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Comparing and monitoring the spectral reflectivity of land cover in Taji using remote sensing data

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Sustainable development of the land cover (LC) requires monitoring the natural features and land uses (LU) for different periods and identifying the changes that have occurred through the use of modern remote sensing techniques, including a comparison of the recorded spectral reflectivity of the land cover features (water bodies, soil, plants, urban) by the sum of the pixels containing the value of each feature. The study area is chosen, which is Al-Taji District, located north of Baghdad, and is considered an agricultural areas depending entirely on water irrigation from streams branching from the Tigris and Euphrates rivers. Landsat 5 and 8 images are used for the MSS and Oli sensors, respectively, with a temporal resolution of 2000-2020 and for the wet and dry seasons. The results showed a degradation in the land cover as a result of random urban sprawl on agricultural lands and farmers leaving their professions to other professions for quick gain, which led to neglecting the vegetation cover, including the fish ponds spread in the study areas. This study can help decision-makers to monitor the state of the land cover and develop solutions to help in sustainable development to maintain sound productivity that serves the residents.

Keywords: Land Cover (LU); Al-Taji District; Landsat 5 and 8 Images.

1. INTRODUCTION

The planning and land administration processes require a suitable amount of land cover [1]. For a better understanding of how a phenomenon changes over time, detecting cover change is crucial [2,3]. Geographic information systems and remote sensing are crucial technologies that use image analysis to offer environmental data for a range of urban applications [4,5]. To ascertain changes in land cover in

the research region, supervised classification is utilized, and the optimum combination is produced [6]. The basic principle in studying land cover changes is to achieve environmental sustainability [7,8]. Remote sensing could be defined as the science and art of acquiring information for an object with measurements made at some distance from it [9]. The techniques involve compiling knowledge that is related to environments by measuring force fields, electromagnetic radiation, or employing cameras [10]. The multispectral data classification problem has been addressed by Several supervised algorithms that are presented in the remote sensing literature [11]. Earth resources and monitoring greatly benefit from remote sensing imagery. The multiplicity of sensors carried by the satellites creates a challenge in analyzing the vast amounts of data that are collected by these sensors [12]. Understanding fluctuations in a phenomenon's nature by observing it over a predetermined amount of time requires. This study aims to identify the land cover categories for the period (2000–2020) and to know the variation that occurred in each land cover category [13].

2. STUDY AREA

Al-Taji is a district located in the north of the Iraqi capital, Baghdad. Most of the area of Al-Taji is agricultural land. The area of the Al-Taji sub-district is 267.4 square kilometers, equivalent to 106,800 dunums. It is divided into nine districts, and its borders are the Tigris River in the east, Al-Tarmiyah district in the north, Al-Anbar Governorate in the west, the center of Al-Kadhimiya district, and That Al-Salasil district in the south. The population of Taji district is 600,000 people; its coordinates in the center are33°41′45.06″N 44°14′6.41″E [14]. Al-Taji district is one of the vital areas enjoying full land cover and land uses (LCLU). There are also some government departments and laboratories in Al-Taji, such as the Taji Gas Plant, Nasr Company for Various Industries, and Al-Taji Stadium under construction [15]. The climate of Al-Taji district is characterized by a mild one, permeated by its agricultural nature, widespread water streams, and its proximity to the Tigris River. Hot, semi-arid, the temperature ranges from (25-45) during the day and (15-25) at night, and the humidity ranges from 30-70% due to the large number of water bodies, such as fish farms. The annual rainfall rate ranges from 120 to 150 mm [16]. What distinguishes the Taji district with its agricultural wealth and animal husbandry is that every remaining part of the district is exploited for agricultural and animal production, as shown in Figure 1.

