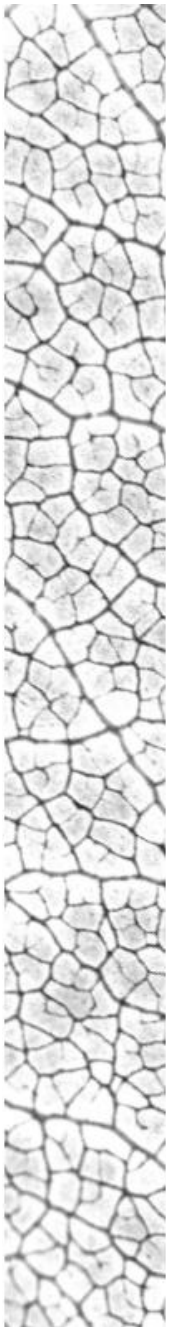

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Spatial monitoring for degradation Al-Razzaza Lake by analysis temporal of remote sensing data using geographic information system techniques

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Abstract
Al-Razzaza lake is the second largest lakes in Iraq, part of a vast valley that includes the lakes of Tharthar, Habbaniyah and the Sea of Najaf. Its total area is 1810 km2, with a storage capacity of 26 billion cubic meters, with a maximum storage level of 40 meters above sea level. Like other water bodies in Iraq, there has between a significant deterioration in its area, especially after 2003 Due to climatic changes, high temperature of the atmosphere and the evaporation process in addition to insufficient water to the lake to compensate for the shortfall as a result of the construction of dams in Turkey and Syria as well as the low level of the Euphrates River, which is the most important source of lake water. The aim of this research is to identify and monitor changes that have occurred in the area of the lake as well as the land cover around it by analyzing satellite images to produce maps of land cover varieties prevailing in the region for different time periods using Geographic Information System techniques. Six seasons within the study area were identified, representing three types of land covers (vegetation, soil, water) for years (1985-2003-2018) by applying Supervised Classification technique depending on the visual interpretation and geographical maps, the percentage of variance in Normalized Differences Water Index was also measured between different years to determine the variance between each year The results showed a clear discrepancy between the three years, in terms of spatial distribution and quantitative estimation of each class. Between 2003 and 2018, the area of the lake decreased by 792 km2 and significantly increased in the area saline land and desert land in 2018. This study shows that there is a significant shortage of water cover in terms of depth and area of the lake because of the significant decrease in the value of NDWI.

Keywords: Al-Razzaza Lake, Landsat Satellite Imagery Dataset, NDWI Techniques, Remote Sensing (RS) and Geographic Information System (GIS) Techniques

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INTRODUCTION

Degradation and shortages water are common in most countries these days, especially the shortage of potable water. According to UN statistics, nearly one fifth of the world suffers from water scarcity due to the lack of available water resources, thereby reducing water availability for drinking and irrigation uses (UN Report 2020). Due to lack of water, usually increases the concentration of salinity and pollutants in water, reducing the biodiversity of plants and animals and increasing desertification, thus endangering human health (Fouad and Zina 2017). There are many reasons for the lack of water, which vary from region to region some as a result of human activities and others due to natural conditions and climate change (Mashee and Hadi 2017). Iraq is currently experiencing a severe water crisis, unprecedented and this crisis is cause by internal and external reasons, the internal reasons are increased demand for water and mismanagement of water resources after 2003, the external causes are the water projects in the neighboring countries and the climate change (Ali 2020). By Given the large study area and the diversity of surface manifestations in it, remote sensing data is an effective means of detecting degradation processes and follow-up the changes, including changes in water cover therefore monitoring and mapping degradation in the lake is the best way to control the degradation process (Nawal et al. 2012) by studying the geographical distribution of land cover types and determining the state of time variability of lake areas through the production of digital maps of the

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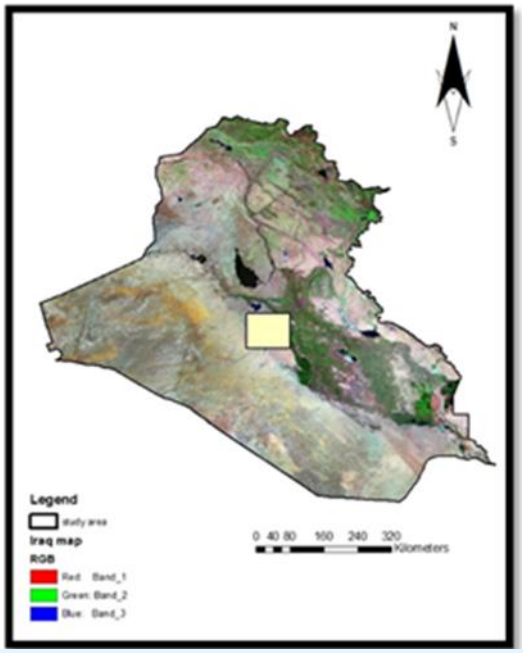


Fig. 1. Location of the study area (Al-Razzaza Lake) in Middle of Iraq

prevailing land cover and calculation the area of each category using Geographic Information System techniques (Ali et al. 2019). In this study, Supervised Classification technique was performed to classify area after obtaining Landsat images and performing some digital processing by use GIS 10.6, in addition to the calculation of Normalized Differences Water Index to diagnose and determine the water cover from other type covers with high accuracy.

