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جامـــعة واســـط
مجلـــــــة كليـــــــة التربيـــــة

Change detection of natural Features by using GIS and RS

Case Study / AL Habbaniya Lake

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Abstract:

The aim of this research is to highlight the relationship between Remote Sensing and GIS For The ability of GIS to analyze, interpret and visualize remotely sensed data by the supported tools in GIS programs that can analyze Images from the satellite allowing the geographer to ask and answer questions about natural features and the stages of it evolving, The research make use of remote sensing data To reveal the changes of the study area location Al-Habbaniya lake by analyzing each image of the study period 2010-2019, the research found that the lake size and shape has changed during the past 10 years ,by using a Calculation method in Remote sensing (NDWI) Index That Show The Water Body status, shape and size, The research also detect a turbidity signature in the north side of the lake in year 2019, the research made 5 maps of the study area to compare each year and reveal the difference between 2010-2019.

Keywords: *Habbaniya, Change detection, GIS, Remote Sensing, Image Analysis.*

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الكشف عن تغير المعالم الطبيعية باستخدام نظم المعلومات الجغرافية والاستشعار عن بعد حالة الدراسة / بحيرة الحبانية

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المستخلص:

الهدف من هذا البحث هو تسليط الضوء على العلاقة بين الاستشعار عن بعد ونظام المعلومات الجغرافية وابراز قدرة نظم المعلومات الجغرافية على تحليل وتفسير وتصور البيانات المستشعرة عن بعد بواسطة الأدوات المدعومة في برامج نظم المعلومات الجغرافية والتي يمكنها تحليل الصور من القمر الصناعي مما يسمح للجغرافي بالسؤال والإجابة. أسئلة حول السمات الطبيعية ومراحل تطورها ، استفاد البحث من بيانات الاستشعار عن بعد لكشف التغيرات في موقع منطقة الدراسة على بحيرة الحبانية من خلال تحليل كل صورة من فترة الدراسة ٢٠١٠-٢٠١٩ ، ووجد البحث أن حجم البحيرة وشكلها قد تغير خلال السنوات العشر المدروسة ، باستخدام طريقة الحساب في مؤشر الاستشعار عن بعد (NDWI) الذي يوضح حالة الجسم المائي وشكله وحجمه ، كما يكشف البحث أيضًا عن زيادة نسبة العكارة في الجانب الشمالي من البحيرة في عام ٢٠١٩ وقام البحث بعمل ٥ خرائط لمنطقة الدراسة لمقارنة كل عام وكشف الفرق بين ٢٠١٠-٢٠١٩.

الكلمات المفتاحية: الحبانية، كشف التغير، نظم المعلومات الجغرافية، الاستشعار عن بعد، تحليل المرئيات الفضائية.

Introduction:

The Map Is a powerful way to highlight facts and reveals relationships, it is a universal language, a map of any phenomenon allows the specialist to Interpret and analyze the phenomenon changes by linking GIS and remote sensing and cartography, the GIS provides improved modern mapping technology represented by the GIS programs that open prospects for new facts and discoveries, reservoirs in the natural depressions are one of the earliest irrigation projects in Iraq in the 20th century, At the first place, the concern of the irrigation reference during the First half of the 20 Century was to decrease the risk of flood by the most possible means and the least

expensive ways to avoid Crisis The idea of it was to find catchment in the shoulder of that river. to direct the water to a nearby natural depression and Store it. This depression was exploited to Handle the river system operation to take in the flood waves before penetrate into the Mesopotamian plain and cause a loss of human life and their Properties .

First plans had been put in place for the application of the first two main projects, al-Habbaniyah on the Euphrates river basin and al-Tharthar project on the Tigris river basin to control Future Floods. (Wilcox, W. 1917) This project was suggested by the preferences of the engineer William Wilcox in 1911, and the accomplishment was overdue because of the Conditions of the First World War. (Sousa, A. 1944).

