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Land Use and Land Cover Change Detection Using Remote Sensing Techniques

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Abstract: *Change detection is the process of knowing the differences in a particular phenomenon over time at different time periods. As a result of the advances in modern techniques of remote sensing, changes in the surface of the Earth can be seen using satellite images, so remote sensing has become the best tool in the evaluation and monitoring of changes, therefore the use of remote sensing in the applications of change detection is acceptable, due to periodic imaging, comprehensive coverage and low cost compared to ground survey techniques.*
The main objective of this paper is to detect the changes in land use and land cover at different periods. Two LANDSAT 5 images were used in two different periods (1990 and 2006), The study area selected in the middle Euphrates Region of Iraq. The results of land use/cover assessment of satellite data between (1990) and (2006) after applying image differencing technique is shown in as differencing image in "RGB-colored".

1. Introduction

Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental change. The rapid development of the concept of vegetation mapping has lead to increased studies of land use and land cover change worldwide. Although the terms 'Land Use' and 'Land Cover' are often used interchangeably, their actual meanings are quite distinct. 'Land Use' refers to human activities that take place on the earth's surface. (How the land is being used; such as residential housing or agricultural cropping.) 'Land Cover' refers to the natural or manmade physical properties of the land surface, [3].
During the past millennium, humans have taken an increasingly large role in the modification of the global environment. With increasing numbers and developing technologies, man has emerged as the major, most powerful, and universal instrument of environmental change in the biosphere today. Several regions around the world are currently undergoing rapid, wide-ranging changes in land cover. Remote sensing provides a viable source of data from which updated land-cover information can be extracted effectively and cheaply in order to inventory and monitor these changes effectively. Thus change detection has become a major application of remotely sensed data because of repetitive coverage at short intervals and consistent image quality. The basic premise in using remote sensing data for change detection is that changes in land cover result in changes in radiance values and changes in radiance
due to land cover change are large with respect to radiance changes caused by others factors such as differences in atmospheric conditions, differences in soil moisture and differences in sun angles, [4]. Nowadays, land use land cover analysis plays an important role in the field of environmental science and natural resource management. The Land cover reflects the biophysical of state of the earth's surface and immediate surface, including the soil material, vegetation and water. Land use refers to utilization of land resources by human beings and land cover changes often reflects the most significant impact on environment due to excessive human activities. Land use/cover pattern of a region gives information about the natural and socio-economic factors, human livelihood and development. Like other resources, land resource is also delimiting due to very high demand of agricultural products and increasing population pressure day by day. Hence, information of land
use/cover and possibilities of their optimal use is essential for the selection, planning and implementation of the land use schemes to meet the increasing human needs and welfare. This also provides the information for managing dynamics of land use and meeting the demands of increasing human population, [5].

2. Land Use/Cover Change Concept

The major problem in detecting land use/cover by using satellite images is to separate the change signal due to actual land use/cover changes from those due to various type of noise. The decision rules for separating these two types of change singles are referred to spectral response of land use /cover change. With the earth surface being monitored, land

use/cover changes can be detected by comparing images acquiring in different time, [6].

3. Change Detection

The basic premise in using remote sensing data for change detection is that changes in land cover must result in changes in radiance values and changes in radiance due to land cover change must be large with respect to radiance changes caused by other factors. These 'other' factors include (1) differences in atmospheric conditions, (2) differences in Sun angle and (3) differences in soil moisture. The impact of these factors may be partially reduced by selecting the appropriate data. For example, Landsat data belonging to the same time of the year may reduce problems from Sun angle differences and vegetation phonology changes. Several researchers have attempted to use digital satellite data to address the

change detection problem: Several procedures of land cover change detection using digital data have been proposed which could aid in updating resource inventories. These methods include comparison of land cover classifications, multi date classifications, image differencing, principle components analysis and change vector analysis, [7].

Digital change detection approaches may be broadly characterized by (1) the data transformation procedure and (2) analysis techniques used to delineate areas of significant alterations.

It may be mentioned here that accurate spatial registration of the two images is essential for most change detection methods. This necessitates the use of geometric rectification algorithms that register the images to each other or to a standard map projection.

The subject of change detection based on analysis of several important factors:

- The sensors should have similar precision and be comparable – ideally, the data will be from the same sensor, thereby minimizing sensor radiometric band differencing and issues relating to spatial resolution, and reducing the need for extensive image calibration; the imagery should be from the same time of year or season, for each date, to account for solar illumination angle effects and to minimize differences in seasonal vegetation cover.
- Images should be co-registered or orthorectified to better than one half pixel accuracy, or 0.5 RMSE (Root Mean Square Error), to minimize spatial offset and distortion effects.
- Radiometric normalization may be necessary to remove atmospheric effects – differences caused by scattering and absorption by atmospheric constituents, and by differing solar zenith angles, can falsely mimic change in land cover types, these might include cloud and cloud shadow problems, [8].

4. Study Area

The study area selected in the middle Euphrates Region of Iraq, Babel city center, the geographic coordinates "latitude (33 14' 34") to (32 06' 14") N, longitude (44 04' 08") to (45 16' 48") E.

5. Data Used

The available data consists of two multibands Landsat Thematic Mapper (TM) images with ground resolution (30m).

- Landsat _5(TM) Red, Green, Blue (RGB) raw image band (4,5,7),taken in June 1990,Fig (1).
- Landsat _5(TM) Red, Green, Blue (RGB) raw image band (4,5,7),taken in June 2006,Fig (2).

Both images were collected in 3-bands Red (0.75-0.9μm) ,Green(1.55-1.75μm), Blue (2.09-2.35 μm).

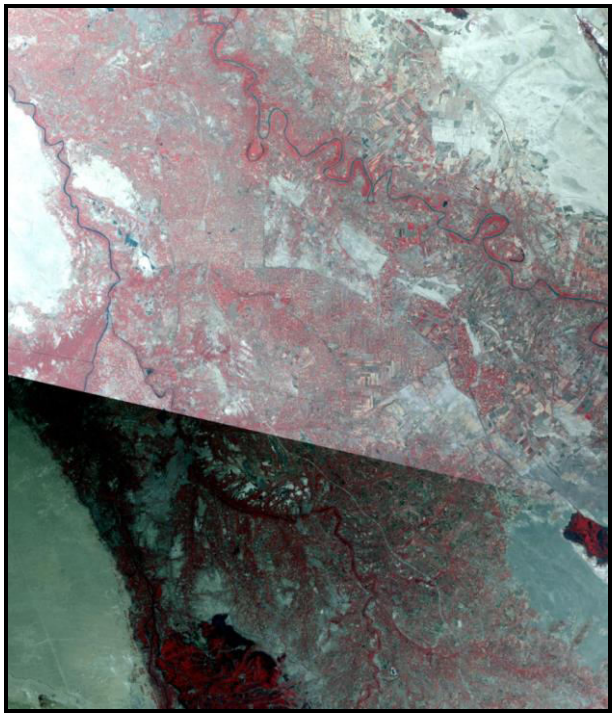

Figure (1) LANDSAT –4 (TM) RGB raw image Band (4,5,7), June 1990.

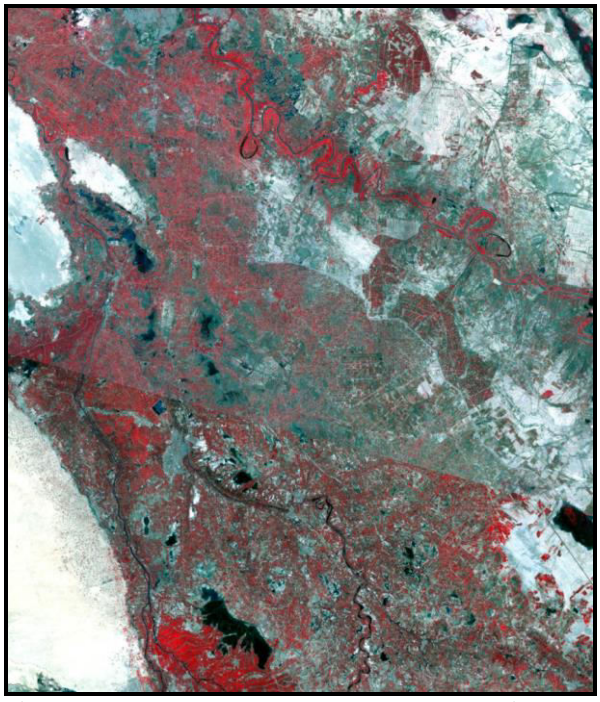

Figure (2) LANDSAT –4 (TM) RGB raw image Band (4,5,7), June 2006.

6. Image Differencing Change Detection

Image differencing may be the most commonly used technique to find changed areas in two or more images of the same area acquired at different times . Typically, the method subtracts the pixel values in the multi-temporal, co-registered, normalized, original or transformed images. This results in a dataset of positive and negative-value pixels representing 'change', and zero (or near-zero) values that represent 'no change, [6].

