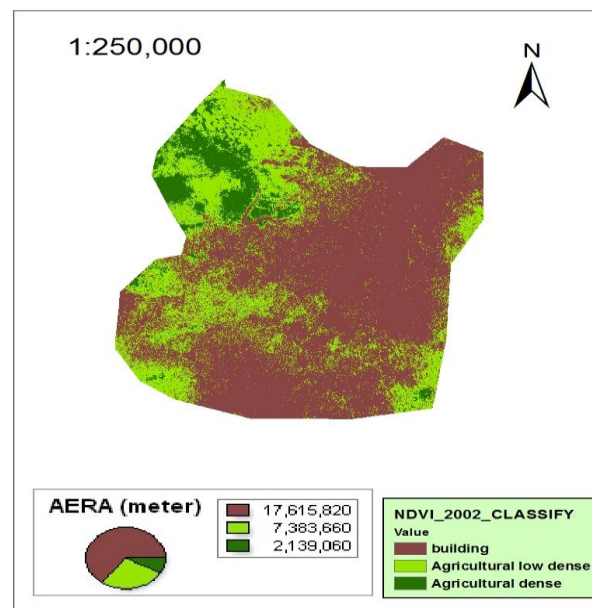

Fig.8: Show NDVI image for study area in date (27/12/2002) with area for each classify.

3- Download satellite video date (2017) for the study area of the site of the US Geological Agency of satellite Figs.9 and 10. The third and fourth band were introduced as being included in the account (NDVI).
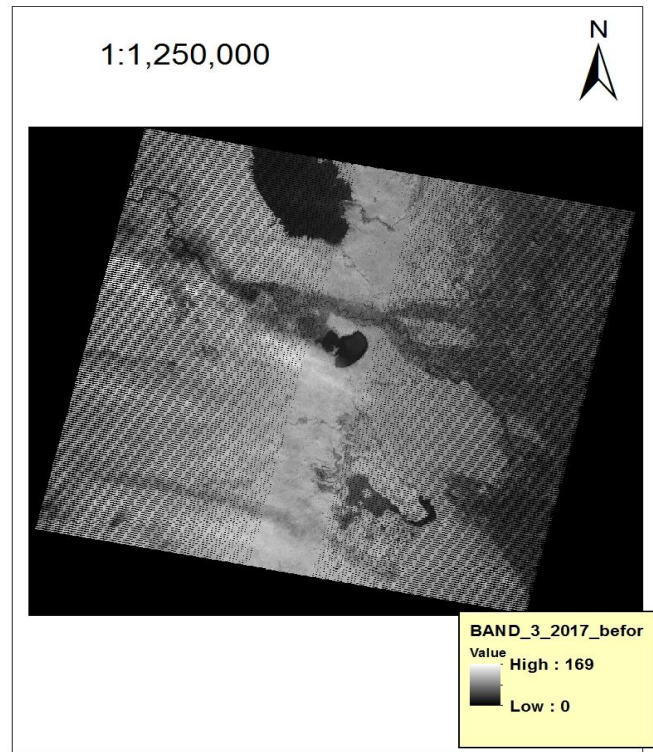
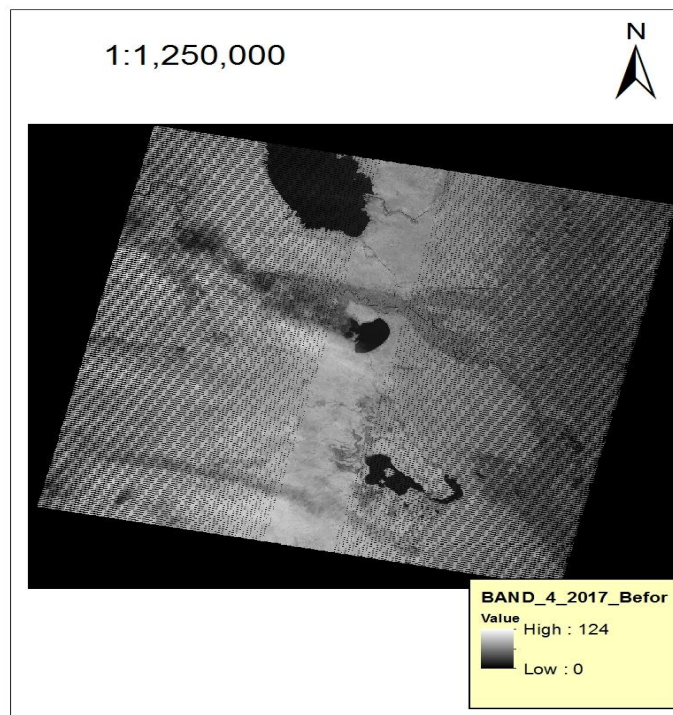*Fig.9: Show image of band (4) in date (27/11/2017).*