The work on the expansion of Habbaniyah Lake was Started again in 1950 as the High advisory Recommended of it, they are assigned for the mission to study the Progress of Tigris and Euphrates river basins. (Commission I.D.C. 1951), to the northeastern side of al-Habbaniya, the lake connected with Euphrates River by the Diban Canal.

Diban regulator is formed of 5 gates with a discharge amount of 800m3 / s. on the Southeastern side of the lake there is a Mijarra regulator that controls the discharge of outrageous water through Mijarra Canal to Razaza Lake. Mijarra regulator formed of 8 openings, the level of the bottom of alHabbaniya Lake is 36m, and the maximum operative level of 51m.

Pertaining to Razaza Lake or its old name before (Abu Dibis) or the other name of it the (Salt Sea), the most important role that the lake plays is to work as a floodwater reservoir from Habbaniya Lake avoiding a future flood. (Sousa, A. 1966).

Habbaniya system has an important role to decrease the dangers of flooding and provide water for irrigation usages. Habbaniya project is one of the most important projects at the beginning of the 20th century, (Sousa, A.1944).

Research problem:

Since the water scarcity crisis in Iraq has several causes, and one of the reasons is climate change, this research explains the impact of water scarcity on Lake Habbaniyah The research problem can be presented as follows: What is the effect of climate change on the amount of water resources, and how does The rainfall and water Imports affect the study area?

Research hypothesis:

The research assumes that the amount of water resources of Iraq's rivers will continue to fluctuate due to climate change and the fluctuation of rainfall This has a negative impact on water bodies.

Study Area:

Habbaniya lake is located southeast of Ramadi the capital of Anbar governorate, and West of Baghdad it is one of the largest water reservoirs in Iraq (map1).

Data and information used:

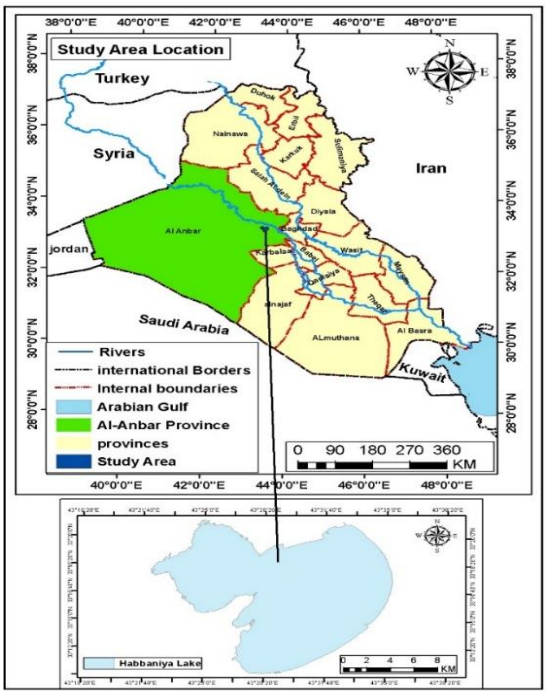
- Satellite images of Landsat 5 and Landsat 8 (2010_2015_2019) from the official website of USGS earth explorer. (https://earthexplorer.usgs.gov)

-Climatic data from the ministry of transport, general authority for meteorology and Seismic monitoring, unpublished data.

-Water imports data from the ministry of planning, central bureau of statistics, water resources reports (2010_2015_2019).

-Climatic data from the ministry of agriculture, Iraqi agricultural meteorological network.

Map 1: Study Area Location in Iraq AlAnbar



Source: Ministry of Water Resources, General Survey Authority, Map Production Division, Iraq administrative map at a scale of 1: 1,000,000 for the year 2018.

