



New investigation on Study of Green Space Capita of Tehran City Using Satellite Data

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ABSTRACT

The remote sensing technology combined with geographic information system can present reliable data around green space changes. Analysis of spatial development and temporal variations of green space using the data resulted from remote sensing is of special importance in urban planning. In this study, green space of Tehran was classified and the temporal changes of this green space were assessed using the provided IRS satellite maps belonging to 1998 and 2006. These changes showed that the green space area has significantly increased from 900.9 acres in 1998 to 1200 acres in 2006 and the area of urban service lands has increased from 2753.5 acres in 1998 to 3551.7 acres in 2006 in the region. Also, extent of the wastelands has had a strong downward trend from 2157.6 acres in 1998 to 959.4 acres in 2006. This study confirms that using satellite remote sensing and geographic information system is an effective approach for analyzing the rate and spatial pattern of changes in land cover.

Key words: Green Space, Remote Sensing, Supervised Classification, Satellite Images, Tehran.

INTRODUCTION

Nowadays, rapid increase in population, urban development and limited natural resources has faced the human being with such problems that the planning is considered as a necessity for all countries (Lenson, 2005; Hashemi, 2011). So that, development of the cities specifically the great cities in the third world countries has a direct relationship with intensification of negative effects of increasing urbanization development and physical development of the cities. Population increasement cause increase of construction in the city and creation of industrial, business and residential centers, inhibited migration, suburb making, marginalization and rising demands for urban lands which themselves set the ground for destruction of green spaces within the city and changing the use of this types of lands (Hui 2006; Aida 2007; Kolehmainen *et al.* 2008). Studying the percentage of green space changes during different periods of time reveals the dispersion rate of these

changes, considering that frequent survey of the urban green space land in addition to enormous costs is also very time consuming. Therefore, studying the urban green space using satellite images, because of having time series and being updated has high accuracy and rate and lower costs that eventually with conducting some processes on the satellite images using geographic information system software, it leads to study and updating (Lenson 2005).

This research aims at studying the rate of green space changes as one of urban land uses and its reasons during last decade, applying IRS satellite images.

MATERIALS AND METHODS

This area is located in Northwest of Tehran in Eastern longitude of 51 degrees and 17 minutes and 30 seconds to 51 degrees and 19 minutes and 56 seconds and Northern latitude of 35 degrees and 41 minutes and 59 seconds and to the extent of

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5901.1220 acres. In this conducted research, IRS satellite images related to 1998 and 2006 taken for changes to green space were used. The important considered point is that the provided images are

related to the growing season. The IRS satellite images from 1998 and 2006 have been respectively presented in fig. 1.

