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Study of Change Detection in the Shikeh Saad Region Using Meltitemporal Method from 2014 to 2024

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ABSTRACT: The study was titled "Detecting Changes in Land Cover in the Sheikh Saad Area Between 2014 and 2024." The importance of the study stems from the importance of land cover as a resource for humans, including phenomena such as soil, which represents the foundation for natural plant growth and a place for crop cultivation. Water is important for humans and animals, as are trees. The study information was collected from books and references, map sites, and satellite images. The study used the European Landsat 8 satellite image to detect changes in land cover and land uses in their various forms. The study followed the descriptive and analytical approaches by comparing land cover between 2014 and 2024. The analysis used the ArcMap ArcGIS 10.8 program. The study concluded that land cover and land uses are classified into five main types, they are green lands, barren lands, wetlands (water), rugged lands, and pasture lands. It also showed that there was a change in land cover and land uses, with the percentage of change in land reaching Barren lands recorded a change rate of (-84.496 km2) due to environmental changes. Wetlands recorded a change rate of (-259.111) where we notice a decrease in their areas between the two periods due to climate change. Green lands recorded a change rate of (291.121 km2) where we notice a change in their areas between the two periods. Rough lands recorded a change rate of (21.82 km2) while pasture lands recorded a change of (30.666 km2). These changes were reflected in the change in the land cover in Sheikh Saad district.

Keywords: NDVI; NDWI; Landsat 8; Samarra; classification; accuracy assessment

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1. INTRODUCTION

information systems (GIS) is a modern technology. To study the soil, water, vegetation cover, and landforms and identifying their characteristics the use of remote sensing and geographic landscape in terms of studying. Monitoring it and developing plans to exploit it, in addition to its applications in monitoring and tracking environmental phenomena through statistical evidence and information, geospatial maps, their characteristics and the spatial connection between spatial phenomena, arriving at results, indicators and predictions of the region's conditions and managing its resources [1] By creating a database and storing it in the computer and linking it to the descriptive data related to geospatial phenomena, building and analyzing databases, and showing the spatial relationship between spatial phenomena [2] It is of great importance to analyze the land cover and identify the most important changes that occurred on the land surface in Sheikh Saad district during a specific period of time. The most important of these changes is the percentage of wetlands, barren lands, green lands, and urban lands, etc. The change in land cover in Sheikh Saad district was analyzed for the period (2014-2024) using field fingerprints, base maps, satellite images, and geospatial geographic information systems programs. Green spaces, barren lands, wetland change, urban expansion, each of these types of shapes has a different reflective nature, as the spectral reflectance of each color differs, which complicates the process of visual interpretation of the satellite images of the site. The process of interpretation or statistical geospatial classification is used by using remote sensing, relying on spatial information systems, as an important source of modern, accurate spatial information difficult to benefit from them [2]. The program (Arc Map 10.8) and remote sensing technology were used, and the site (Google Earth Engine [3]. Which depends on technology Geographic Information Systems (GIS) uses a multi-stage approach to detect changes in the region. Change detection is a process that aims to identify differences in the state of a target or phenomenon. By monitoring it over several periods

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of time, or digital change detection (Digital changed detection) It aims to identify or describe changes in land use based on the analysis of remote sensing data, multi-duration [4]. Raw satellite images (RAW Image) of Landsat satellites were used. Landsat-8 LDCM)) seven views of visualizations covering the entire Sheikh Saad district in the past years and the ability to benefit from the satellite visualizations (MSS) and use them in applying indicators and statistical equations related to surface classification and comparison between them to help in detecting change due to the difference in the general specifications and characteristics of these Visuals, descriptions and characteristics of the satellites used in studying the region in terms of discriminative accuracy, radiation and spatial accuracy, differences in elevation and the number of bands for each specific time period for the region[5].