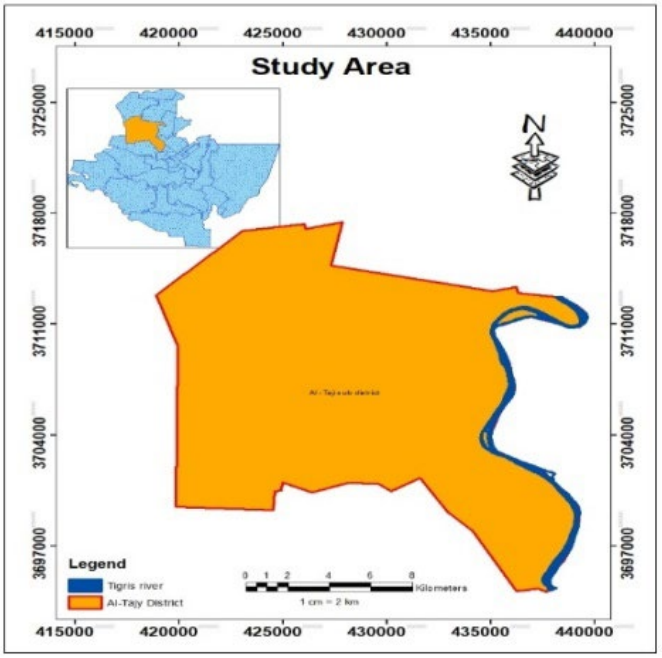

Figure 1 Illustration, the study area.

3. MATERIALS AND METHODS

3.1 SATELLITE IMAGERY ACQUISITION

Land cover information is extracted and divided into four main categories using remote sensing data and satellite images [17,18]. Using the ArcGIS 10.4 extraction tool, the scene of the Landsat image that makes up the research region is separated into its component pieces [19].Composite imaging comprises three primary hues (red, green, and blue) used to create images. The goal of the composite color technique is to combine multispectral data with visible wavelength information for the research area. Allows it to be seen by the naked. Eye Integration completes this enhancement. Bands in both the visible and infrared spectrums, a true-color image is created. Bands 7, 4, and 2 on Landsat 5; bands 7, 5, and 3 on Landsat 8 [20].

Table 1 Detailed information about the used data.

ID	Satellite Image	Sensor	Path/Row	Acquisition Data	Source
1	Landsat-5	Thematic Mapper (TM)	168/37	3/5/2000 10/5/2000 14/8/2000 23/8/2000	USGS Earth Explorer Database
2	Landsat-8	Operational Land Image (OLI)	168/37	15/4/2020 10/5/2020 30/8/2020 21/8/2020	USGS Earth Explorer Database

3.2 SUPERVISED CLASSIFICATION

Machine learning techniques such as supervised classification use training samples. Samples are selected for each land cover category, and then the changes occurring in each category are studied and analyzed using remote sensing technology. The Landsat image categorization method's supervised section serves as the training sample [21-25].

4. RESULTS AND DISCUSSION

4.1 EXTRACTION OF THE STUDY AREA

The removal Cropping of the Landsat satellite imagery is done through processing and thus creates the research area, as shown in Figure 2.

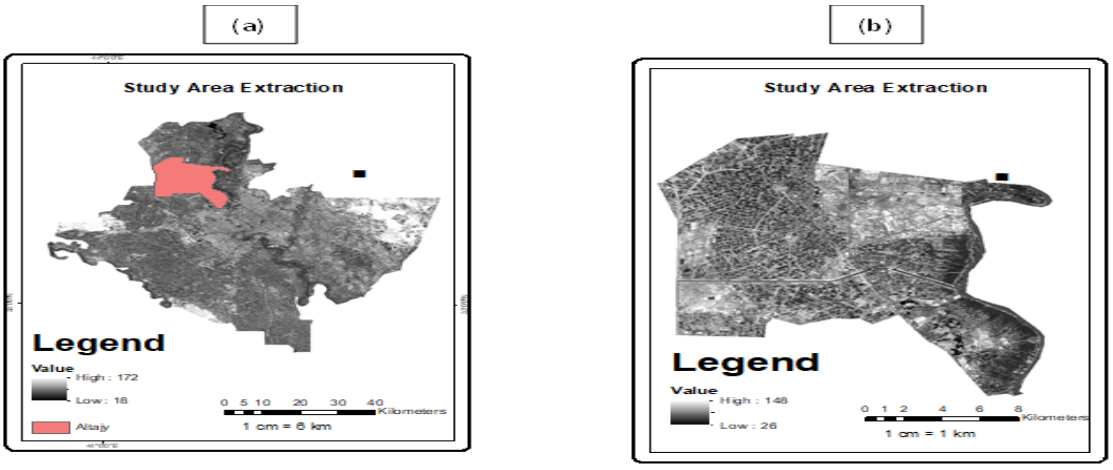

Figure 2 (a) and (b) the extraction of the Landsat image's research area.

