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The Study of NDVI Fluctuation in Southern Iraq (Hor Ibn Najim) Using Remote Sensing Data

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Abstract
This study was carried out to determine the nature of the land cover in the area of Hor Ibn Najim and its surroundings. These changes had occurred changes in the environmental conditions between 1986 and 2016. Remote sensing (RS) and geographic information system (GIS) techniques were used to monitor changes in the region as well as changes in NDVI values. Satellite images of Landsat 5 and 7 with sensors TM and ETM +, were used respectively. The extraction of land covers in the region was executed by the application of the supervised classification processes. The area has been classified in to six main land categories (water bodies, low density of vegetation cover, high density of vegetation cover, wetlands, abandoned land, and land suitable of agriculture).

Keywords: Hor Ibn Najim, Remote sensing, GIS, Supervised classification, NDVI.

الخلاصة
نفذت هذه الدراسة لتحديد طبيعة الاغطية الأرضية في منطقة هور بن نجم ومحيطها الناتج من التغيرات الحاصلة في الظروف البيئية مابين عامي ١٩٨٦ و ٢٠١٦. تم استخدام تقنيات الاستشعار عن بعد (RS) وتقنية المعلومات الجغرافية (GIS) لرصد التغيرات في المنطقة وكذلك التغيرات في قيم NDVI. وتم اختيار الصور الفضائية للاقمارالصناعية لاندسات٥ ولاندسات٧ للمتحسسات TM و ETM+ على التوالي, حيث تم إستخراج مساحات الاغطية الأرضية الرئيسية في المنطقة بعد تطبيق عملية التصنيف الموجه وعلى هذا الأساس تم تصنيف الاغطية الارضية الى ستة اصناف رئيسية وهي (مسطحات مائية ، اراضي ذات كثافة زراعية واطئة ،اراضي ذات كثافة زراعية عالية, الأراضي الرطبة, الأراضي المهجورة والأراضي الصالحة للزراعة).

Introduction

The lands of Mesopotamia are described as black soil to indicate the high productivity of these lands as a result of their physical and chemical conditions and high fertility. This is due to the availability of suitable water for agricultural production.

The agricultural land in southern Iraq is considered as one of the most important natural and economic resources. The problem is the deterioration in agricultural land is one of the most serious problems confronting southern Iraq[1].

With the development of remote sensing technology, it is possible to monitor the changes that occurred over land covers. Therefore, it is possible to apply some of the remote sensing techniques and geographic information systems to monitor the effect of some climate factors on the deterioration of land covers

Hor Ibn Najm and surrounding lands were chosen in this study because of being agricultural land with rich water bodies. Each land cover was monitored and the changes had occurred in the areas during the period of last 30 years were calculated using remote sensing and geographic information systems.

This study aims to Monitor the changes that have occurred over land covers, by comparing multi space images for the years (1986, 1999, 2016), which is called the multi temporal analysis, Calculate the normalized difference vegetation index (NDVI) to separate vegetation cover from the rest of land covers and Study the effect of some climate factors on the land covers of the study area (Hor Ibn Najm) and the surrounding areas extracted from classified satellite images.

Research problem

The problem of research can be formulated in the form of the following questions:

1. Do the global climate changes and seasonal changes have some effects on the environment conditions and land covers in Hor Ibn Najm and surrounding areas?
2. Can we rely on satellite imagery to study the changes in the land covers of the Marshlands (Hor. Ibn Najm) and how much Iraq was affected by climate?
3. How deep is the impact of climate change on the climate of the marshland (Hor Ibn Najm) in southern Iraq?

Location of the study area

Hor Ibn Najm is one of the marshes of Iraq. It is situated between longitudes (32^o and 33^o) N and latitudes (44^o and 45^o) E North and north-east of Bahr AL-Najaf vast depression near the holy city of AL-Najaf. It has the area of ($145.69km^2$) as Figure 1 shows[2].

