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Investigation of Quickbird Satellite Image Capability in the Separation of the Canopy of Zagros Forest Trees

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ABSTRACT

Aims 2005 DashteBarm forests of Fars province image is used to investigate and evaluate the capability of Quickbird satellite imagery to differentiate tree canopies regions from no-tree areas.

Materials and Methods First, the validity geometric correction of satellite image was assured. By systematic random sampling, 79 square footages of (20*20) in ARCGIS 9.3 software was designed and on the footages' places of the combined image from Quickbird panchromatic band and multispectral band, the samples of no tree canopies and tree canopies areas was obtained. Then, 20% of the footages were considered as test samples and the rest was studied as training samples. In the next step, processes on a multivariate image were performed by ENVI 4.3 software and some indexes such as NDVI, GNDVI, RVI Partial Component Analysis (PCA) were created and integrated and were combined. Then, two classifications on the original image and processed bands with two methods of maximum likelihood and Support Vector Machine (SVM) were categorized, in which the images were classified into two classes of trees and non-trees.

Findings Evaluation of the classified images using the test samples showed that the accuracy and Kappa coefficient in the classified images of the original bands were 94.478% and 0.789 for the maximum likelihood method and 94.848% and 0.877 for the support vector machine, respectively. Also, the results of the processed band's classifications by maximum likelihood and support vector machine methods showed that these images have 94.274 and 94.683% accuracy and Kappa coefficient of 0.875 and 0.882, respectively.

Conclusion: The results of this study show that the Quickbird satellite image is suitable for separating tree canopies and no tree canopies areas in Zagros forests and similar areas.

Keywords Quickbird Image; Remote Sensing; Tree Canopy; Zagros Forests

CITATION LINKS

[1] Forest ...[2] Determination of the appropriate area and shape of the sample plot in the canopy estimation using forest simulation ... [3] Estimating defoliation in boreal coniferous forests by combining Landsat TM, aerial photographs and ... [4] Investigation of changes in range of Zagros forests using aerial photographs and satellite images ... [5] