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Studying the inventory of Canopy cover trees using Ikonos images (Case Study: City of Sari)

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ABSTRACT: Urban forests are an indicator for establishing cities and due to the green space that they provide, other than environmental effects, they have important aesthetic values. Trees have the most important effect on green space on the weather of cities and the larger the area of forested land, the more positive outcomes it will have, in this study, a systematic random inventory method and satellite images of Ikonos (scale of 1:2000) in Google Earth software were used and compared to estimate the canopy area of trees in Maziyar street in Sari, Iran, in order to evaluate the accuracy of satellite imagery for estimating canopy area of street trees. The results of paired t -test (df = 118, $\hat{t}$= 1.20) showed that the result of the two methods was not significantly differed in a 95% level. The results of regression analyzes indicated that using Ikonos images (R^2= 0.96) was suitable for estimating canopy area on the street.

***Keywords*:** Ikonos images, green space, canopy, inventory.

INTRODUCTION

With increasing population and technology development in urban communities, the needs to improve and develop urban green spaces for air sublimation and improvement and city beauty is felt more than ever. So, dynamism, vitality, continuity and survival of a city depends on a series of principles specified urbanization, which is one the most important principles in developing green spaces. In recent years the idea of reclaiming urban area from congestion and pollution has gain more attention and authorities are looking for solutions to reduce these problems. The urban forestry and related professionals, by planting trees and enhancing the natural environment in the city play an important role in reducing various pollution and stress due to urbanization in urban ecosystems and insist on the importance of these issues, tree planting and green space increasing. Designing and management of urban forests can use as a natural biotechnology for reducing some undesirable environmental effects which are with urbanization case, which could be resolved by long-term planning and policy (Zare,2008). The area of green space in big cities is significantly growing faster, which this requires optimize management to economize the cost of mapping, construction development and maintenance of green spaces. In this regard, one of the most important issues in decision-making is to have accurate and update statistics of the trees and grass area in the urban green space as well as their geographical location, which helps in costs reducing of the green space organizations (Nourian,2001). Now, with the advancement of technology, satellite data due to the repeated cover, integration of information, data providing in different parts of the electromagnetic spectrum and using hardware and software tools has gain great interest in the world (Zahedifard ,2004). Today, the use of satellite data is a good way for evaluation and comparison of vegetation at different times. Given the high capabilities of satellite images such as timeliness, multi-spectrum and repetitive, spacious coverage and increasing in the spectral and spatial resolution, they can be used for earth study (Chitsaz,1999). Today, the advantages of working with remote sensing data have attracted the attention of many researchers and have led to the development of technology. Remote sensing techniques in comparison with other methods of producing information, has several advantages such as increasing the speed of

information gathering and cost reducing. According to its great efficiency such as sensors variety and their data, the spectral variation of data, increasing spatial and spectral resolution, easily accessible, extensive, and repeated imaging, which provides timeliness images and it has also eliminated the difficulty of area access in land methods and provides a good coverage of the area. Therefore, the cost of operation would reduce and it is economically efficient, because this technique requires less labor and limited land operations. In connection with the inventory of the urban forest, numerous studies have been conducted so far. Jahani (1998), The estimation methods of vegetation in urban studies using remote sensing data is dealt with. In this study the main capabilities of remote sensing data in the evaluation of urban green spaces as an important element of environmental noted. Teymori (2008), examines the current status and potential of urban forestry with GIS (Case Study of Tehran Municipality Area 2) is addressed in this study Ikonos of satellite and aerial ability to learn and calculate the surface condition of vegetation in urban area Green space area in the North West of Tehran area of 538 hectares was used. Also (Jafari, 2010) in a comparative study between land inventory and QuickBird images for quantitative estimation of some characteristics of the urban forest, which is part of Region 5 of Isfahan, showed that the estimation of canopy the street with images satellite is more accuracy. . In the third Tehran to investigate the potential of satellite imagery Geo Eye and various methods of inventory land estimate canopy street is about the results of t-test analysis indicated amounts of inventory entirely ground and Audio Geo Eye Not significantly different from each other(Golshani2011). The purpose of this study was to compare the estimation accuracy of the canopy area of trees on road verge using Ikonos satellite images in Google Earth software and systematic randomly sampling in the area, as well as to achieve an appropriate inventory method for estimating canopy area and acceptable results for planning by spending optimal time and cost.