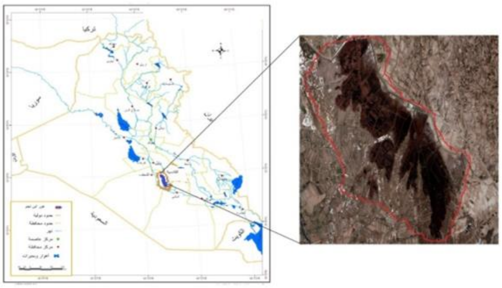

Figure 1: Represents the location of Hor Ibn Najm in Iraq.

Climate

Climate has a great importance and direct impact on agricultural, production and type of plants that grow in each region. The most important elements of the climate affecting the plants are temperature, precipitation and wind speed and direction[3]. As a result of marshes presence in a dry and subtropical climate under the influence of the warm winds in summer and cold wind in winter, they are characterized by high temperatures during summer, with the increasing of solar radiation[4]. The average summer temperature is about 35 ˚C in July and about 10 ˚C in January. Rainfall rates are low in winter, about 100 mm per year[5]. Wind directions are north and northwesterly in winter and spring, but in summer the area is vulnerable to hot winds[6].

Satellite data

The images used in this study are from Landsat 5 and Landsat 7, which carry sensors TM and ETM +. Data obtained from the USGS site[7]. The bands used are (3, 4, 7), as shown in Table 1.

Table 1: the bands of color composite image

Band	Wavelength (μm)	Color	Resolution (m)
3	0.63-0.69	Blue	30
4	0.76-0.90	Green	30
7	2.08-2.35	Red	30

Figures 2 and 3 show the color composite images of the entire area for the gears of 1986 and 2016, respectively.

Image subset and geometric correction of the study area

The area of the study (Hor ibn Najm) was subtracted from the original image using (ERDAS IMAGEN) program.

Satellite images obtained from the ETM + sensor on Landsat 7 contain black holes and lines due to the failure of the SLC system and the loss of approximately 22% of the data due to the increased scan gap.

This correction was carried out using the analysis tool of ERDAS IMAGINE 2014 program, as well as the restoration and filling of the black lines in the image dated 2016. The tool corrects the black lines by replacing the reflective value of the Pixel cells with a black color (0) with values adjacent to it.

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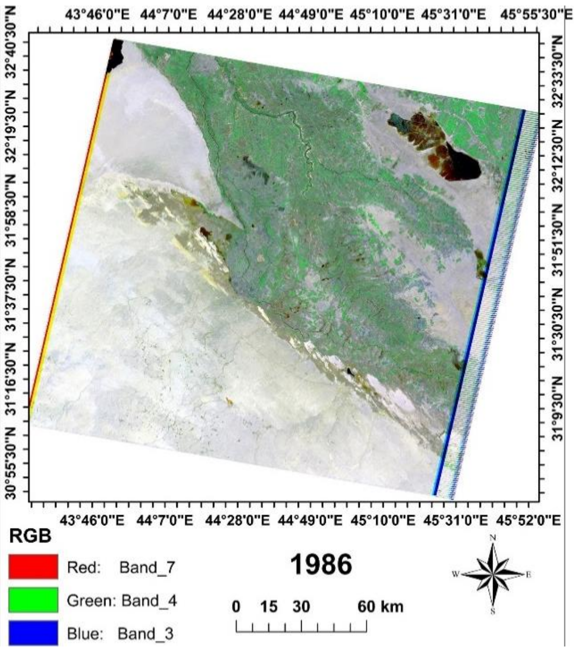
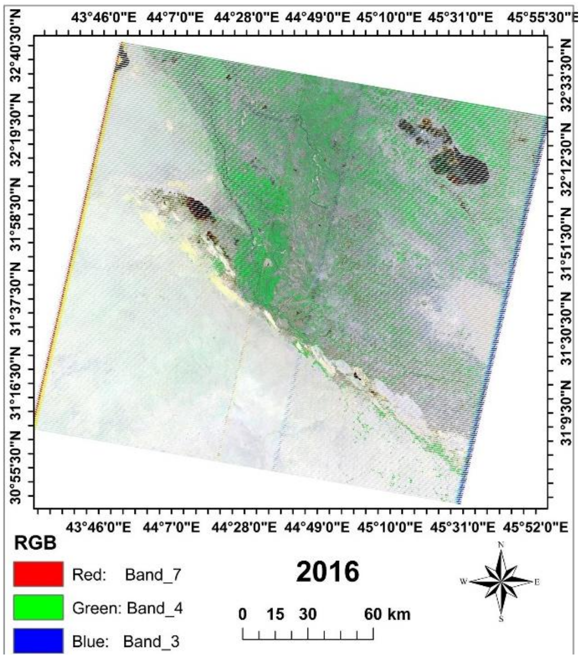


Figure 2: The entire area of 1986 color composite image.