It is of great importance to analyze the land cover and identify the most important changes that occurred on the land surface in Sheikh Saad district during a specific period of time. The most important of these changes is the percentage of wetlands, barren lands, green lands, and urban lands, etc. The change in land cover in Sheikh Saad district was analyzed for the period (2014-2024) using field fingerprints, base maps, satellite images, and geospatial geographic information systems programs. Green spaces, barren lands, wetland change, urban expansion, remote sensing technology helps reveal geospatial and non-spatial features, shapes, and relationships of surface phenomena that are difficult for researchers to detect directly from the studied surface. This is achieved by relying on digital indicators and artificial intelligence in geospatial analysis, As these visuals reflect the spatial changes that occurred in a specific place and time in the landscape of the Sheikh district, this technology helped the researcher to obtain information about the landscape of the year 2914 and the year 2024, and compare it with what the region has become at the present time, and the most prominent of these changes is the change, Green spaces, barren lands, changing wetlands, expanding urban areas, Each of these types of shapes has a different reflective nature, as the spectral reflectance of each color differs, which complicates the process of visual interpretation of the satellite images of the site. And the use of the process of interpretation or statistical classification of geospatial data by using remote sensing, relying on spatial information systems as an important source of modern, accurate spatial information [6].

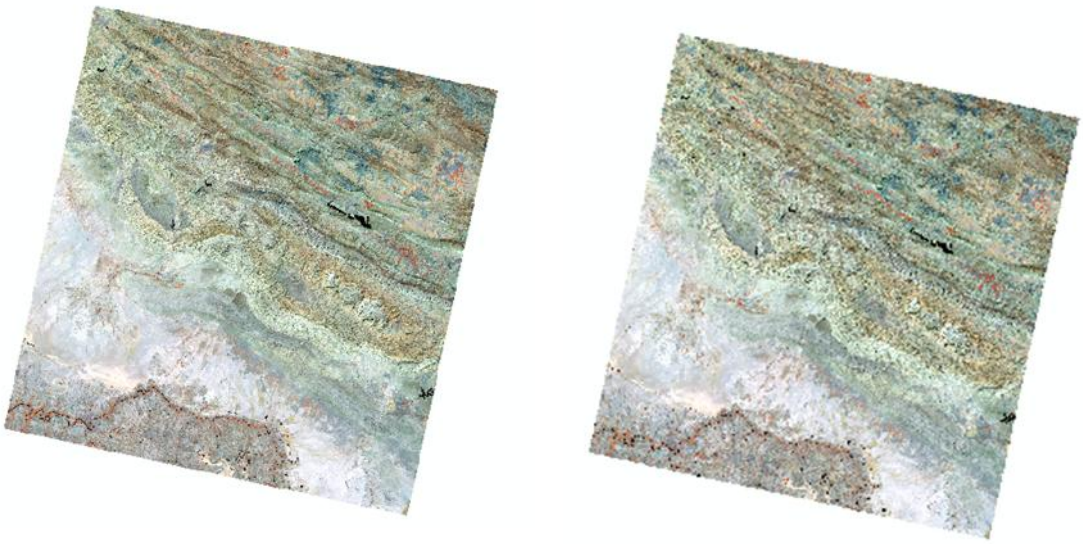
2. STUDY AREA

The Sheikh Saad district is located in Wasit Governorate, 174.2 kilometers from the capital, Baghdad. Nasiriyah is located to the south, 169.9 kilometers away. To the east, Khuzestan Province, Iran, is 22.31 kilometers away. To the west, Hillah is 169.6 kilometers away. Sheikh Saad district has an area of about 1,791 square kilometers. It is one of the districts of Kut city, the center of Wasit Governorate in southern Iraq. The city is located to the southeast of Kut city, which is 50 kilometers away from it. The population reached 38,408 people (2014 census), at coordinates (37-167) for the specified area (path 167) and row 37 [7].