MATERIALS AND METHODS

In this research, the study area is located in the city of Sari. This city is located between 53 59 longitude and 36 50 latitude and the average elevation is 132 m above sea level. In this study, the trees on Maziyar Street were chosen because of the suitable tree canopy. Trees on two sides of Maziyar Street, which are located around Imam, Hossein Square, were randomly selected and measured. In addition, the satellite imagery of the study area on (14 july2007) were used. The used land measuring method to estimate the canopy area was systematic random sampling for determining the canopy area. First, after field visiting, trees on both sides of the street were systematic randomly selected and large and small canopy diameters were measured. In addition, the correlation between these two variables (large and small canopy diameter) was investigated. Equation 1 was used to calculate the canopy area.

Equation 1

$$CA=\frac{\pi \times D1\times D2}{4}$$

CA = tree canopy area (square meters)
D_1 = small diameter of tree canopy (m)
D_2 = large diameter of tree canopy (m)

In this study, after the preparation of these images, preliminary processing and detection including radiometric corrections, atmospheric and geometric correction were accomplished. The Dark Subtract was used to remove atmospheric errors, and towards the area zone (UTM zone 39N) were georeferenced (Figure 1).

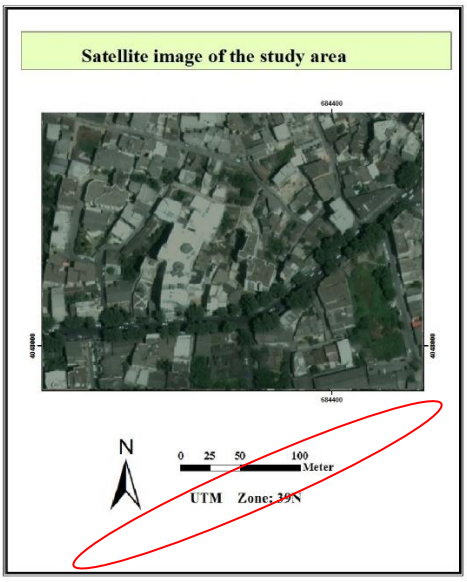

Figure 1. Ikonos image in Google Earth database of the study area

After corrections, with the help of these images, the canopy areas were initially determined in the Arc GIS software, version 10 and then the area of tree canopy on each side of the street assigned. Eventually, by transferring the obtained canopy areas to the SPSS 17, data analysis was conducted (Table 1).

RESULTS AND DISCUSSION

Results

Estimating canopy area:

Descriptive statistics including sample number, mean, standard deviation and standard error of collected data of canopy area from land inventory and satellite images is presented in Table 1.

Table 1. Statistical Information of trees canopy

Street name	Tree canopy	Mean (m^2)	Standard deviation (%)	Standard error (%)	sample number
Maziyar	land	*79/05*	52/32	6/44	*60*
	image	60/54	41/29	6/17	*60*

In this research, before conducting calculation and data analysis, the normality of distribution was assessed by a Kolmoogrov- Smirnov test. The test results showed that all data had a normal distribution. For comparison of the obtained area from a random land inventory and Ikonos images, paired t -test at 95% confidence level was used. The result (df= 118, $\hat{t}$=1.20) indicated that there was not a significant difference between the two methods at 95% confidence level.

The depicted diagram illustrates this fact (Figure 2). The results of the regression analysis also showed that satellite images with a coefficient of determination of 96% (R^2= 96%) indicated that by using the data of this study, the canopy area of street trees could be estimated on with high precision on the Ikonos images (Table 2).

Table 2. coefficient of the depicted model on the study area

Street name	model	R^2 Coefficient	r Coefficient	Statistic model
Maziyar	linear	*0/96*	*0/97*	Y= -9/451 + 0/9681x

In Table 2, results of analysis of variance table and coefficients test represent that, existent images could be used to estimate tree canopy area. In Figure 2 the scatter plot is depicted which the Y and X axes are canopy area on the ground and on the satellite image, respectively.

