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Evaluation of Environmental Development and Degradation Using Satellite Data in Tabriz, Iran

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Abstract. This study was conducted in order to changes detection have taken place during the last seven years in Tabriz, Iran. Tabriz is located in central part of Azerbijan-e-Sharqi province of Iran. In this study, the trends of changes in the landscape and green space patterns of the study area were investigated. Land cover maps were provided using the satellite images of a Land sat TM and an IRS LISS-III image during 1989 and 2006. A supervised classification was carried out on six reflective bands for two mentioned images, individually. Cross-classification was also used to produce change detection map in the study area. Results revealed a considerable increase in human buildings as well as degradation of green spaces in the study area. The main causes of land degradation in the study area were conversion of green spaces to bare zones, and bare zones to buildings. It concluded that the study area has been undergone very severe land cover changes as a result of mismanagement and non sustainable development, and so new planning for ecosystem management seems to be necessary.

Keywords: Change detection, Tabriz, Landsat, LISS-III .

1. Introduction

The study area is located in North West of Iran and central part of Azerbijan-e-sharqi province. This region is a mountainous area with height around 1470 m above the see level. The area is located between 38°01´N and 38°04´N latitude and between 46°23´E and 46°19´E longitude. The study area includes about 2082 ha. Temperate front of Mediterranean and Siberian climates causes accumulation of snow in the crest of the study area's mountains such as Eynali in winters. Average temperature is 12.2 °C and precipitation is 312 mm (Fig 1).

Because of quick development of cities, the update of sustainable develops in municipalities urban changing is very important. As main factors in this subject is green spaces and human buildings, urban green spaces are remnants of nature in this environment and play an important role in ascending the level of life quality in the city. With the rapid changes of urban area in Tabriz city during the past seven years, green spaces have been fragmented and dispersed causing impairment and dysfunction of these important urban elements. Change detection using satellite data is a reliable method for quality and quantity assessment of land changing. Remote Sensing data techniques have recently received lot of attention in agriculture and natural resources. Natural resources and environmental conservation needs more attention especially on developing countries. Using satellite data for evaluating environmental changes are rapidly growing (2). Objective of this study was to provide a recent perspective for land cover types and land cover changes that have taken place during the last seven years in Tabriz city, Iran.

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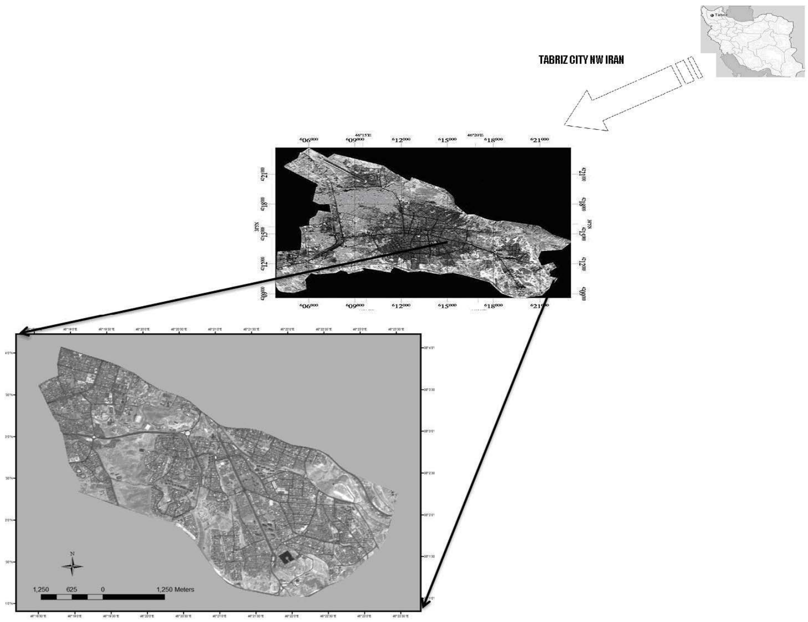

Fig 1: The study area's map

2. Material and Methods

Three sets of material were used here. landsat Thematic Mapper (TM) and IRS LISS-III images acquired on 2006 and 1989, respectively (Table 1).