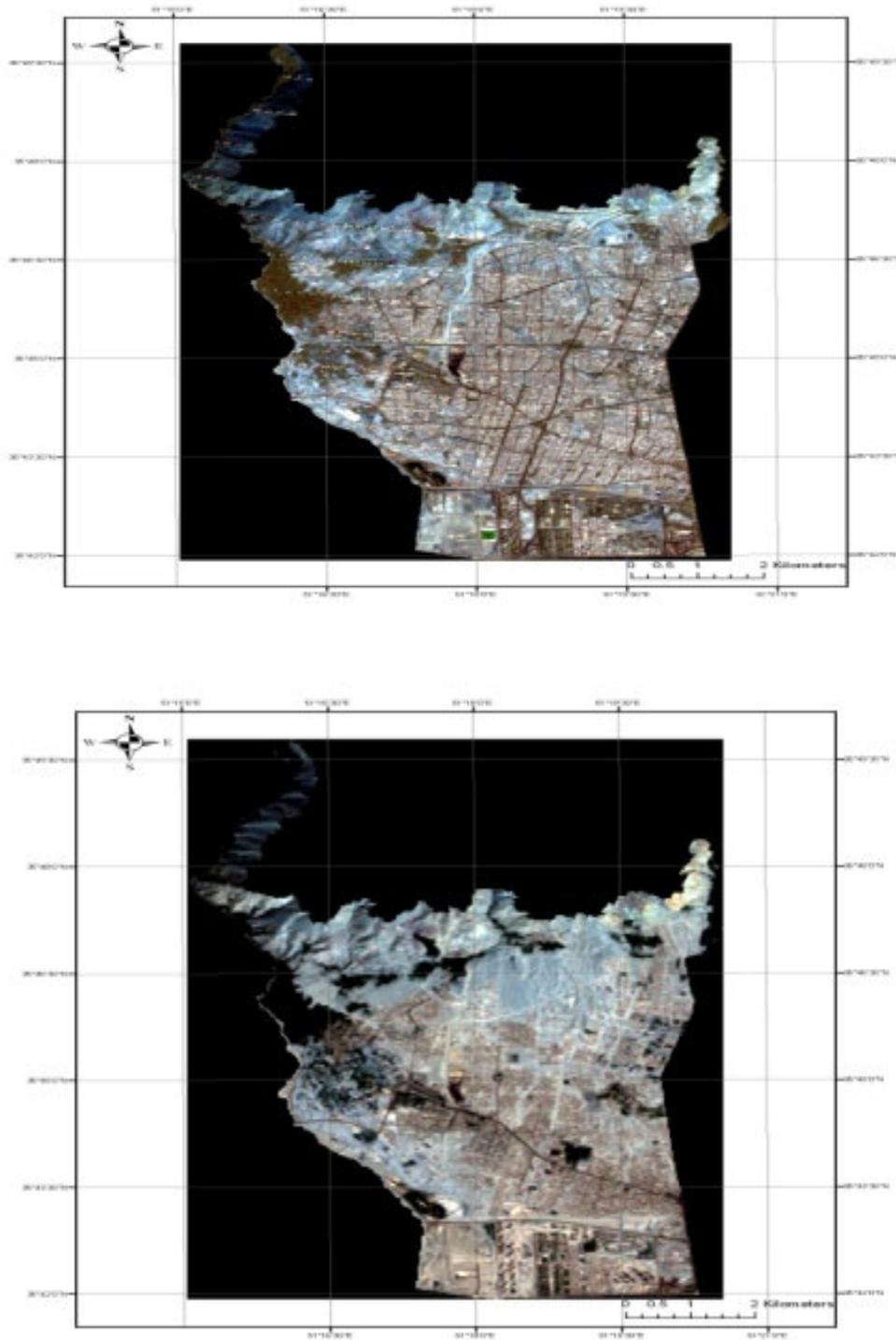


Fig. 1. IRS satellite image in 1998 and 2006.

These images were prepared and processed after provision, and then geometric and atmospheric corrections were made on them:

Geometric Correction: the images used in raw form have image coordinates and in order to use them as maps, they need geometric correction or geo referencing.

Atmospheric Correction: in the upcoming research, the used images do not have the problem of cloud covering or other abovementioned problems and consequently no atmospheric corrections have been made on them. As we know, the amount of radiant energy absorbed by water in infrared spectral range is very small (1.5 to 0.7 micrometers) and almost zero, because in mentioned spectral range the reflection rate is so high.

NDVI Index:

NDVI is an index that shows the greenness and density of green space rate of the study area. These rates include good, moderate and weak greenness and no vegetation. The changes in value of this index are next to each picture, the changes range from +1 to -1.

The Results from Interpretation of Vegetation Maps of District 5 of Tehran Municipality:

By applying NDVI Index for IRS image and considering the obtained histograms, the vegetation maps of district 5 of Tehran municipality were provided. In the research conducted for studying the green space changes of Tehran's district 5 municipality, through preliminary familiarity with the study area, visual study of the images by making a true color combination, the results from performance of the supervised classification, performing filed operations and also using 1:50000 map of Tehran, it was determined that the following applications have been existing in the area and they are also separable visually on the images. These applications are:

Urban and service lands, green space, wastelands and unused lands.

It should be mentioned that by urban and service lands class, we mean all of the constructed residential lands, streets and highways. By identifying the user classes in the area, in order to study the green space changes, maps of the land use were provided in each studied periods of time using the supervised classification method, the likelihood maximum method.

RESULTS

The results of supervised classification method have been presented in images from 1998 and 2006. The image of NDVI plant index in 1998 and 2006 was also presented respectively in figures 2 and 3.

Study of the Green Space Changes of the Area: Results from Interpretation of Land Use Maps of Tehran in 1998:

In 1998, the urban-service lands class has devoted the maximum area of district 5 to itself. Also, the extent of wastelands and unusual lands and green space is considerable in order of extent. In this season in order to obtain results, first the maps of altitude, slope and direction were provided and then the results from the supervised classification in two periods of 1998 and 2006 were interpreted.

Comparison of the classification of the Images from 1998 and 2006:

Considering the process of changes, different land use classes have been compared in 3 studied periods of time (Table1).

Above table implies that the changes in extent of urban-service lands under the studied period of time, follows an upward trend. It is notable that it has been more severe between 1998 to 2006. Observing the above-mentioned diagram, the gradual process of increase of green space class extent during 1998 to 2006 is determined. It can be said that this process has a steady increase rate during the study period. Therefore, according to table (1), different classifications of Tehran's lands can be expressed as follows:

As it has been specified in above table, the increase process of green space and urban-service lands classification has been increased from 1998 to 2006 and the extent of wastelands has been increase from 1998 to 2006.