Figures 3: The entire area of 2016 color composite image.

Image interpretation and classification

After supervised Classification was applied on satellite imagery visual interpretation was carried out on the study area supported by geographical maps. The differences between the classes are clear and visually distinguishable, as well as field information was obtained for the study area and its nature from the existing land cover maps. The method used to implement the categorization process is the Maximum Likelihood Classification (ERDAS IMAGINE 2014). Six categories within the study area were identified (wetlands, high density of vegetation cover, low density of vegetation cover, water bodies, abandoned land, Land suitable for agriculture). They are shown in the figure (4) and (5).

The areas of the classified land covers were quantified as shown in table (2). In the first category, which represents low-density agricultural areas, the area was 167.46 km^2 in 1986, while the area in 2016 was 506.87 km^2 as a result of land reclamation.

The second category, characterized by high density of agricultural land, often on the banks of rivers. This area covers 234.56 km^2 in 1986 and decreased to 174.84 km^2 in 2016 due to low water levels and water scarcity.

The third category of water bodies was nearly the same area.

The fourth category, representing wetlands, which can be suitable for agriculture, was 4.64 km^2 in 1986, while in 2016 increase to 6.89 km^2.

The increase in the area of abandoned land is offset by a decrease in arable land area. The total area of abandoned land was 42.03 km^2 in 1986, while the total area of abandoned land was 219.56 km^2 in 2016. The last category, land suitable for agriculture, the area was 652.73 km^2 in 1986, while in 2016 it become 199.95 km^2, due to desertification and salinity problems.

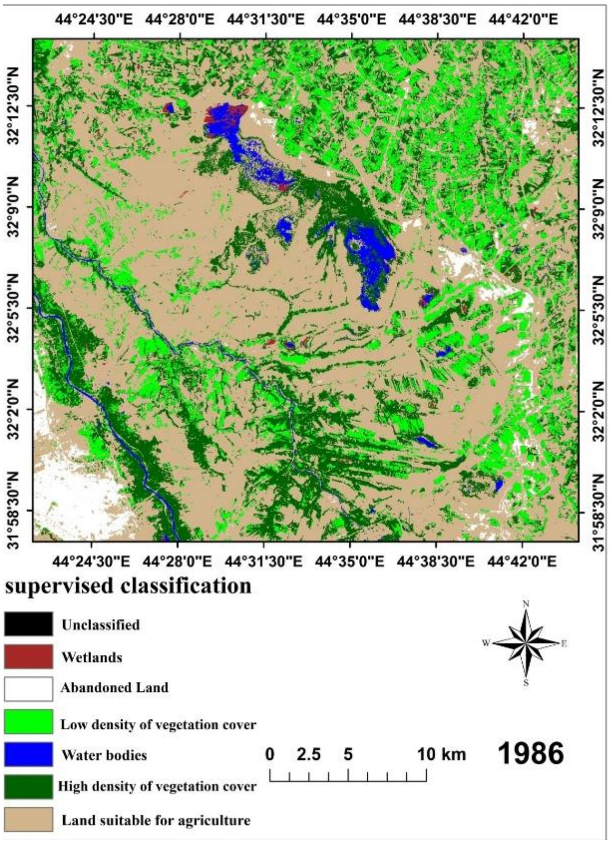


Figure 4: The classified satellite image in 1986.