2.1. Geometric correction

Accurate per pixel registration of multi- temporal Remote Sensing data is essential for change detection since the potential exists for registration errors should be interpreted as land cover and land-use change, leading to an overestimation of actual change.

Change detection analysis is performed on a pixel by pixel basis, therefore, a misregistration greater than one pixel will provide an anomalous result of that pixel. To overcome this problem, the root mean square error (RMSE) between any two dates should not exceed 0.5 pixels.

In this study, geometric correction for image of 2006 was carried out using ground control points from topographic maps with scale of 1:5000 produced in 1989 by Iranian Army Surveying Center (IASC) and this image then was used to register the image of 1989. The process of visually interpreting digitally enhanced imagery attempts to optimize the complementary abilities of the human mind and the computer. The mind is excellent at interpreting spatial attributes on an image and is capable to identify obscure or subtle features. Contrast stretching was applied on the two images and two false color composites (FCC) were produced. These FCC were visually interpreted using on screen digitizing in order to delineate land cover classes that could be easily interpreted such as village. Some classes were spectrally confused and could not be separated well by supervised classification and hence visual interpretation was required to separate them.

Table 1. The data specification.

Sat name	Made country	Sensor name	Date of images	Pixel resolution	Band number	Period time day	Scene size km
Landsat	USA	TM	1989.6.30	28.5	7-1	16	185*185
IRS	India	LISS-III	2006.8.30	23.5	4-1	24	140*140

2.2. Image classification

Land cover classes are typically mapped from digital remotely sensed data through the process of a supervised digital image classification (8).

The overall objective of the image classification procedure is to automatically categorize all pixels in land cover classes or themes (3, 9).

The maximum likelihood classifier quantitatively evaluates both the variance and covariance of the category spectral response patterns when classifying an unknown pixel so that it is considered to be one of the most accurate classifiers since it is based on statistical parameters (4).

Supervised classification was done using ground check points and digital topographic maps of the study area. The area was classified into two main classes: the first class is green space in study area and second one is human buildings such as houses roads and etc, which all of them was taken at group 2. Then accuracy assessment was carried out using 200 points, 100 points from field data and 100 points from existing topographic maps dated 1989 and land cover map dated 1989. The location of the 200 points was chosen using random stratified method to represent different land cover classes of the area. In order to increase the accuracy of land cover mapping of the two images, ancillary data and the results of visual interpretation were integrated with the classification results using GIS in order to improve the classification accuracy of the classified image (5, 8).

2.3. Land cover/use change detection

Regardless of the techniques used, the success of change detection from imagery will depend on both the nature of the change involved and the success of the image pre-processing and classification procedures (7). If the nature of change within a particular scene is either abrupt or at a scale appropriate to the imagery collected, then change should be relatively easy to detect. Problems occur only if spatial changes are subtly distributed and hence not obvious within any image pixel (1). In the case of the study area chosen, field observation and measurement have shown that the change between the image collection dates was both marked and abrupt. In this study, post-classification change detection technique was applied. Post-classification is the most obvious method of change detection, which requires the comparison of independently produced classified images. Post-classification comparison proved to be the most effective technique, because data from two dates are separately classified, thereby minimizing the problem of normalizing for atmospheric and sensor differences between two dates. Cross tabulation analysis was carried out to analyze the spatial distribution of different land cover classes and land cover changes (1, 6).

The second operation that CROSSTAB offers is cross- classification. Cross-classification can be described as a multiple overlay showing all combinations of the logical AND operation (7, 8). The result is a new image that shows the locations of all combinations of the categories in the original images. A legend is automatically produced showing these combinations. Cross-classification thus produces a map representation of all non-zero entries in the cross-tabulation table.

3. Results and discussion

This study provided a recent perspective for land cover types and changes that have taken place during the last seven years in Tabriz, north west Iran, to integrate visual interpretation with supervised classification using GIS and to examine the capabilities of integrating Remote Sensing data and GIS in studying the spatial distribution of different land cover changes. It was found that integrating visual interpretation with supervised classification led to increase overall accuracy by about 10%. Table (2) and table (3) represent the study area condition in 1989 and 2006, respectively. Comparison of Tabriz maps in 1989 and 2006 (Figures 2 and 3) demonstrated that the study area has undergone a very severe land cover change as a result of mismanagement and economical condition (fig. 2 and 3). A considerable increase in human building has taken place as well as degradation of green spaces.