DISCUSSION AND CONCLUSION

Nowadays, the necessity of preservation, maintenance and development of the green space has become more tangible every day for myriad reasons and it is considered by people and officials with more significance. Today, a good and targeted management of the resources and the environment

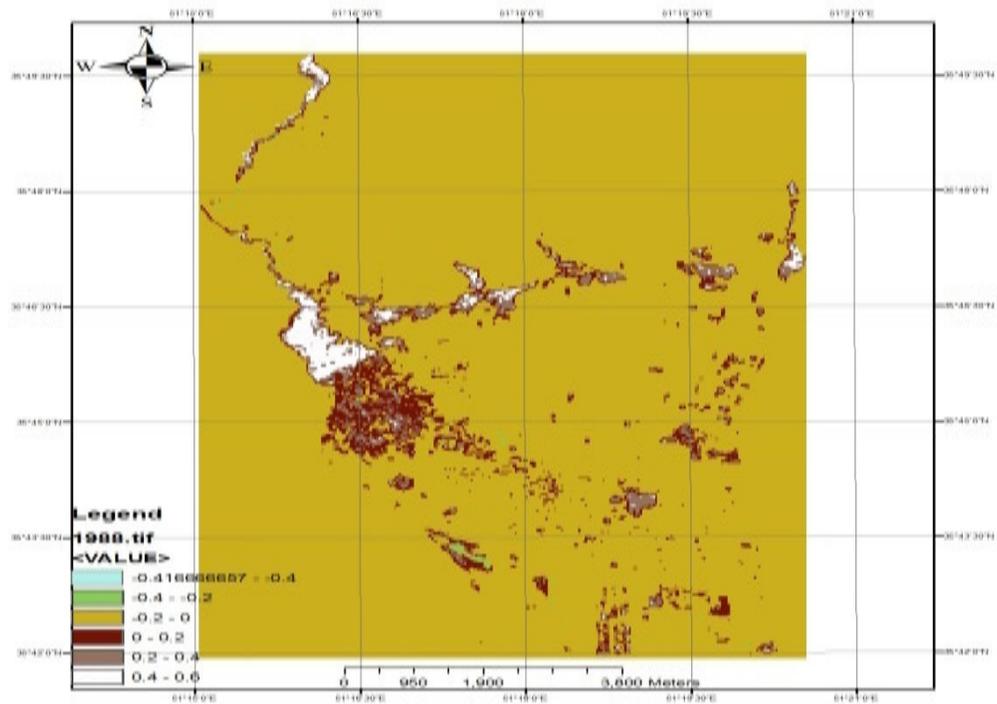


Fig. 2. The Vegetation Density of District 5 of Tehran Municipality in 1998.