4.2 COMPOSITE BANDS

Since grayscale satellite images are gathered for a particular region, a composite image is produced by fusing data from three bands to turn a grayscale image into an RGB image. The spectral characteristics of land features are contrasted in several bands (color composites) and shown as a red, green, and blue image, as shown in Figure 3 and Table 2.

Table 2 The Bands of Composite Color Images.

Landsat 5 (TM sensor)	Wavelength (μm)	Resolution (m)
Band 7	2.08-2.35	30
Band 4	0.76-0.90	30
Band 2	0.52-0.60	30
Landsat 8 (OLI and sensor TIRS)	Wavelength (μm)	Resolution (m)
Band 7	2.11-2.29	30
Band 5	0.77-0.90	30
Band 3	0.53-0.59	30

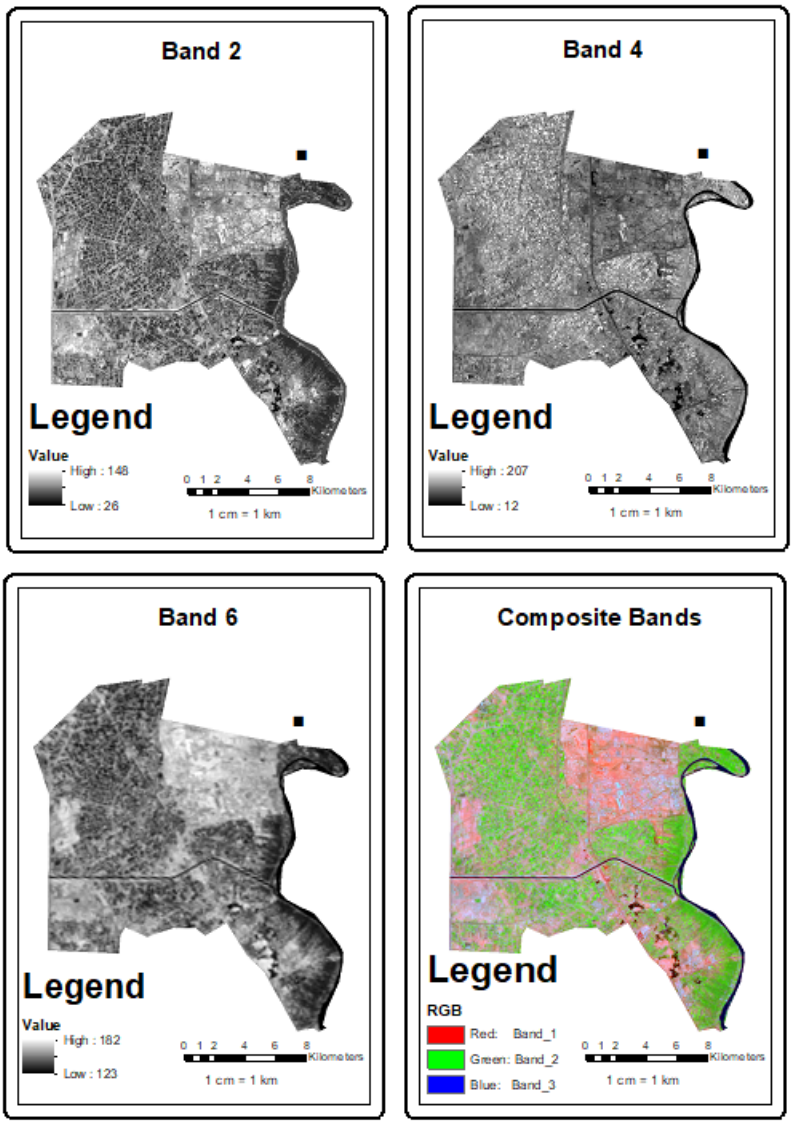

Figure 3 Band 2, Band 4, Band 6 and Composite Bands of Landsat Satellite Images.