Fig.10: Show image of band (3) in date (27/11/2017).

The satellite images of the Landsat_7 satellite ETM taken after September 2003 containing 22 % of the black lines (SLC-off) covering the image resulting from the technical failure of the reflection mirror in the sensor need special treatment to remove their effects.

Using the ArcMap program, the problem was solved. The study area was then cut from both the third and fourth bands after the correction. The fourth and third bounds were obtained for the study area as in the Figs.11 and 12.
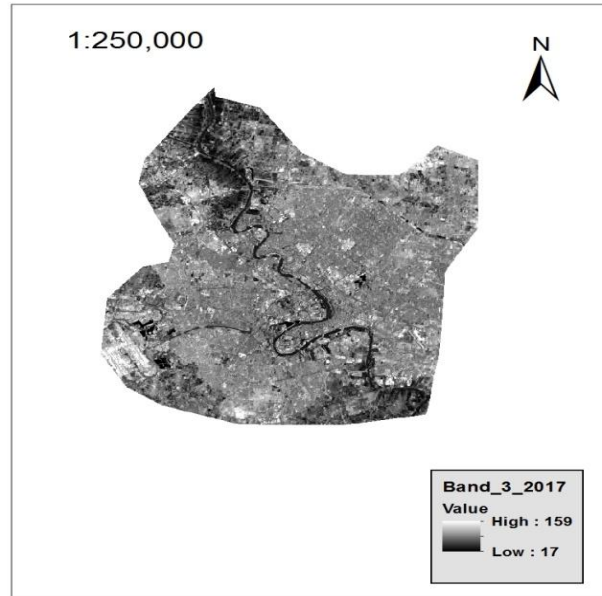

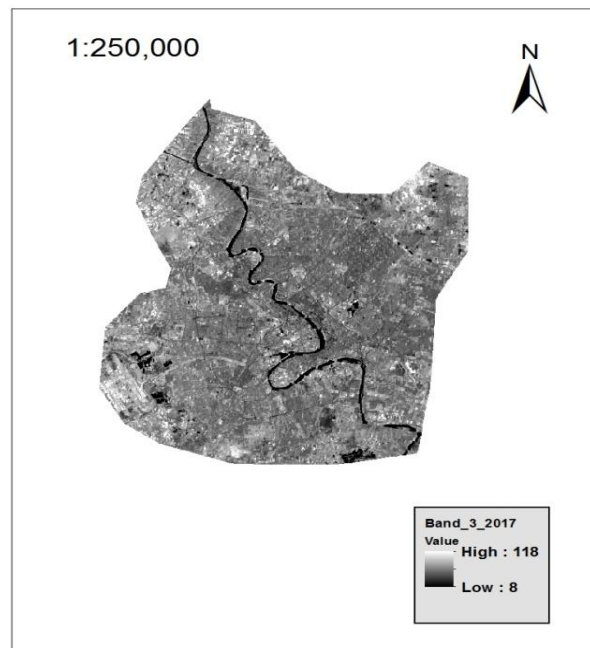*Fig.11: Show image of band (3) for study area in date (27/11/2017).*

Fig. 12: Show image of band (4) for study area in date (27/11/2017).