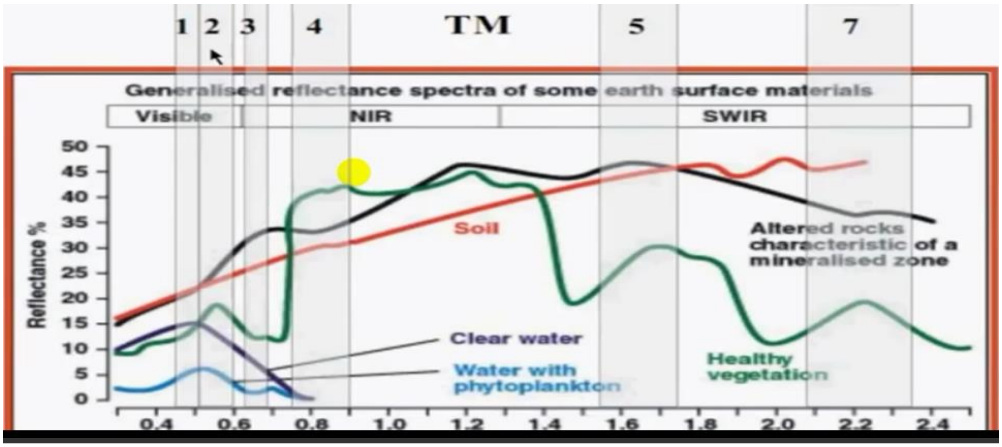
Methodology:

This research has been followed the NDWI Index to display the changes of study area during last 10 years, the Normalized Difference Water Index (NDWI) is a new method that has been developed to delineate open water features and enhance their presence in remotely sensed digital imagery. The NDWI makes use of reflected near-infra-red radiation and visible green light to enhance the presence of such features while eliminating the presence of soil and terrestrial vegetation features. It is suggested that the NDWI also provide researchers with turbidity estimations of waterbodies using remotely sensed digital data. (S. K. McFEETERS 1996).

Water bodies having low reflectance, it only reflects within visible portion of the electromagnetic spectrum. Water bodies in their liquid state are generally high reflectance on Blue (0.4 - 0.5 µm) spectrum than Green (0.5 -

0.6 µm) and Red (0.6 – 0.7 µm) spectrum. Clear water having greatest reflectance in the blue portion of the visible spectrum. So, water appear blue. Turbid water has higher reflectance in visible spectrum. There is no reflection in Near- Infrared (NIR) and beyond. (Gao, B. C. 1996)

Figure (1): Reflectance of Water in Remote Sensing



Source: Stuart K. McFeeters International Journal of Remote Sensing, vol. 17, issue 7, pp. 1425-1432

Calculation of the index (NDWI).

Normalized difference water indexes it's one of the Calculation in remote sensing that focuses on detection water from a sensor it's from ratio index, the object that a study is Interested in will be Highlighted (In This case Water is the object that is interesting), for other ground objects it will be Suppressed, that the case won't need to study other objects like (snow, soil, Vegetation) etc.

And that interesting object of study will be easier for the researcher when the time comes for the need of extraction. (XU han-qiu,2005).

spectral knowledge is playing the important role on extracting a remotely sensed information. Satellite Remotely sensed image can record reflection of electro magnetically waves by land objects and its own back radiation. the

water body is a low reflective in range of visible light, (Yu J K, Huang Y S,2001).

This method is commonly and successfully utilized in surface waterbody detection and mapping. In this study, the waterbody detection capability of NDWI model (Green ,NIR) using Landsat 8 and Landsat 5, focusing on water body mapping by extracting the water body from the Imageries of study area Al Habbaniya lake , by getting these images of the study period from 2010 to 2019 and analyze each Image using the NDWI method to show the size and the shape of the lake in each year of study and make maps that shows the waterbody changes from (2010 to 2019) to make a comparison maps for each year , as the NDWI formation also can be used for turbidity estimations, (S. K. McFEETERS 1996)

The Calculation of NDWI= G=B3, NIR=B5

Green Band – (Near-Infra-red Band)/Green Band + Near-Infra-red Band

(NDWI) value Is between (-1) to (1). generally, waterbodies NDWI value is greater than 0.5. Value (1) represents water content value (-1) represent soils, rocks, snow, no water content. (Ceccato et al 2001), the process done by using ArcMap 10.4 all results are maps made to compare the lake size and shape during study period, the output results of study area have been converted from raster to polygon to calculate geometry for the output result of each selected year.