4.3 CLASSIFICATION

Four land cover features are identified in Taji plant, water bodies, soil types, and urban, to ensure the accuracy of the supervised classification results. The categorization accuracy is strongly reliant on the training samples chosen. Each class is assigned a classification, referred to as training in the industry. The user must choose an area of interest in supervised categorization. In a map, this will operate as a classifier. The entire image's pixels will be used.

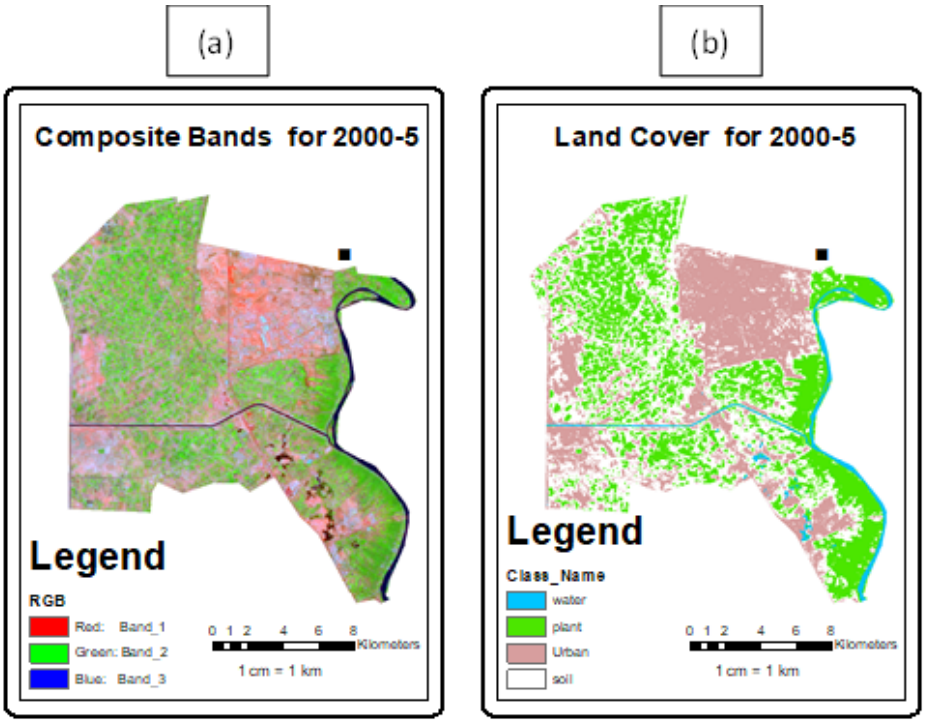

Figure 4 (a) The composite color image and (b) LC map of 2000 for spring.

TABLE 3. Land covers area of 2000-5.

Land cover	Year	Area in km^2	Area in %
water		7.3	2.6
plant	2000-5	89.1	32.7
Urban		73.1	27
Soil		97.9	35