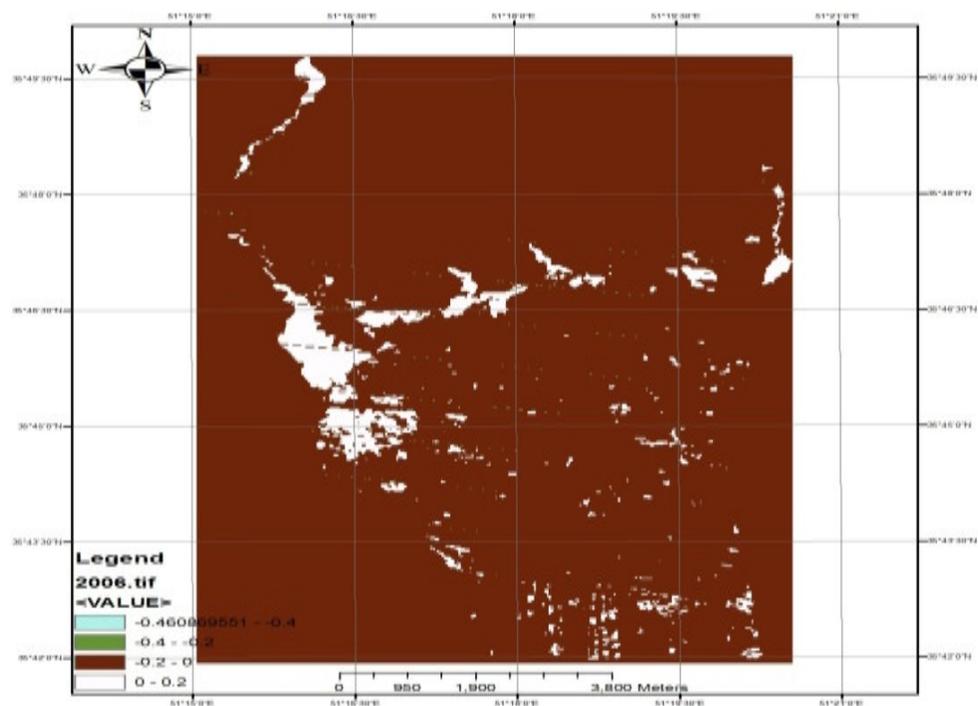


Fig 3. The Vegetation Density Map of District 5 of Tehran Municipality in 2006.

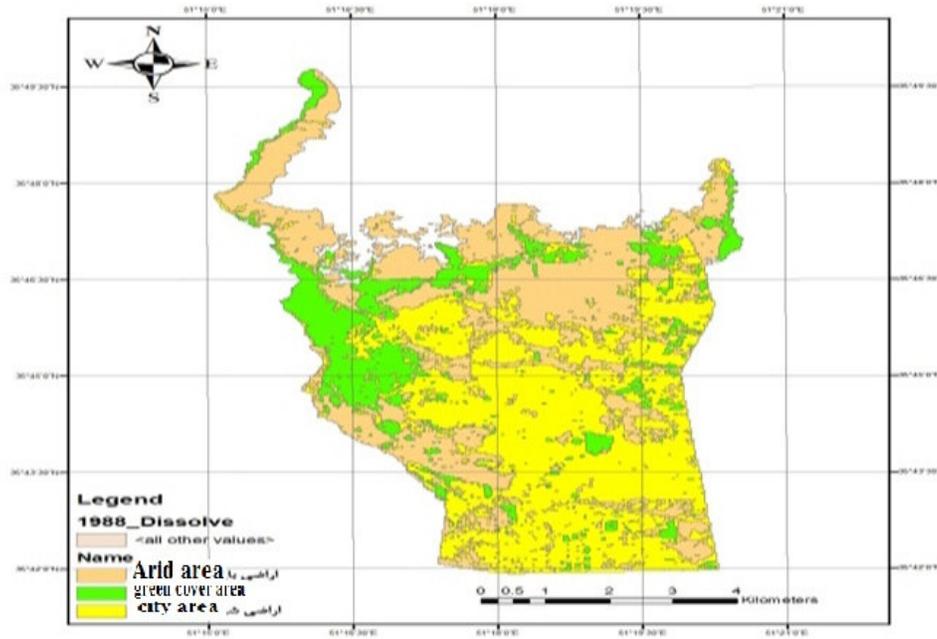


Fig. 4. Land Using Map of District 5 of Tehran Municipality in 1998

Table 1. Changes in different classifications of the lands.

	1998	2006
Area of the region (acres)	5901.1220	5901.1220
Area of green space lands (acres)	900.9	1220.6
Area of urban service lands (acres)	2753.5	2915.7
Area of wastelands (acres)	2157.6	1715.7

without proper awareness about amount and rate of the occurred changes is a difficult job. Awareness about these changes by the decision makers and the planners causes correct guidance of the policies in order to reduce its crisis. For studying these changes during the time, the most effective and economic method is using satellite images so that, the data extracted from these images determine assessment and study of the change rate during the time. Also in Tehran metropolis, considering the increasing population growth, uncontrolled migration increase of the constructions and factors like this, study of the changes in land use and specially the changes made in green space seem

important. In this research, NDVI index has been used for studying the qualitative changes of green space of the study area. In this regard, aimed at increasing the accuracy of vegetation maps, NDVI index values based on spectral changes of vegetation and considering the histograms resulted from application of this index in each period of time, it was determined that the quality level of Tehran's green space has been downward. A similar research studying the temporal changes of vegetation quality has defined the different classes of greenness (very good, good, moderate, weak, very weak and no vegetation) into 6 NDVI classes