MATERIAL AND METHOD

Study Area

Al-Razza Lake lies between the Karbala and Anbar governorates 15 km northwest of Karbala, and 50 km southeast of Ramadi, between Coordinates 32º 15` and 32º 45` N latitudes, 43º 25` and 44º00` E Longitudes. It is the second largest lake in Iraq, part of a vast valley that includes the lakes of Tharthar, Habbaniyah and the Sea of Najaf. Its total area is 1810 km2, with a storage capacity of 26 billion cubic meters, with a maximum storage level of 40 meters above sea level (Al Ramahi and Al Bahadly 2020). Connected to water via an artificial canal links it with Habbaniyah Lake, called Sin-Al-Thibban Canal. Al-Razzaz Lake is considered to be a semi-saline lake, which is one of the dead lakes. In order to enter the water and not to exit it, salinity depends on the amount of water entering it, which evaporates in addition to the ground absorption.

Evaporation rate is about 1.5 -2 meters during the year, especially the hot months, where evaporation is estimated at 2 cm per day. The Climate of this lake is characterized by a semi-arid, hot dry summer and cold dry winter with annual mean rainfall (109 – 122mm) mainly during January to May and annual mean evaporation (3194.3 – 3332.7 mm).

It is considered one of the important areas of Iraq (Sabah et al. 2018). There are many interests in this lake between tourist, religious, historical, economic, social and environmental, shown in (**Fig 1)**, the location of the lake from Iraq.

Table 1. Composites bands of satellite image (RGB)

Resolution	TM	OLI/TIRS	Color
30	Band-7	Band-7	Red
30	Band-4	Band-5	Green
30	Band-2	Band-3	Blue

Data Source and Processing

The satellite images covering the study area were obtained for different periods of time and the following years were selected (1985-2003-2018) with spatial resolution (30) meters from Landsat 5 and Landsat 8 satellites from USGS website. During the spring season for the purpose of minimizing the impact of abandoned or uncultivated land and its impact on classification and NDWI value.

After obtaining Landsat images many processors have been performed using GIS 10.6 like geometric correction was done using the (Map to Image) method, depending on map with known geographic coordinates, where all the features have known a projection system that is similar to the corrected map used in the debugging process and radiometric correction was performed using ERDAS Version 14.00.0.

Then many bands of satellite images were composite to produce (RGB) image with false color for both sensors (TM, OLI) and the bands used for the composite are shown in **Table 1** then calculated of Normalized Differences Water Index to diagnose and determine the water cover from other type covers with high accuracy.