3. DATA AND METHOD

data were collected. Some information was also collected from geographic data sites such as the USGS website and the European satellite Landsat 8 website, it is distinguished by containing 11 bands, three of which have new wavelengths and an altitude of 705 km. The moon's return period is 16 days, and this moon collects 400 scenes per day. The new band is the deep blue, with a wavelength of 433-455 micrometers. which provided land cover data for the study area with a resolution of 30 meters [8]. Software used: - GIS Arc10.8 is a software program from the American company ESRI, which specializes in geographic information system, Landsat 8 acquires high-quality, well-calibrated multispectral data over the Earth's land surfaces. On average, over 650 unique scenes are acquired per day [9]. Across the globe and sent to the USGS Center for storage, archive, and processing. All of these scenes are processed to a standard Level 1 product. The highest available product derivative is made available for download at no cost to users. A complete standard Level 1 product consists of 13 files, including OLI Bands 1-9 (one file per band), TIR Bands 10, 11 (one file per band), a product-specific metadata file, and a QA file. Landsat 8 satellite images were used because of their low cost, especially about the area covered. Another advantage of Landsat image is the copyright, which permits a legal sharing of data among government departments, academia, and donor agency. The images used in this work were taken during the same season (summer season), were not highly affected by the atmosphere (scattering and absorption), and the clouds were clear. To analyze land cover change over a 10-year period, images were taken from the Landsat-8 satellite, the image for each year 2014, 2024 was downloaded from the USGS website. Details of the Landsat-8 images are provided on the official USGS website. The images are collected in September because of the clarity of the sky and nearly the absence of the clouds that can be controlled from the USGS site and choose less than 10%. The original image of size 7611 x 7751 pixels all with a spatial resolution about 30 m and the clipped image size of Wasit governorate was 6492 x 5895 pixels. A complete level 1 product consists of 13 files, including the 11 band images, A complete level 1 product consists of 13 files, including the 11-band image a product-specific metadata file, and a Quality Assessment (QA) image. The met data file MTL is created during product generation and contains information specific to the level 1 product ordered and contains identifying parameters for the scene, along with the spatial extent of the scene

and the processing parameters used to generate the level 1 product. Where the first seven bands were combined for each satellite view for two different years 2014-2024, each view on one side as shown in the figure (1).



(a) **(b)**

FIGURE 1 a): 2024 Risual bands merge. b): 2014 Risual bands merge.

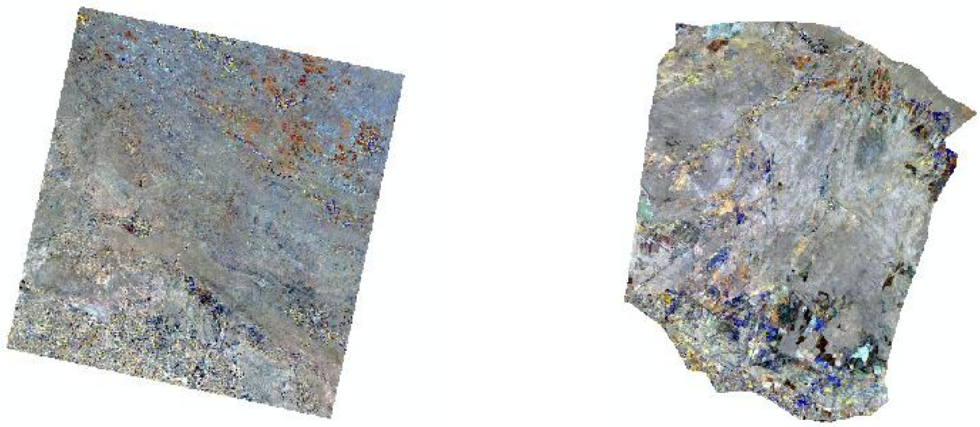
Then the study area was deducted for each satellite image for the years 2014-2024 as shown in the figure (2).



(a) **(b)**

FIGURE2 a): The cut-off view of the study area for the year 2014. (b): The cut-off view of the study area for the year 2024.