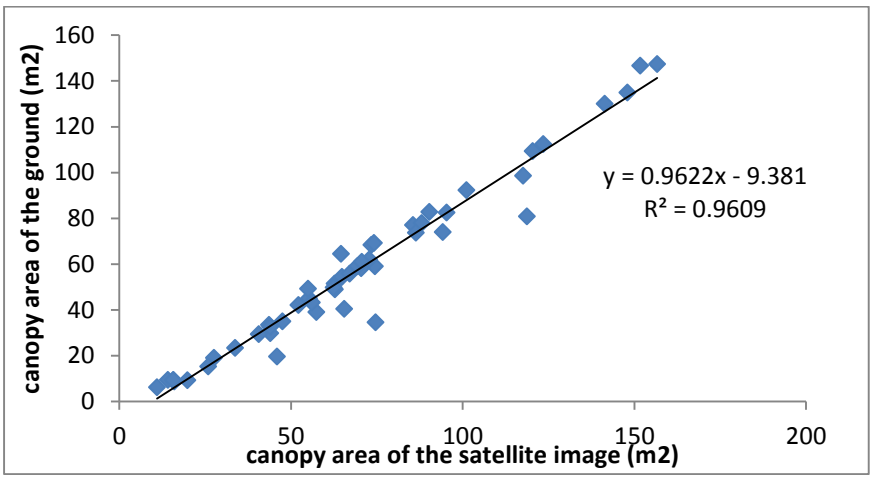

Figure 2. The relationship between land canopy and satellite imagery on Maziyar Street

Measuring the large and small diameters of study trees canopy

Large and small average diameters of tree canopy on the study street were estimated by land measuring which are listed in Table 3.

Table 3. Statistical characteristics of tree canopy diameter on the study street

Street name	Tree diameter (m)	Mean (m^2)	Standard deviation (%)	Standard error (%)	sample number
Maziyar	Large diameter	8/38	4/69	*0/47*	*60*
	small diameter	6/40	4/21	*0/41*	*60*

The results of calculations of the land sampling method indicated that there was a significant difference between trees mean large diameter and canopy small diameter at 95% level on the Maziyar (Table 4).

Table 4. mean Comparison of tree diameter (t-test)

Street name	Statistic t̂	df	Two-way significant level	Mean difference (m)	Standard error m	Low limit at 95% level	top limit at 95% level
Maziyar	4/162	*118*	*0/00*	*1/98*	*0/63*	0/64	*2*/32

Discussion and conclusion

Today urban forests play an important role in improving urban environmental quality. The importance of green spaces in the urban environment is considered to be one of the development indicators of communities (teymori .,2008). Tree Protection Plan and Management Strategy is not only based on the conceptual understanding of urban trees and the on trees health, but it is based on the duty of politicians in managing the urban forest. The common method to measure green space is land measuring. Since these methods are very costly and time consuming (rafieian ., 2006) Ikonos images were used for this purpose. The purpose of this study was to assess the accuracy of Ikonos images in estimating canopy area in urban green spaces. To obtain the area and distribution of green space in urban areas is one of the main issues in planning and urban management (Simpson ., 2005). These results are in agreement with (jafari, 2010), (golshani,2011) which suggests that the use of satellite imagery processing techniques has a high efficiency in urban green space and it could be used as an appropriate tool for urban management with less time compared to the land method. Results of Table 4 in measuring large and small diameter of trees on both sides of the study street showed that there was significant difference between large and small diameter, which the reason was probably the tree pruning on the street to reduce nuisance for buildings, electricity and telephone poles. In addition, trees tend towards open space in the street can be the other reason. It should be noted that the planting space between the trees in the study street was very low therefore, the possibility of trees canopy towards street width is limited due to the competition. According to the rapid changes in land use in urban environments, updated information about trees canopy area is necessary. So today, by developing satellite data with high resolution that can be produced in a short period, green space managers can use this data as a useful tool for monitoring changes in the trees canopy. Also, using remote sensing data in the estimation of trees canopy area on the streets, boulevards and etc would reduce the risk of probable incidents such as car accidents during inventory.

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