7. Image Registration

Image registration is the process of overlaying two or more images of the same scene taken at different times, from different viewpoints, and/or by different sensors, [1]. It geometrically aligns two images—the reference and sensed images. The present differences between images are introduced due to different imaging conditions. Image registration is a crucial step in all image analysis tasks in which the final information is gained from the combination of various data sources like in image fusion, change detection, and multichannel image restoration. Typically, registration is required in remote sensing (multispectral classification, environmental monitoring, change detection, image mosaicing, weather forecasting, creating super-resolution images, integrating information into geographic information systems (GIS) .The image registration is considered as an essential and important task in any remote sensing analysis in order to remove geometric errors. Image registration is the process of matching two images so that corresponding coordinates points in the two images correspond to the same physical region of the scene being imaged,[2]. Fig(3) shows the first and second time images after registration.

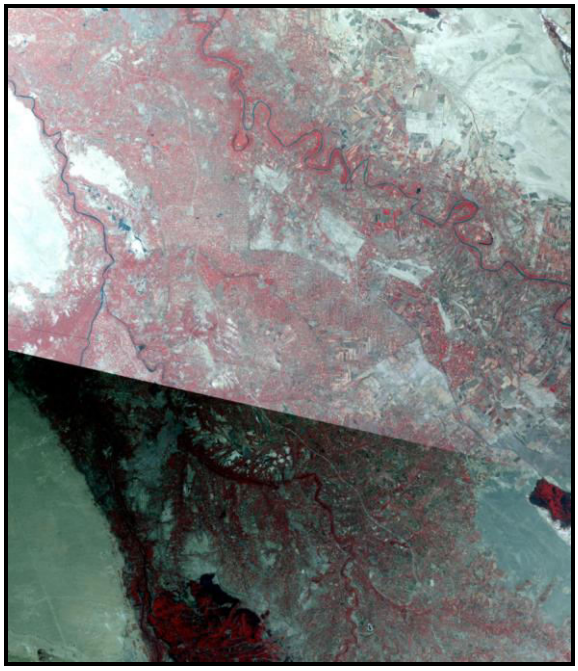

Figure (3) The images after Registration.

8-Results Analysis

The results of land use/cover assessment of satellite data between (1990) and (2006) after applying image differencing technique is shown in Fig (4) as differencing image in "RGB-colored".

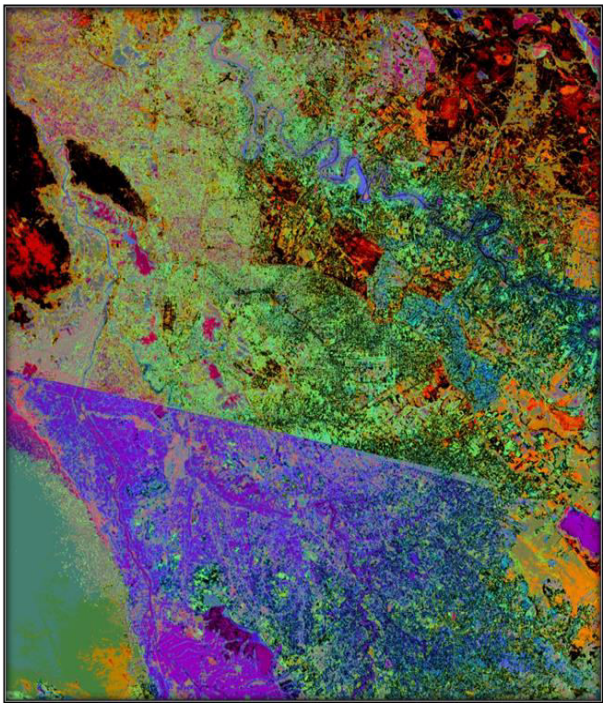

Figure (4) RGB Image differencing

9-Conclusions

The land use/land cover pattern of a region is an outcome of both natural and socio-economic factors and their utilization by man in time and space, [3]. Land is main natural resource for life support system. The land and land cover changes are equally important elements of the larger problem of global and regional environmental changes. Hence, information on land use/land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare, [4]. In this study, using satellite images of (1990) and (2006) land use changes were evaluated. The study revealed that the major changes occurred in cropland and scrubland. The reason behind this is the area under scrubland is converted into agricultural or crop zone. We can conclude that satellite data has the unique capability to detect the changes in land use quickly and accurately. The high resolution satellite data such as Landsat TM are good source to provide information accurately. Accurate land cover change information is necessary for understanding main factors causes and environmental consequences of such changes, [8].

8. References

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