After presenting the two visuals for the seven integrated bands for the years 2014-2024 shown in the figure (a) (3, it results as



(a) **(b)**

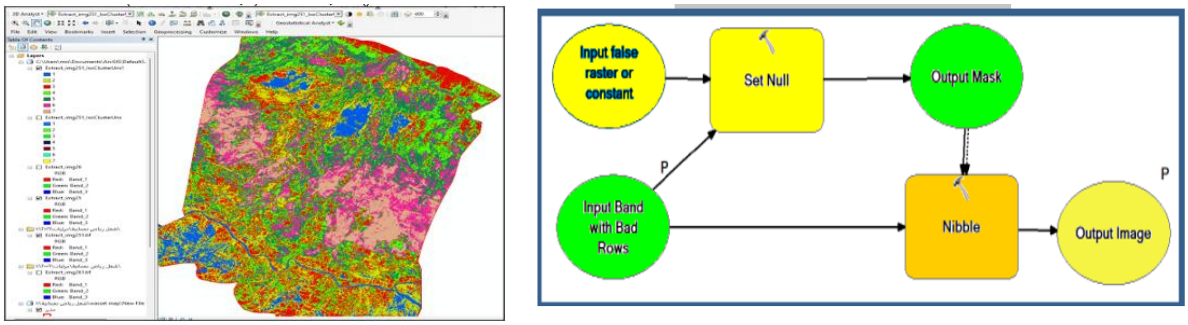
FIGURE 3 (a): The satellite image after differencing. (b): same satellite image after subtracting by matching the map

When cutting the study area after subtracting the two combined images for the two years, we get the figure (b)(3).

Satellite image processing is based on the fact that each cell has a numerical value based on the concentration of electromagnetic energy recorded by that cell from terrestrial scenes. These numbers are known as (Digital numbers) The values of these numbers start from zero for completely dark targets (which do not reflect any energy) and end with a value of 255 for high brightness targets such as clouds and snow. This range (zero-255) is known as the color gradient, where (X, Y) determine the position of the cell in the matrix and (Z) determines the value of reflection and brightness [10].

Digital processing is one of the most important technologies currently used in the field of remote sensing due to its role in the analysis and interpretation processes to obtain accurate results from satellite images and digital elevation data. Digital processing of images includes dealing with the images and interpreting them by entering coordinates and indicators into the Google Earth Engine website, and computer programming in the BASIC and Python languages, and computer programming to enter this data in the form of an equation or a set of equations, then storing the computer results for each element. These results are new digital visuals that can be displayed on a computer screen or recorded in pictorial order. They can also be used at other times and periods and in other programs such as Arc Map 10.8. The basic idea of processing is that when satellites broadcast large amounts of data when they monitor and observe terrestrial phenomena, this data is exposed to distortions and needs digital processing using digital spectral indicators. Therefore, the satellite image goes through other stages before the interpretation and analysis stage to increase its interpretive capacity [11]. These approved treatments include:

Color Composite Enhancement; Color mixing enhancement is a broad technique in visual processing, as it distinguishes features in color images better than grayscale images. Because the human eye has a higher ability to distinguish color differences than it has to distinguish black and white images, the image is produced by combining the three colors (Blue, Green, and Red). The landmarks appear in a colorful and more visually perceptible way, and in false colors, and this depends on the color reflection capacity of the geographical landmarks [12]. The Figure (4) looks like color mixing.



(a) **(b)**

FIGURE 4 a): Enhancement by Color Mixing (Color Composite Technique, (b): Color mixing enhancement (color composite image technique)

This method relies on the use of mathematical equations and statistical the Google Earth Engine website, and computer programming in BASIC and Python languages, and computer programming to enter this data in the form of an equation or a set of equations, then storing the computer results for each element. These results are new digital visuals that can be displayed on a computer screen or recorded in pictorial order. They can also be used at different times and in other programs such as (Arc Map 10.8).