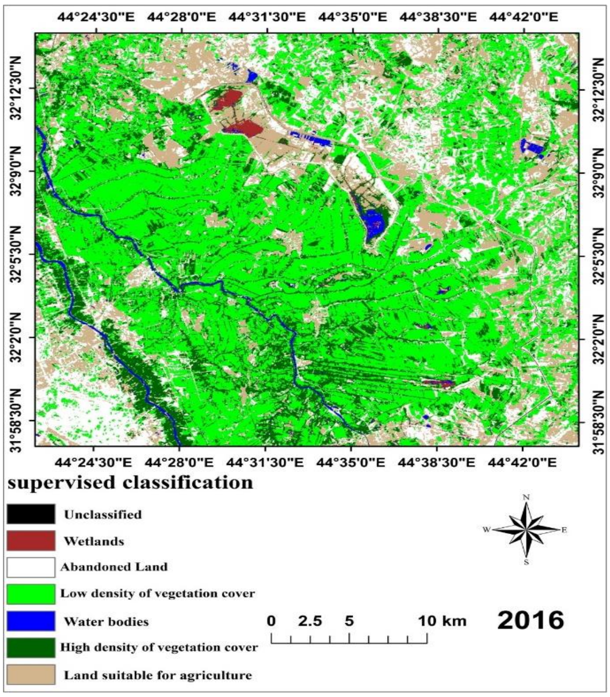


Figure 5: the classified satellite image in 2016.

Table 2: The quantified areas of land cover categories in (km^2)

Number Of Categories	Categories	Area in 1986	Area in 2016
1	low density of vegetation cover	167.46	506.87
2	high density of vegetation cover	234.56	174.84
3	water bodies	20.6316	19.9419
4	Wetlands	4.6467	6.8949
5	abandoned land	42.0399	219.56
6	land suitable for agriculture	652.73	199.95

Unsupervised classification on NDVI image

The vegetation cover index is one of the most accurate methods of digital processing of space images in vegetation presentation. It is represented by the following equation[8]:

$$NDVI = \frac{(R_{nir} - R_{red})}{(R_{nir} + R_{red})} \quad (1)$$

NDVI values have a range (-1 _ + 1). In general, the result is positive, indicating that the cell contains a cover, the higher the positive value resulting, the more plants and density. In contrast to the absence of vegetation and the presence of water bodies indicates negative values. The standard index of variation in vegetation was calculated using equation (1) and the results were shown in figure (6) and figure (7). The results of unsupervised classification on NDVI were shown in figure (8) and figure (9).

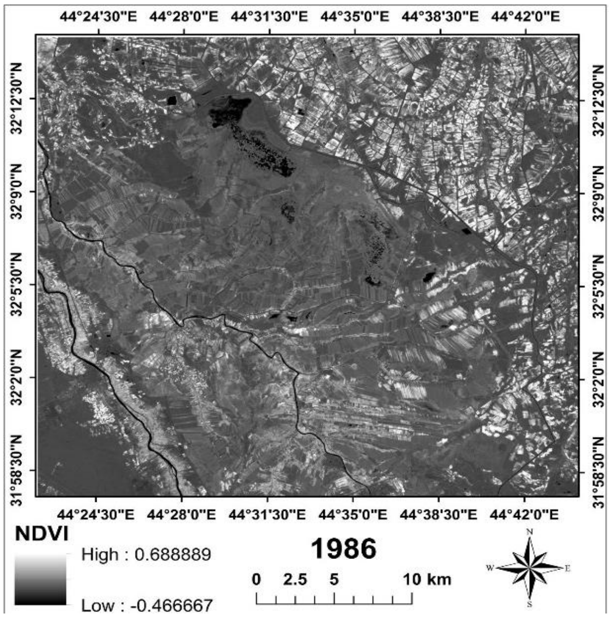


Figure 6: Vegetation cover (NDVI) of space images used in the study of 1986.