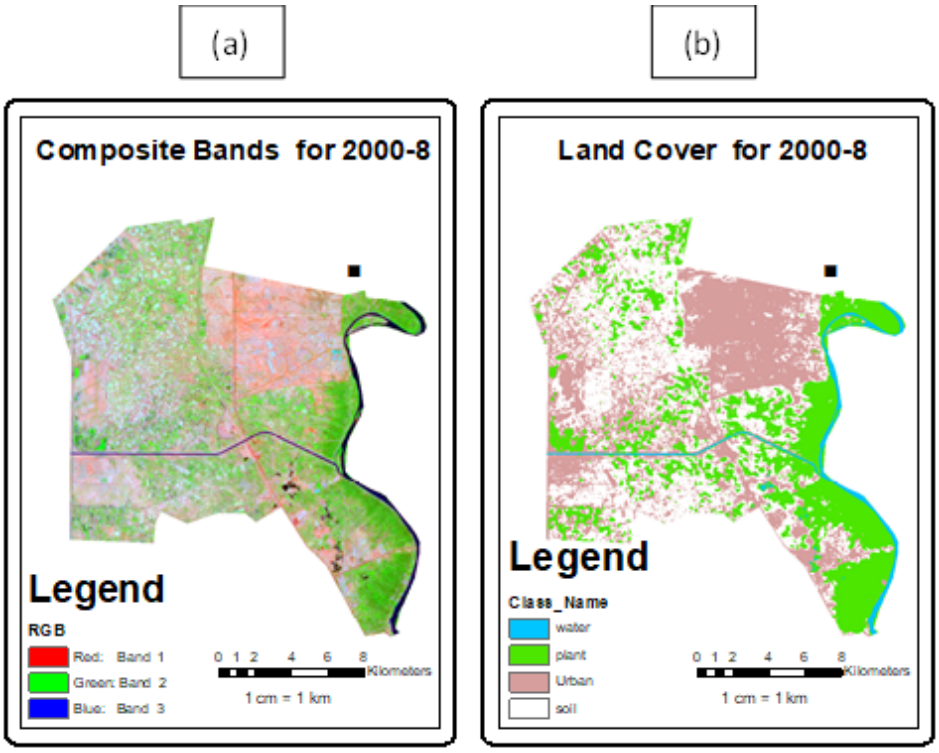

Figure 5 (a) The composite color image and (b) LC map of 2000 for summer.

Table 4 Land covers area of 2000-8.

Land cover	Year	Area in km^2	Area in %
water		6.5	2.4
plant	2000-8	72.5	26.6
Urban		95.1	34.9
Soil		10.2	37

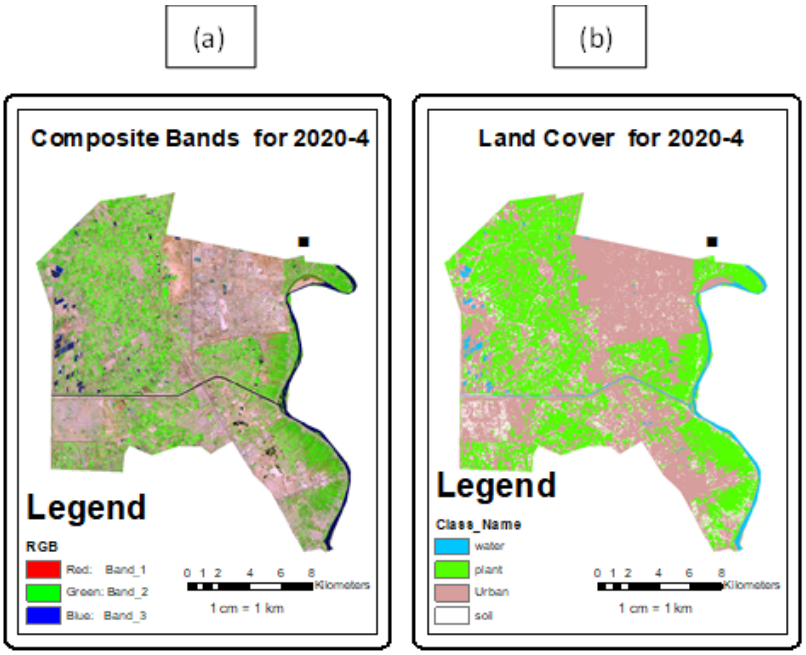

Figure 6 (a) The composite color image and (b) LC map of 2020 for spring.

Table 5 Land covers area of 2020-4.

Land cover	Year	Area in km^2	Area in %
water		11.6	4.2
plant	2020-4	98.1	36
Urban		120.4	44.2
Soil		42	15.4