4. INTERPRETATION AND CLASSIFICATION STAGE

Unsupervised classification was used in this research. This method is used in classification when training samples are not available. This method relies on the use of mathematical equations and statistical models when testing a large number of unknown image units. After that, they are classified into groups based on the spectral value of each unit of the satellite image. Where it was done to compare these varieties with the same varieties of topographic maps, aerial photographs and satellite images, to know the type of spectral fingerprint of these varieties and define them according to their geospatial distribution. A number of statistical indicators and evidence were relied upon in order to classify the land cover using the total channel index (BR) based on the color, or what is known as the Hue, and the areas of spread of the cover distribution. Vegetation, erosion of all types, wetlands, and other digital indicators, in addition to areas of water presence using the Normalized Water Index (NDWI) and natural vegetation using the Normalized Vegetation Index (NDVI) and minerals, which are based on the mineral compounds index. These indicators are one of the most important improvements applied to space visualizations, which result from dividing the numerical values of one spectral band by the corresponding values in another spectral band. The importance of these lies in converting the spectral properties of the visual values to conduct geospatial analysis of geographical phenomena. These methods clarify the extent of the difference between space visualizations and clarify the difference. ...and by applying spectral evidence to space images and studying various natural phenomena such as monitoring vegetation cover, drought, land degradation and salinization, and monitoring floods, dust storms and sandstorms [13]. Spectral indicators are indicators based on two or more spectral domains designed to improve the recording of land cover conditions of various types. These indicators are based on the use and application of mathematical models and statistical equations for each indicator used in the study. Spectral domains were adopted to detect land change in Sheikh Saad. The spectral domains used in designing the mathematical model vary depending on the geospatial natural phenomenon and its distribution. The importance of using spectral indicators and evidence with raw primary data is to enable the study of basic land cover and land use categories. Therefore, land use and land cover have become a fundamental component of current strategies for natural resource management and monitoring environmental changes, to preserve and develop existing natural resources, analyze the causes of overexploitation of soil and water resources in land use, and produce maps. It depends on more than just an analysis of reflectance values in the Sheikh Saad district. By working to improve the initial information that goes into the classification, thus achieving a high degree of accuracy and efficiency in geospatial analysis [14]. One of the most important indicators, 1- Normalized Difference Vegetation Index (NDVI): The Normalized Difference Vegetation Index (NDVI) was developed by (Rouse, 1974) and is the most common and widely used index. This index is one of the methods of digital processing of space data in detecting vegetation cover, as it depends on the fact that plants show high reflectivity in The near infrared range is the fifth band (Near infrared) with a wavelength of (0.85-0.88) microns, and its low reflectivity in the visible red range (Red) which is the fourth band with a wavelength of (0.64-0.67) microns in the satellite (Landsat 8) as these channels contain (90%) of the information related to plants, By applying the Normalized Difference Vegetation Index (NDVI), a color visualization is obtained, as dense vegetation appears with high reflectivity (dark green), and in areas with sparse vegetation, it appears with less reflectivity and a lighter and lesser color, as the density and vitality of the vegetation are directly proportional to the value of (NDVI). This helps to distinguish the vegetation from other land covers, such as soil and water, in the Sheikh Saad district, The visible water cover can be distinguished by the black color [15]. It is the ratio of the difference between the spectral reflectivity of infrared and red wavelength rays over their sum, according to the following equation:

$$NDVI=(NIR-RED)/ (NIR-RED) \quad (1)$$

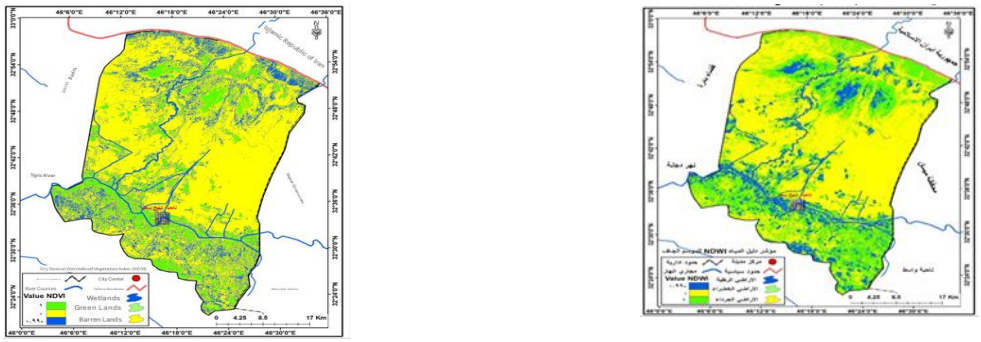
The NDVI values have a range from (+1 to -1) and the result is positive, which is an indicator that the cell has a vegetation cover. The higher the resulting positive index value, the higher the density of the vegetation cover. The opposite is true for negative values that indicate non-green surface features. Therefore, the vegetation difference index is used to distinguish between diseased and healthy plants [6].