The bands 3 and 4 for landsat7 can be classify two band as in Figs.13 and 14.
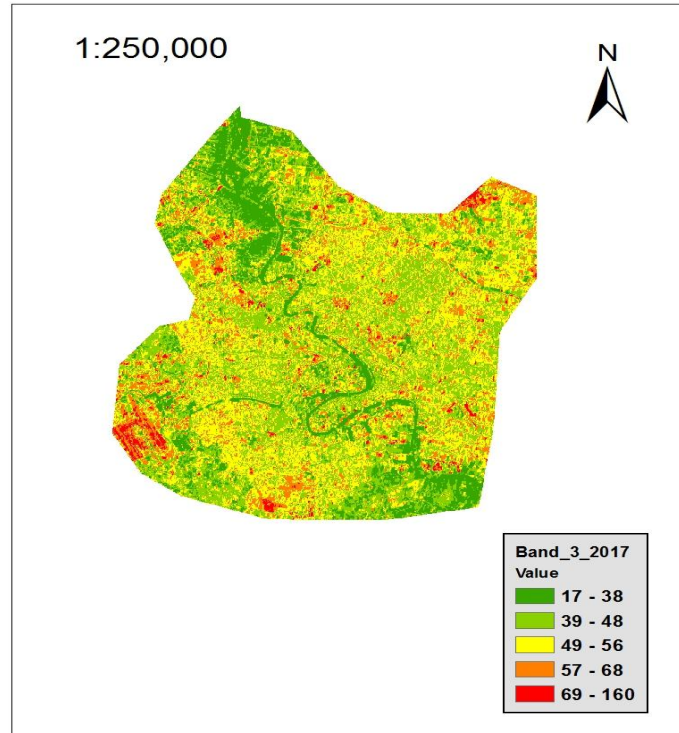
Fig.13: Show image classification of band (3) for study area in date (27/11/2017).
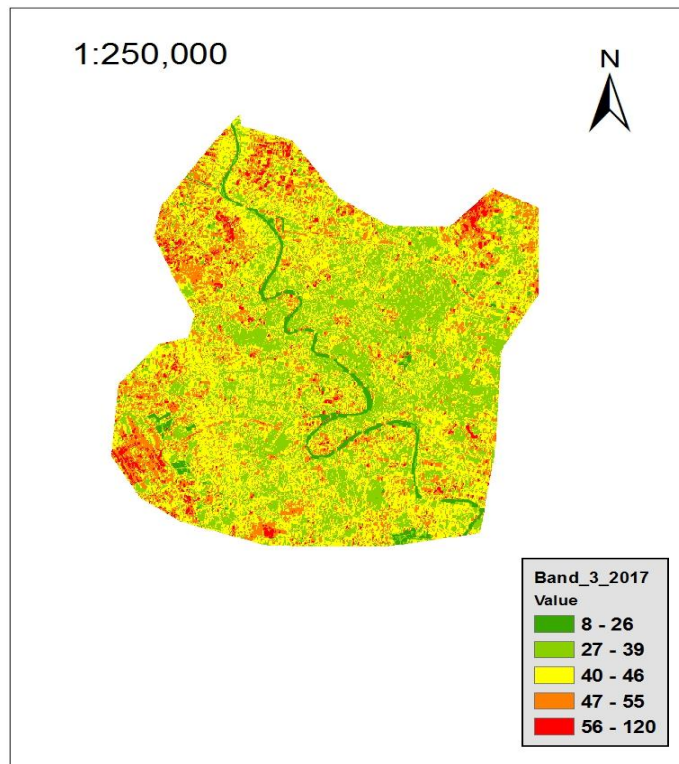

Fig.14: Show image classification of band (3) for study area in date (27/11/2017).

4- Calculate the value of (NDVI) for study area by using the tool (raster calculator) in Arcmap program through applying the Eq.(1) and The result show in Fig.15.
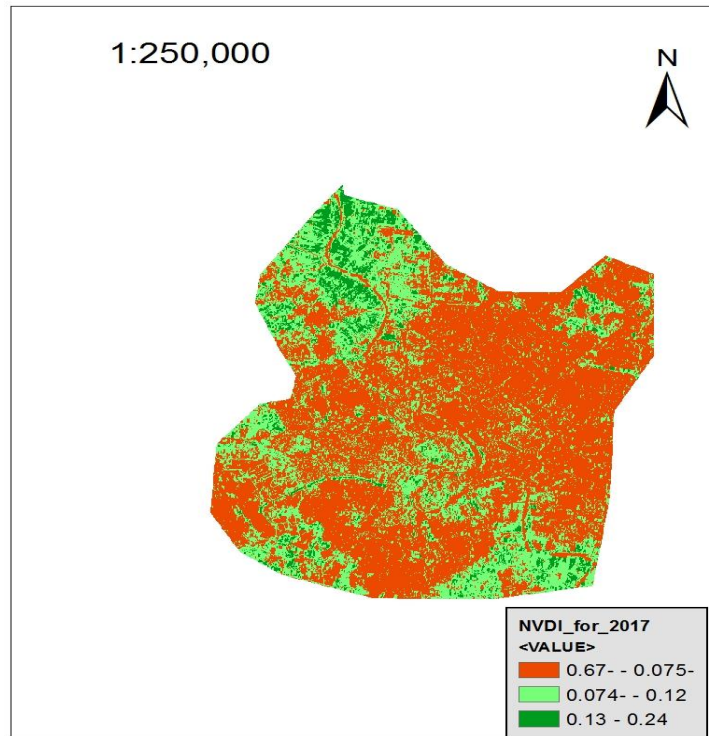
100