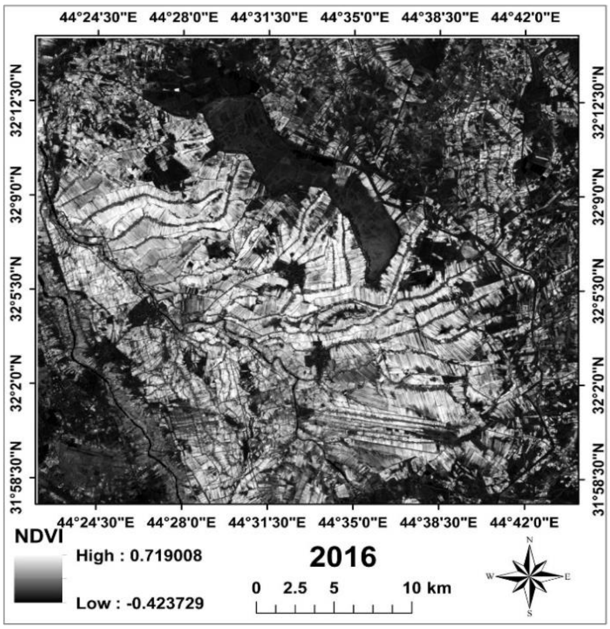


Figure 7: Vegetation cover (NDVI) of space images used in the study of 2016.

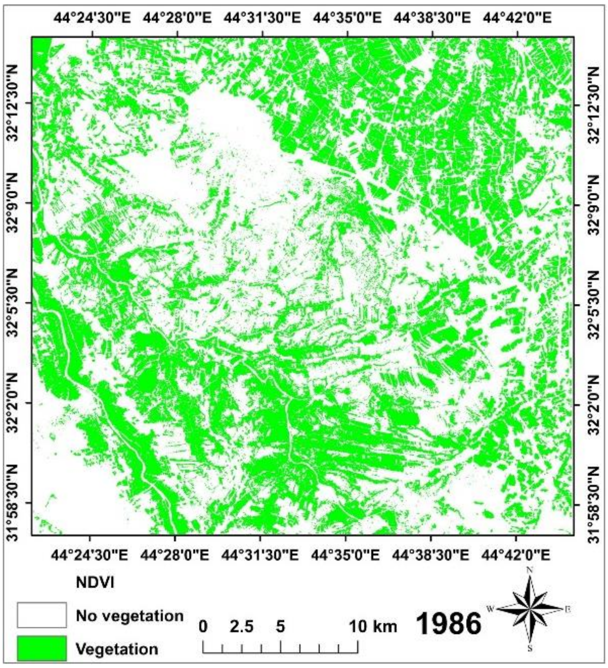


Figure 8: Unsupervised classification of NDVI index of Satellite Images in 1986.

The quantification results of vegetation cover area are included in each image in Table (3). Table (3) shows the gradual increase in the vegetative cover from the image dated in 1986, till the image dated in 2016.

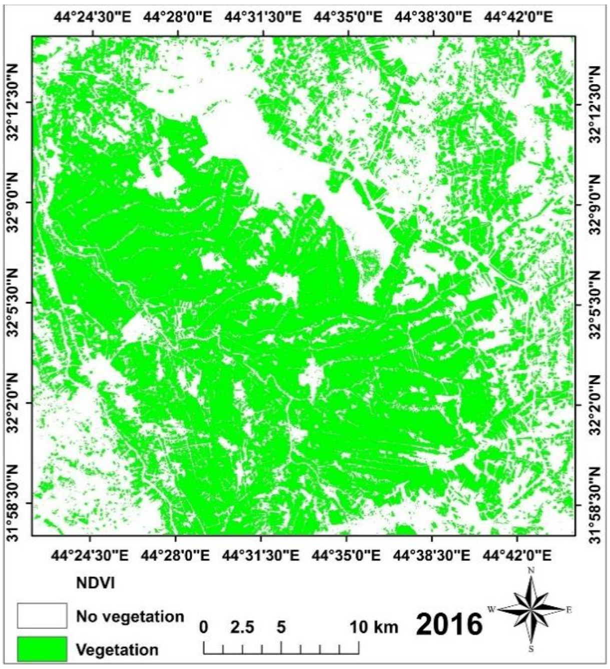


Figure 9: Unsupervised classification of NDVI index of Satellite Images in 2016.

Table 3: Area of vegetation cover extracted from the NDVI.

Image date	Vegetation cover area of NDVI unit (km^2)
22/2/1986	357.72
17/2/2016	600.18

Conclusion

The study showed the ability of remote sensing technologies and GIS in the study of land covers and the production of accurate images of land covers by distinguishing different uses and the improvement between 1986 and 2016. The use of (NDVI) gives high performance in distinguishing vegetation cover in terms of area and density. The results showed that there is an increase in the area of vegetation cover in the study area with a decrease in density.

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