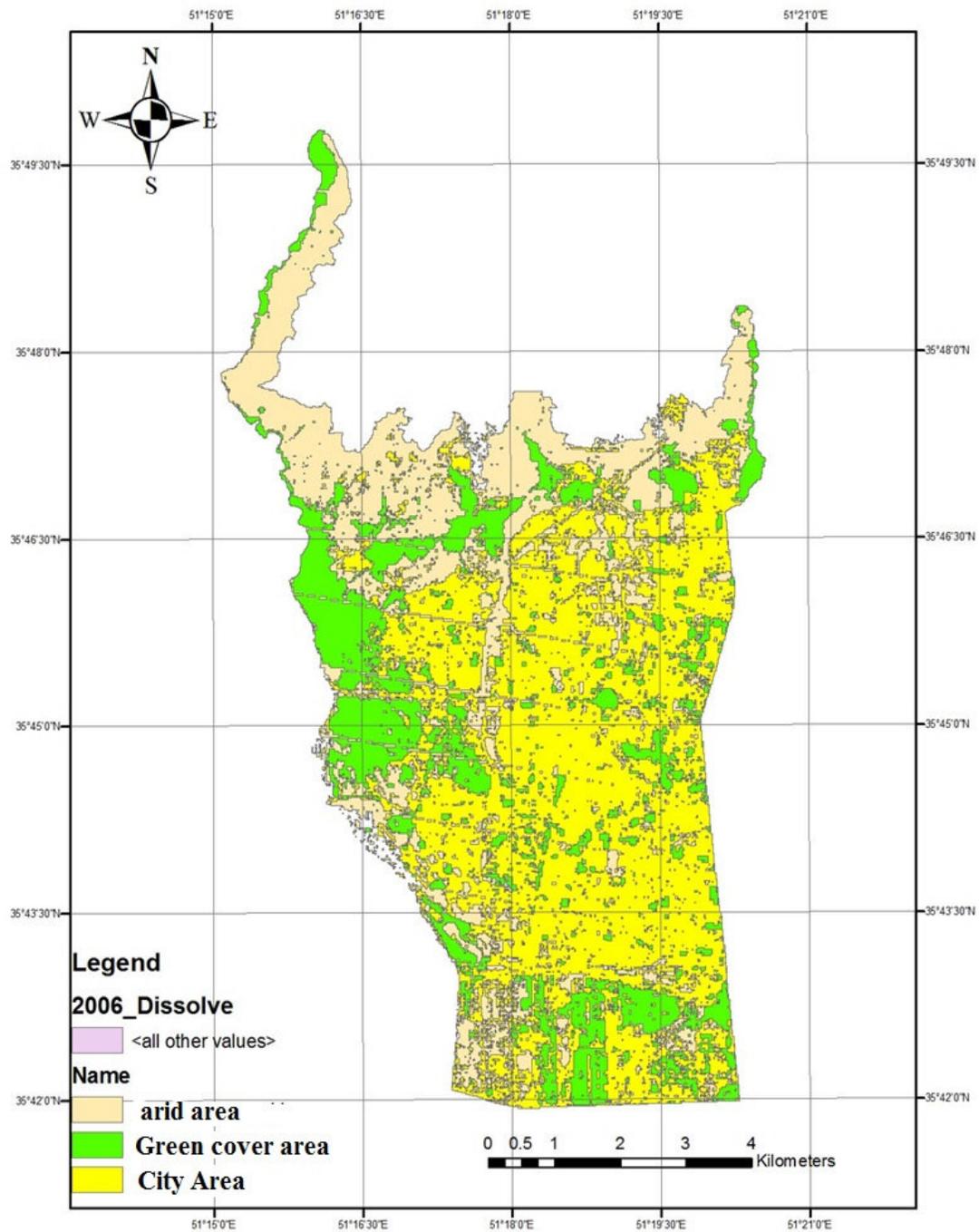


Fig. 5. Land Using Map of District 5 of Tehran Municipality in 2006.

based on values of normalized differential vegetation index and classified them into equal numerical values (Xion 2007). Results of the study show that vegetation quality level of Yazd city had negative changes between 1990 to 2005. So that, the area of vegetation has been decreases in all greenness classes and area of the regions with no vegetation has been increased.

Also in second part of the conducted study around green space changes of Tehran, aimed at studying the quantitative green space changes of this area, using satellite images and aerial photos, the land use maps were provided in each periods of 1998 and 2006 and then area of each land use classes were compared to their corresponding classes in two periods of time. The results from comparison of obtained statistics considering diagram (2) imply the increase in green space extent in district 5, so it shows that the extent of this class has been increased from 900.9 acres in 1998 to 1220.6 acres in 2006. The best time for monitoring vegetation changes using the data from remote sensing is when the chlorophyll has reached its peak and the light intensity is also high. Necessarily, images with high resolution should be used to obtain an acceptable result (Zhu 2003). But the important point is that according to what the calculations show, capita of green space in Tehran during the study period has been downward. It 1998, the green space capita is 17.34 square meters and in 2006 it is 19.39 square meters, of course it should be noted that the rate of green space capita in Tehran municipality in 22 districts is 12 cubic meters in 1384 which implies that the capita of this area is higher than the standard level.

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