2- The Normalized Difference Water Index (NDWI): The Normalized Difference Water Index (NDWI) was derived using the same principle as the previous index (NDVI), as the spectral reflectivity of water is high in the green wavelength range (0.60 – 0.52) microns and very low in the near infrared wavelength range (0.90 – 0.76) microns and short infrared waves (Short Near frared), and the current reflectivity of plants and soil in the infrared

wavelength range makes the (NDWI) values positive in Water areas appear bright and have positive values in the NDWI image, while green and built-up areas appear dark and have negative or zero values. Most of the radiation falling on water surfaces is absorbed by the water or passes through it, and a small amount of it is reflected back to the atmosphere. Water absorbs most of the infrared radiation, which makes the contrast between it and other surface materials very large in visible satellite images taken in the near-infrared radiation range. As for radiation in visible waves, most of it passes through the water and approximately (50%) of it is reflected, and it is represented using the following equation:

NDWI = (GREEN-NIR)/(GREEN+NER) (2)

BAND GREEN = Green visible light range. As the [15]. infrared range = BAND NIR



(a) (b)

FIGURE 5: (a) Season Normalized Difference Vegetation Index (NDVI), (b) Normalized Dry Season Water Index (NDWI) for Sheikh Saad District.

5. RESULTS AND DISCUSSION

The practical procedure is done by merging the spectral channels (Bands) of a single scene belonging to the raw image adopted in the study using the (Layer stack) method, except for the thermal band, which has specific uses and the researcher needs a great deal of experience to be able to deal with it. The band is merged to convert the scene from the (TIFF) extension to the (IMG) extension.

To save time and effort and to quickly complete the display, processing and analysis processes on the computer, the first task in any project before applying the processing operations is extracting a part of the image (extracting sub setting) that covers the area to be processed visually. The extraction depends on defining a frame of the location coordinates of the area or drawing a mask for the area (Border of area of interest) in order to facilitate the matching of satellite images together, and to remove the presence of areas exceeding the site that constitute a barrier in geospatial analysis. It is necessary to match all pixels in the different satellite images spatially [16]. This process was carried out in Arc Map GIS V. 10.8 to exclude areas located outside Sheikh Saad district and to facilitate work on the satellite image to obtain more accurate results. Figure (6) of the deduction process for the visualization of the study area.

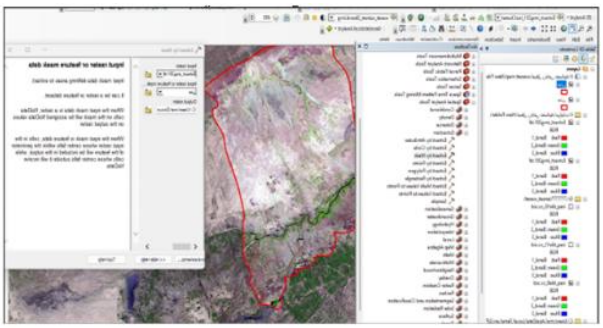


FIGURE 6: of the deduction process for the visualization of the study area.

Source: Researcher based on ARC Map10.8 and Landsat 8 visualization. the statistical and numerical classification stage, as follows:

1-Visual (Manual) Interpretation: It is the interpretation of the visual by the human sense of visual perception to identify the spatial ground features of the phenomenon in the satellite image, analyze, interpret, identify, draw and measure it, know its connotations and estimate its importance, according to the different degrees of color or shade in the satellite image and what it represents in terms of contrast between surface materials and different types of land cover. This depends on the level, efficiency, nature and characteristics of the image in terms of the accuracy of geospatial discrimination, spectral characteristics and the date of its capture, in addition to the level of experience of the interpreter, i.e. the scientific background of the researcher, due to its role in the interpretation process. The interpretation process is done through visual perception, color mixing, and satellite channel installation; to distinguish the land cover, specific bands are used for each satellite. For example, bands (3, 5, 7) are used for the Landsat-7 satellite, and bands (4, 5, 6) for the Landsat-8 satellite, to distinguish the land cover in the studied Sheikh Saad area, such as vegetation, rivers, valleys, barren lands, wetlands, and other geospatial phenomena within the satellite view of the specified area. This is because there is a specific application field for each spectral channel through which it measures specific phenomena of the Earth's surface. Interpretation and classification of the land cover in Sheikh Saad district