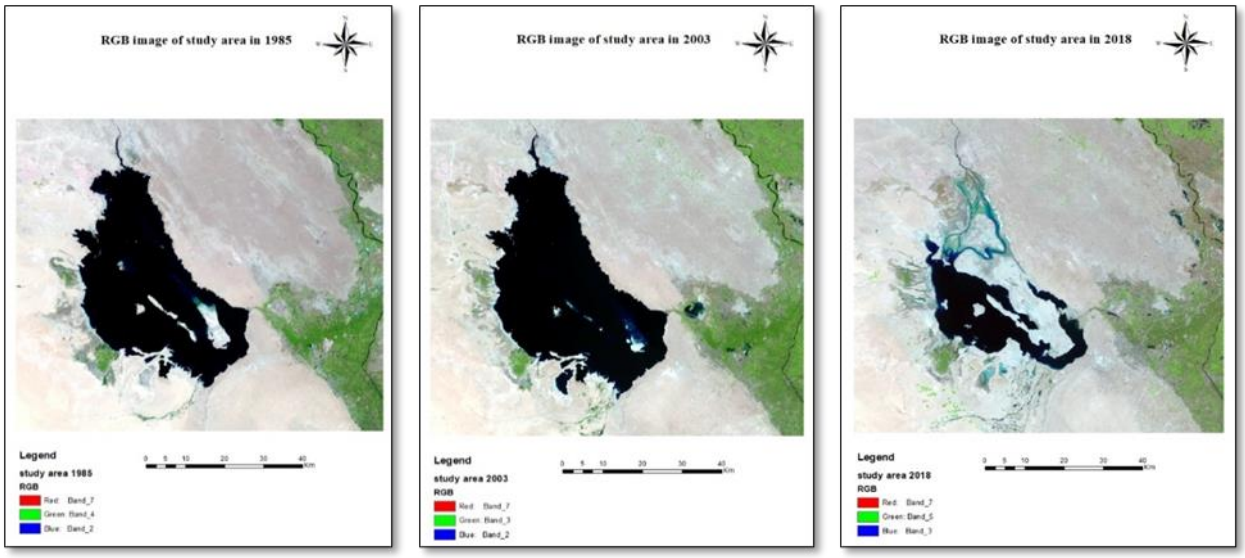
INTERPRETATION AND ANALYSIS IMAGE

Visual Interpretation

The visual interpretation of the color image that produced from the composite bands was performed as a first step in the interpretation process, where it relies on certain principles, including the analyst's experience in addition to the spectral characteristics of images and the date of their capture play a role in the interpretation process. The visual interpretation of the current study was based on the following criteria: size, texture, tone / color, shape and pattern, to arrive at the diagnosis of ground features in the image of the satellite and to know its importance (Abdulrahman et al. 2018).

Classification Process

Image classification is defined as the process of splitting the digital image into a number of geographical regions according to the homogeneity of the spectra of geographical phenomena (land use & land cover) (Al Ramahie 2012). There are two methods to classify digital images as a supervised classification and



(a) (b) (c)

Fig. 2. Illustration, (a) RGB image of 1985 for study area, (b) RGB image of 2003 for study area, (c) RGB image of 2018 for study area

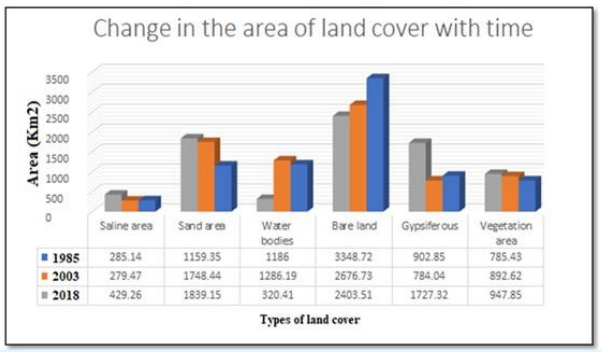


Fig. 3. Land Cover area for study area

unsupervised classification, the main difference between the two methods is that the supervised classification based on real information about the geographical phenomena given to the computer and select areas for each type of land cover in the area concerned and these areas are called the training sample while the unsupervised classification is based on mathematical equations that determine the clusters and thus categories of classification according to the relationship between the digital values of the image ranges (Fouad 2018).

The supervised classification based on field visit information was implemented, as well as the use of Google Earth, which has a high discriminating capacity, to ascertain the nature of the land cover of the inaccessible areas. The classification process was performed as well as the calculation of spaces using GIS 10.6. Six classes were identified within the study area represented by (Gypsiferous, Sand area, wetland, Vegetation area, Saline area, Water bodies and Bare land) for years 1985, 2003 and 2018. The results are shown in **Fig 3**.

The following table illustrates the areas of land covers in (Km^2).

Fig 4, The temporal variation in the land cover areas during the extended period (1985-2018) using supervised classification.

Normalized Differences Water Index (NDWI)

Normalized Differences Water Index is based on the spectral reflection of the water which is high in the green wavelength range and low in the near infrared range (Muthanna et al. 2018). The values of NDWI have a range of (-1 to +1) in general, the Negative values are an indicator of the absence of water cover in the area like (Vegetation, bare land and other types of covers), while positive values are indicators of the presence of water cover like (water bodies, rivers and canals). This guide is used primarily to diagnose, identify and isolate water bodies from other types of land coverings, especially those with near-water reflectivity, and to eliminate interference between them as well as for water body mapping and drought monitoring and it is sensitive to change in water content, [13]. (NDWI) is represented by the following equation;

NDWI = (Green- NIR) / (Green + NIR)

Table 2. Account the land cover geometry areas in Km^2

Date of image	Vegetation area	Gypsiferous Area	Bare land	Water bodies	Sand area	Saline area
12/03/1985	785.43	902.85	3348.72	1186	1159.35	285.14
17/03/2003	892.62	784.04	2676.73	1286.19	1748.44	279.47
11/03/2018	947.85	1727.32	2403.51	320.41	1839.15	429.26