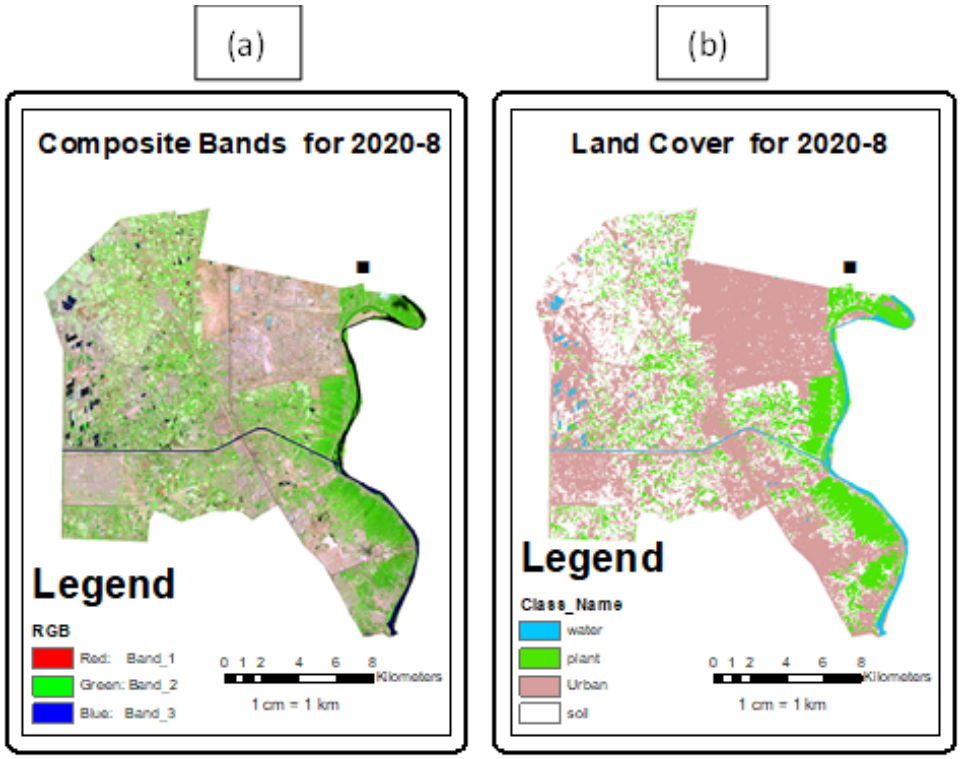

Figure 7 (a) The composite color image and (b) LC map of 2020 for summer.

Table 6 Land covers area of 2020-8.

Land cover	Year	Area in km^2	Area in %
water		6.2	2.3
plant	2020-8	46	16.9
Urban		131.8	48.4
Soil		88	32.3

To determine changes in the land cover in Al-Taji between the years 2000 and 2020, the findings are extracted based on remote sensing and geographic information system technique. The results of the supervised classification revealed that the area of the land cover varied, as shown in Figures 4-7 and Tables 3-6. In supervised classification for land cover between spring and summer during the years 2000 and 2020 in Taji Province, the findings show a shift in land cover in terms of area with a change in the time of image capture, which is affected by seasonal and global climate changes, as well as the impact of the human factor. The changes in categories represent the vegetation and water. Note from the results above the increase of plants and water during the spring and its decrease in summer. Moreover, the changes in categories represent the soil and built-up; note the decrease of soil and built-up during spring and its increase in summer.

5. CONCLUSIONS

The study showed the spatial variation in LC of Taji from 2000 to 2020: notice an increase in plant cover and water bodies during spring and a decrease in summer, while the soil and urban decrease in spring and this increases in summer. The area of plant cover and water bodies during spring of the years 2000 and 2020 is greater than the area during summer in 2000 and 2020; the area of plant cover reached 89.1

km^2 in the spring 2000, and in spring 2020 it reached 98.1 km^2. In summer 2000, it decreased to 72.5 km^2 and 46 km^2 in summer 2020. The area of water bodies reached 7.3 km^2 in spring 2000, and in spring 2020 it reached 11.6 km^2, decreased to 6.5 km^2 in summer 2000, and decreased to 6.2 km^2 in summer of the year 2020. As for the soil and the urban, note that its area decreased during spring in 2000 and 2020 and increased during summer in 2000 and 2020. It reached 97.9 km^2 in spring 2000, and in spring 2020, it reached 42 km^2. The soil area increased to 10.2 km^2 in summer 2000 and 88 km^2 in summer 2020. The urban area is 73.1 km^2 in spring 2000, and in spring 2020 it reached 120.4 km^2, increased to 95.1 km^2 in summer of the year 2000, and reached 131.8 km^2 in summer 2020. The results showed a degradation in the land cover as a result of random urban sprawl on agricultural lands and farmers leaving their profession to other professions for quick gain, which led to neglecting the vegetation cover, including the fish ponds spread in the study areas.

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