The results of NDWI calculations for water content as following:

Climatic Stations:

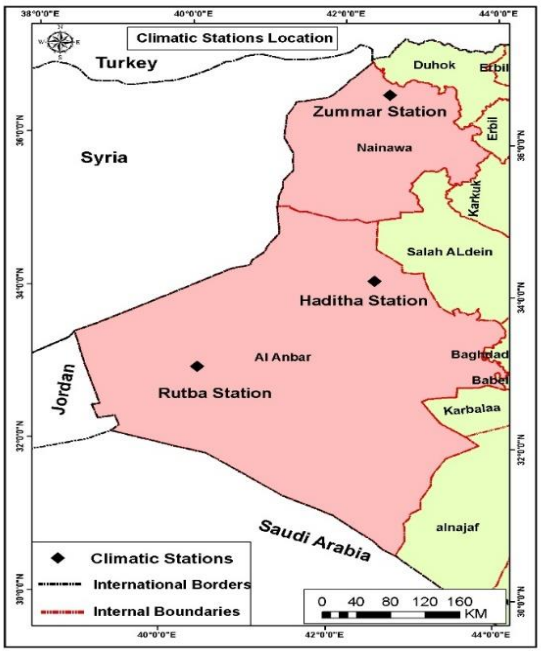
The climatic stations (Haditha Station , Rutba Station , Ukashat Station , Zummar Station) was chosen for the purpose of measuring the extent of the impact of rain on the lake level, and it was chosen due to its proximity to the water sources of the lake, and the rainfall data for these stations for the years (2010-2015) were taken, and the location of the climate stations is shown below in the tables(2) and map(3).

Table2: Climatic Stations Coordinates

Gov.	Station	Coordinates	
		Lat.	Lon.
Anbar	Haditha	34.20N	42.48E
Nineveh	Rutba	33.02N	40.31E
	Zummar	36.64N	42.29E

Source: Ministry of Agriculture, Iraqi Agricultural Meteorological Network.

Map 3: Climatic Stations Location



Source: Ministry of Agriculture, Iraqi Agricultural Meteorological Network.

Rain and water imports:

Rain is the main source of water that feeds water bodies, and the rivers feeding the lakes depends on the fall of rain to release the largest possible level. Rivers drainage is important because Lake Habbaniyah receives its water from the Euphrates River that supplies it and that the water Imports have fluctuated, as shown below in the Tables of Rainfall and river discharges. Table (3), table (4), Table (5), Table (6) and Table (7).

Table (3): Rainfall Data Recorded from The Climatic Stations
Haditha Station, Rutba Station, Ukashat Station

station	year	total
Haditha	2011	75.4
Rutba	2010	109
Ukashat	2010	73.8

Source: Ministry of Transport, General Authority for Meteorology and Seismic Monitoring, unpublished data.

Table (4): Water imports Of Euphrates River in Iraq2010/2011billioM^3

2011	2010	river
14.6	19.3	Euphrates

Source: Ministry of Planning, Central Bureau of Statistics, Water Resources Reports.

Table (5): Rainfall Data of Haditha And Zummar Station 2015

station	year	Rainfall mm.
Haditha	2015	119.3
Zummar	2015	255.5

Source: Ministry of Agriculture, Iraqi Agricultural Meteorological Network.

Table (6): Water imports Of Euphrates River in Iraq

Water imports	River
7.5	Euphrates

Source: Ministry of Planning, Central Bureau of Statistics, Water Resources Reports

Table (7): Water imports Of Euphrates River in Iraq/Billion M^3

Water import 2019	Water import 2018	River
16.95	9.65	Euphrates

Source: Ministry of Planning, Central Bureau of Statistics, Water Resources Reports.