The area of the region reached (1920.163 km2), and Anderson's classification was adopted to classify the land cover. When distinguishing and classifying the study's visuals, it included five categories, namely: green lands, barren lands, wetlands (water), rugged lands, and pasture lands. The classification includes. Wetlands covered an area of while the dry season covered 401,765 km2, representing 20.923%. Green lands: Green lands represent the second rank in the classification, as for the dry season, it recorded an area of (351,861 km2), representing (13.117%) of the area. Pasture lands: for the dry season, the area of the category reached (101,914 km2) at a rate of (5,308%). Badland: the area of the category reached (290.763 as) at a rate of (15.143%) Barren lands: for the dry season, it amounted to (873.86 km2) of the total area.

Table 1: of land cover types, areas and percentages for the year 2014 in Sheikh Saad District

	Land cover classification for 2014 dry season	Area km2	% percentage
1	Wetlands	401.765	20.923
2	green lands	251.861	13.117
3	pastures lands	101.914	5.308
4	Badlands	290.763	15.143
5	Barren lands	873.86	45.510
6	the total	1920.163	100

Interpretation and classification stage: This includes the visual (manual) interpretation stage and

Interpretation and classification of land cover from the Landsat 8 satellite image of the

wetlands: The wetlands area during the dry season reached (142,654 km2) and a percentage of (7,429%). Green lands: Green lands represent the second place, and in the dry season, they recorded an area of (542,982 km2), representing (28.278%). Pasture lands: The area of pasture lands reached (132.58 km2), representing (6.905%) of the dry season. Rough terrain: The area of rugged terrain in terms of the area it occupies, as recorded for the dry season, was (312,583 km2) and a percentage of (16.279%) Barren lands: The area of barren lands for the dry season is (789,364 km2) and a percentage of (41.109%)

Table 2: of land cover types, areas and percentages for the year 2024 in Sheikh Saad District.

	Land cover classification for 2024 dry season	Area Km2	Percentage%
1	Wetlands	142.654	7.429
2	green lands	542.982	28.278
3	pastures lands	132.58	6.905
4	Badlands	312.583	16.279
5	Barren lands	789.364	41.109
6	the total	1920.163	100

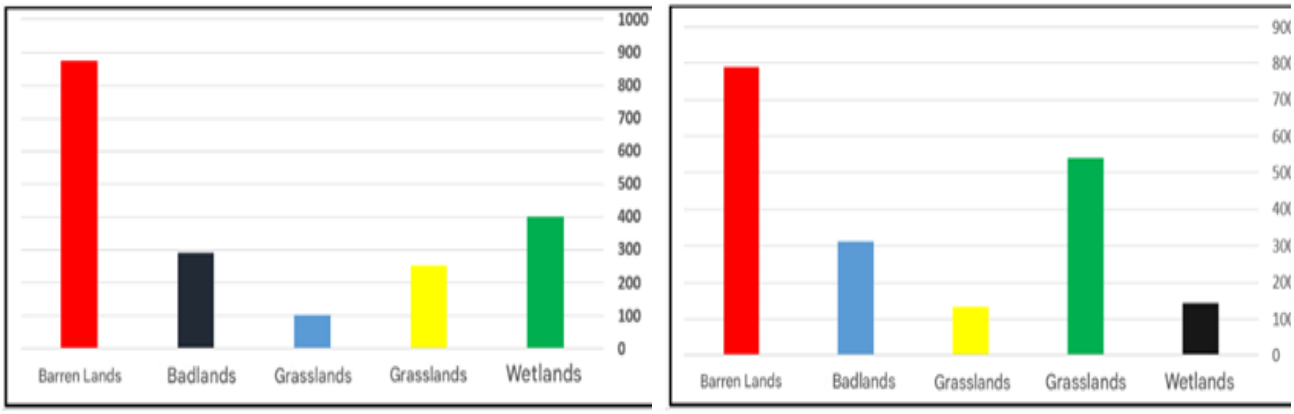
Spatial and temporal analysis of the spatial changes of land cover variables: -