Fig.15: Show image NDVI for study area in date (27/11/2017).

5- Calculate areas of agriculture area

To calculate the area of the areas classified in Map (NDVI), the map has reclassify. Using the ArcMap program techniques, the area was calculated and added to the final map to calculate the value of (NDVI) in 2017 date for study area as in Fig.16.
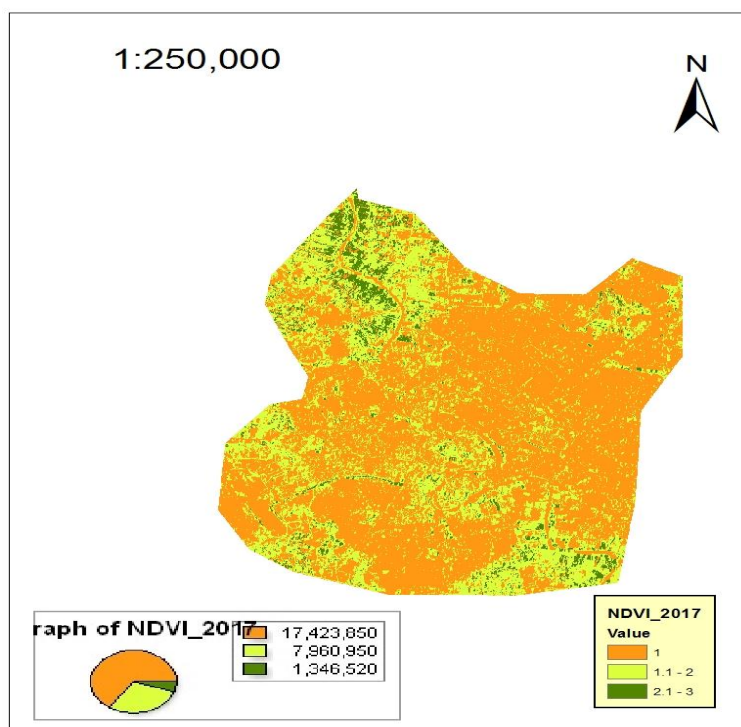

Fig.16: Show image NDVI classification for study area in date (27/11/2017).

Conclusions

1- Note that the dense agricultural areas have decreased by about half. Where before 2002 it was 2139060 square meters. While in 2017 the area amounted to 1346520 square meters.

2- The impact of urban expansion and the sweeping of agricultural areas due to the economic and security conditions was clear "through the reduction of agricultural areas.

3- The housing crisis in Iraq and in Baghdad, especially as it is the economic and administrative capital of Iraq, has a great impact on the decrease of the vegetative areas, especially in the residential areas due to the shrinking of the gardens and the populations exploitation to expand the building to accommodate the growing population.

4- The lack of interest of the state in agriculture in Iraq after 2003 and the dependence of Iraq on imports from agriculture and the trend to sell their land and turn it into residential areas.

Recommendations

The study recommends the following

1 - Urban planning for the city of Baghdad, in accordance with the environment

2- The ministries and concerned bodies should take the initiative to encourage the planting of trees in all regions for its many benefits of health and environmental aspects.

3- Support the agricultural sector and farmers in a way that does not allow the farmer or owner of the farm to leave the village and live in the city.

4- Solving the problem of selling agricultural land and converting it to housing because of the housing crisis. And trying to find solutions to prevent this phenomenon.

References

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