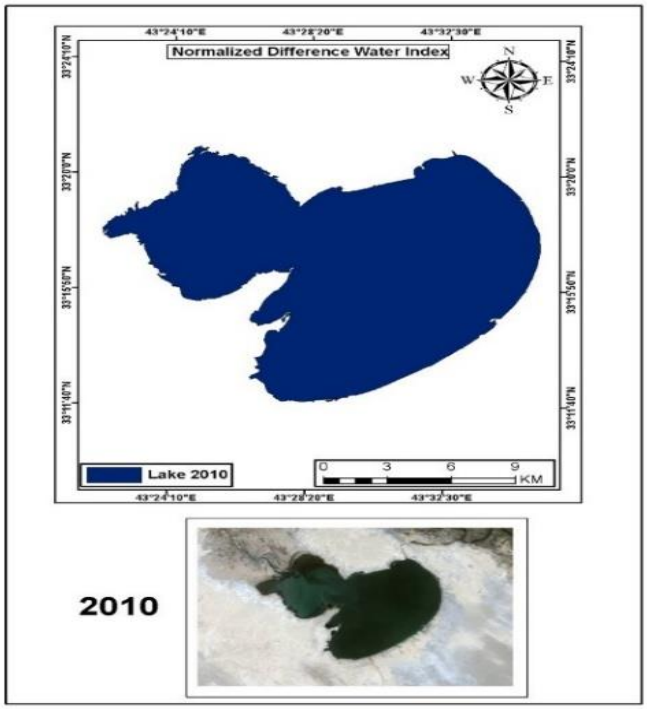
Changes in the lake area:

The lake faced changes in terms of the amount of water due to the variation in rainfall and river Discharges. In the first period, the area of the lake reached (204 Sq.km) as shown below in Map (2). In the second period, the area of the lake decreased to (186 Sq.km) due to decreased rain and river Discharges, as shown below in Map (4). In the third period, the area of the

lake increased and reached (286 Sq.km) due to the increase in water Releases and the fall of rain, and during this period water turbidity appeared in the northern part of the lake to take its final Shape in this period as shown below in the map (5)

First Period: Lake Area by Calculate Geometry2010: (204 Sq. km).

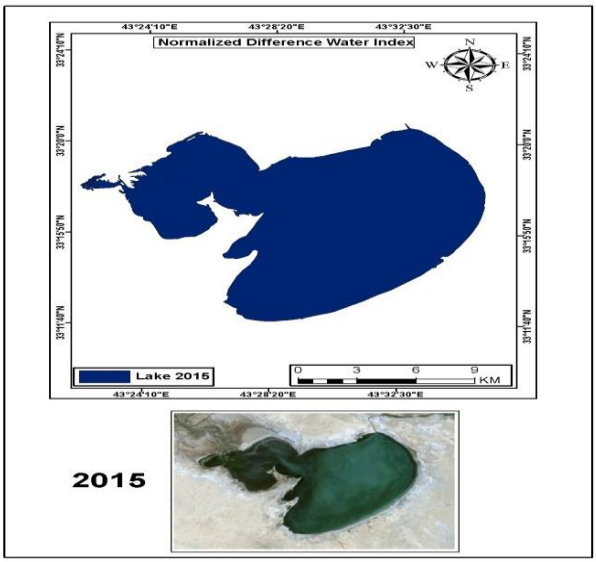
Map (2): Lake Area 2010



Source: LandSat5 Image from Website Of USGS.

Second Period: The Lake Area by Calculate Geometry 2015: (186 Sq. km)