Accurate and reliable information based on scientific geospatial analysis is used, which is one of the key requirements for optimal and sustainable use of land resources and land cover analysis. The importance of the study lies in its provision of information and maps on land use and land cover types in the Sheikh Saad district. In order to plan for sustainable land use and proper management of resources and thus achieve development and social and economic well-being, it aims to use remote sensing and digital processing of available satellite images in order to classify land cover and use geographic information systems in data entry, storage, processing, analysis and output of results and then show the final picture of the role of the natural and human components that these types appear on for the region[17]. Calculate the rate of change and percentage for the year 2014-2024 and the dry season

The dry season is the hot season with the greatest variability and impact in the region. The rate of change for both 2014 and 2024 is for the dry season only. The change between the dry season for the two periods is calculated, as the change represents an important part of calculating the coefficient for the variables for the Sheikh Saad district by analyzing two tables (1)(2) and comparing the dry season of 1914 with the dry season of 2024 Calculating the area of the variables of the categories showed the results, as we note that the category of barren lands recorded a change rate of (-84.496 km2), and this is due to environmental changes. Wetlands recorded a change rate of (-259.111) as we notice a decrease in their areas between the two periods due to climate change. Green lands recorded a change rate of (291.121 km2) as we notice a change in their areas between the two periods. Rough lands recorded a change rate of (21.82 km2) while pasture lands recorded a change of (30.666 km2). These changes were reflected in the change in the land cover in Sheikh Saad district.

Table 3: Change rates for land cover classification for the year 2014-2024 for the dry season.

	Land cover classification for the tw years	Area km2 for the dry season of 2014	Area km2 fc the dry seas of 2024	Change in area km2
1	Wetlands	401.765	142.654	-259.111
2	green lands	251.861	542.982	291.121
3	pastures lands	101.914	132.58	30.666
4	Badlands	290.763	312.583	21.82
5	Barren lands	873.86	789.364	-84.496



(a) (b)

FIGURE 7 a) Show the diagram for the variables of 2014, b): Show the diagram for variables for 2024

6. CONCLUSION

The study confirmed that remote sensing technology is an important and accurate source of information when studying land cover and detecting spatial and temporal changes, and building databases for those changes for the Sheikh Saad area for the period between (2014-2024). It was an effective and rapid tool in obtaining the best results with the least time and effort and the cheapest costs compared to traditional survey methods, The study proved that the undirected classification method is more effective in distinguishing land covers compared to other classification methods, due to the possibility of adding external data and the possibility of modifying it, in addition to the fact that it complements the visual and digital classification method and does not cancel them out. Through the analysis of satellite image data using remote sensing technology and geographic information system, the study identified the main first-level categories using the (USGS) classification system, which has proven its efficiency in classifying land cover and land use types in the study area. The study proved that the use of digital indicators (NDWI, NDVI) achieves high accuracy in the process of surveying, interpretation, classification, calculating areas and monitoring changes. The GIS environment can provide a comprehensive picture of the environment of the studied area and thus can provide sufficient indicators in the spatial signature of various activities, in addition to its contribution to the spatial signature of future investments, the area of green land increased significantly in 2024, reaching approximately 542,982 km2, up from 251,861 km2 in 2014. This increase in the region was a result of climate change and floods coming from Iran, recording a change rate of 291,121 km2. We notice a change in its area between the two periods. We notice that the barren lands category recorded a change rate of (-84,496 km2) due to environmental changes. As for wetlands, they recorded a change rate of (- 259,111), as we notice a decrease in their areas between the two periods due to climate change.

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