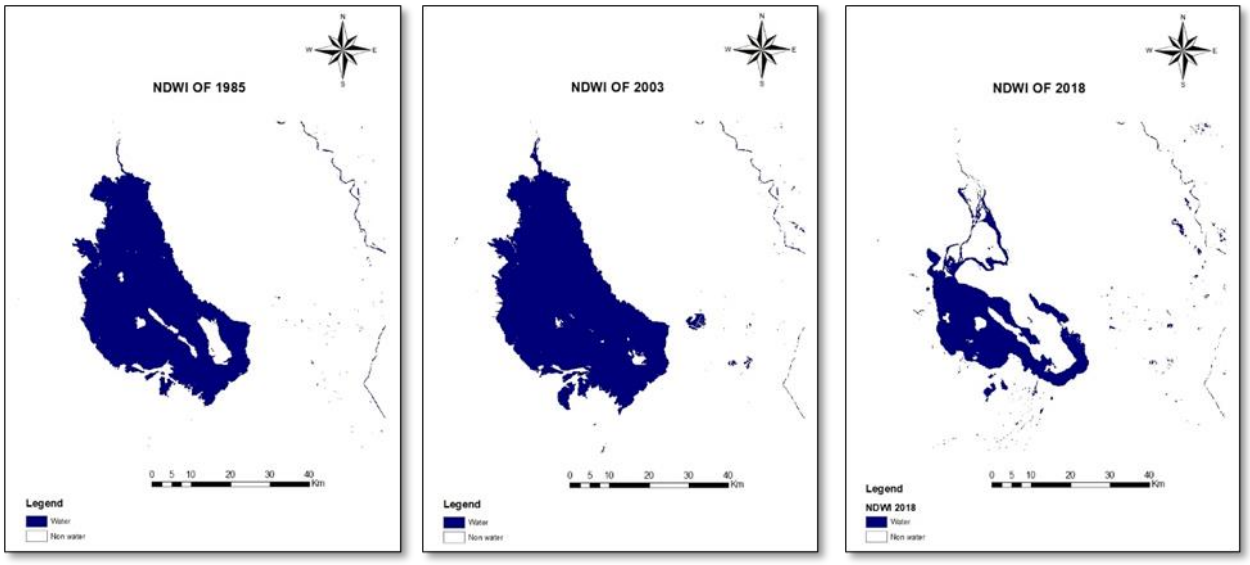


Fig. 4. Illustration, (a) unsupervised classification for NDWI images in 1985, (b) unsupervised classification for NDWI images in 2003, (c) unsupervised classification for NDWI images in 2018

Table 3. Area of water cover extracted from NDWI in (Km^2)

Date of image	Area of water cover in (Km^2)
1985/3/12	1295.41
2003/3/17	1453.24
2018/3/11	502.76

The NDWI was calculated using GIS 10.6, the highest and the lowest value for the NDWI index are shown in **Table 2**.

The area of water cover was calculated in each image taken in **Table 3**.

DISCUSSION AND CONCLUSION

After making the classification and determining the land uses of the study area and isolating the water areas from the rest of the items and calculating the area of each category, the final results showed the following:

1. The results of the supervised classification process indicate to identified six classes within the study area represented by (Gypsiferous, Sand area, wetland, Vegetation area, Saline area, Water bodies and Bare land) for years 1985, 2003 and 2018. It is clear from the analysis of the prevailing land cover areas that the area has witnessed a significant deterioration in the area of plant and water coverings as well as increase in desertification.
2. The current study shows that the region has undergone significant changes in the period between (1985-2018). Where the study revealed that the main changes occurred in agricultural areas and desert or bare land as well as water areas, when applying the water guide (NDWI) on the study area in 1985 we noticed that his highest value was 0.589 indicating high water density, while the highest value was 0.908 in 2003 this is due to an increase in water releases from the main sources represented by Turkey and Syria, either in 2018 we notice a significant decrease in NDWI value indicating the decrease in water cover due to severe climatic conditions and water shortages from the main sources in addition to the construction of dams in Turkey.
3. The area of Bare land cover has increased at the expense of the area of water bodies, which is one of the most important environmental problems that cause desertification because the region is characterized by dry climate and also affected by the problem of global warming, which led to increasing evaporation rates in addition to water shortage in the lake which affects the chemical composition of water and soil The spread of pollutants that negatively affect water, mainly due to the lack of appropriate management by the government for this lake.
4. The temporal analysis of satellite images showed that the decrease in the area of the water bodies led to an increase in the area of saline in addition to the Gypsiferous land, which foreshadows the future danger of the lake's biodiversity.
5. The study showed the importance of relying on remote sensing data and satellite imagery to detect, distinguish types of land cover for the study area after performing some digital processing.

Geographic Information System Techniques contributed to the presentation of the results obtained through the analysis of the satellite images in the form of covers prevailing in the region and determine the pattern of spatial distribution as well as the calculation of their areas and ratios.digital maps of the land.

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