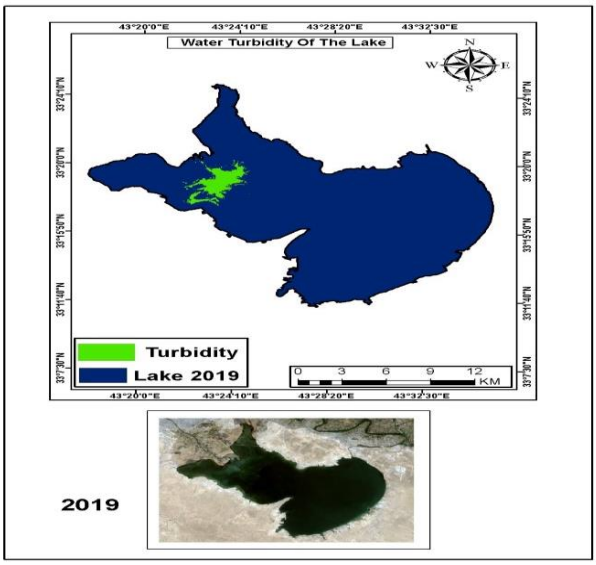
Map (4): Lake Area 2015



Source: LandSat8 Image from Website of USGS 2015.

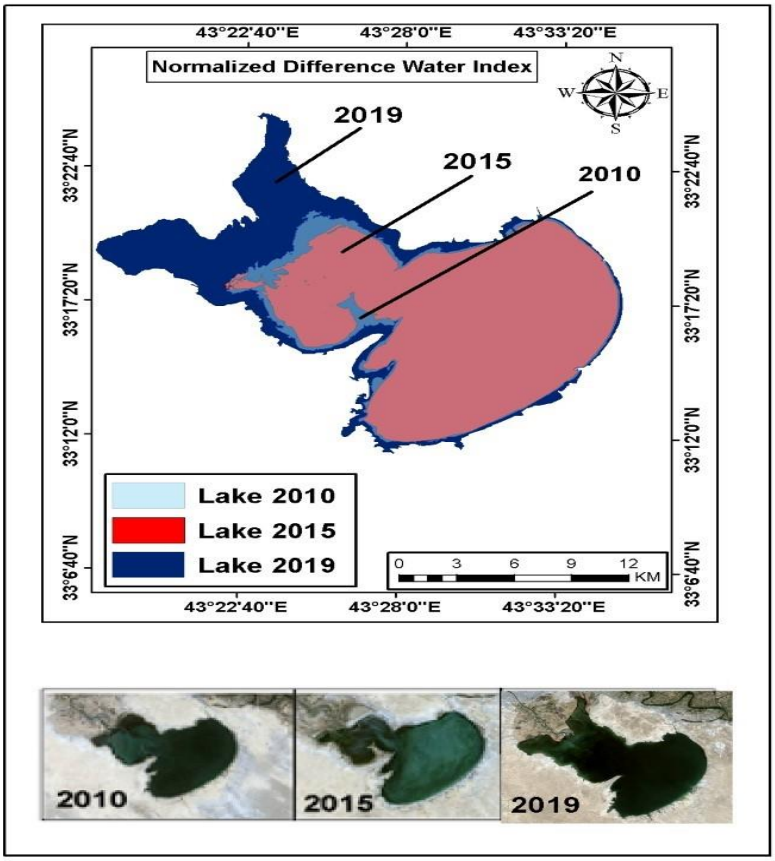
Third Period: Lake Area by Calculate Geometry 2019: (286 Sq. km)

Map (5): Lake Area and Water Turbidity 2019



Source: LandSat8 Image from Website of USGS 2019

Map (6): Lake Area Comparison (2010 – 2019)



Source: All Imageries of Study Period.

Conclusions:

Remote sensing and GIS techniques provide a great possibility to analyze the environmental processes and detect changes in natural features to decrease risks and understand how a phenomenon has changed by following the stages of its evolving, This research has revealed that spectral indices can enhance landscape features, extracting water information accurately is important for water resource survey, for water information extraction based on remote sensing The (NDWI) effectiveness can estimate water content and water turbidity as a popular method, Iraq is facing water challenges as the annual water imports of Euphrates and Tigris is decreasing this has an impact on Habbaniya Lake by decreasing water amount, The impact of climate change has effected on rainfall average especially rivers that depends on rainfall water, in this research, it was concluded that the lake level fluctuated from year to year, as shown below:

Lake area 2010: (204 Square Kilometers). Lake area 2015: (186 Square Kilometers).

Lake area 2019: (286 Square Kilometers).

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