Table 2: Study area condition at 1989

	LSI	ED	TE	LPI	PD	NP	PLAND	CA
City green space	11.9889	14.9249	61080.87	0.9807	2.5656	105	3.9112	160.0675
Buildings and Municipality lands	22.2364	33.8197	138408.5	2.4626	5.058	207	5.9216	242.3444

Bare lands	9.412	36.8352	150749.2	37.452	1.6127	66	39.2863	1607.805

Table 3: Study area condition at 2006

	LSI	ED	TE	LPI	PD	NP	PLAND	CA
City green space	18.6465	20.9984	88536	0.5464	5.6685	239	3.3251	140.1984
Buildings and Municipality lands	23.2432	88.092	371424	37.3484	1.257	53	37.6544	1587.629
Bare lands	35.9554	64.2532	270912	1.1352	20.6104	869	8.4071	354.4704

The main causes of land degradation in the study area were conversion of green spaces to bare zones, and bare zones to buildings. This problem showed to be continued for disclimax and needs to be seriously studied through multidimensional fields including socioeconomy. In the other words, environmental evaluation and new planning for ecosystem management seems to be necessary.

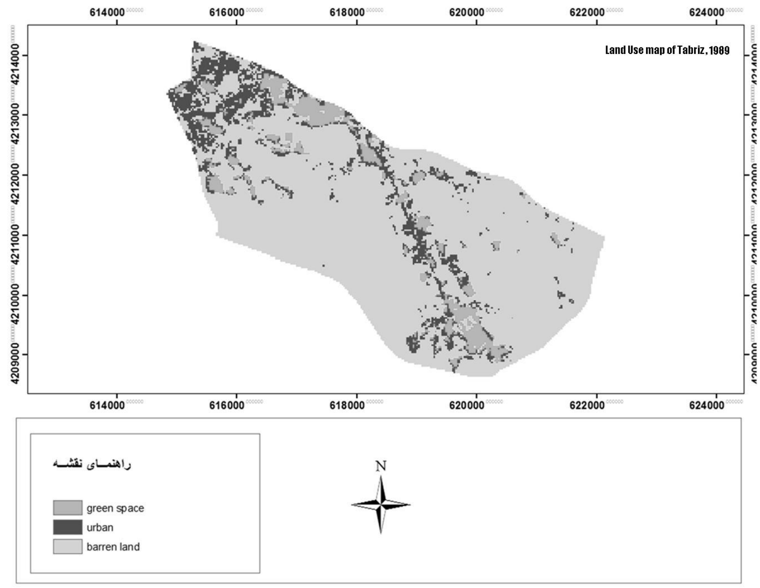

Fig. 2: Land use map of Tabriz in 1989

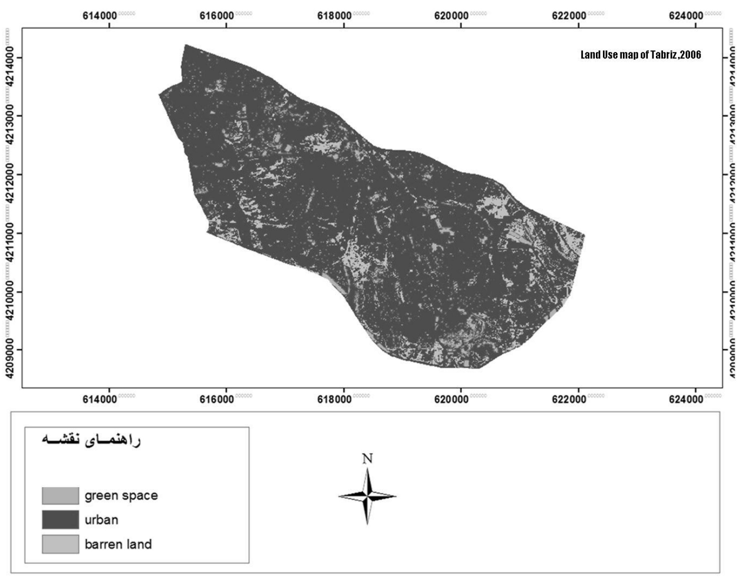

Fig. 3: Land use map of Tabriz in 2006

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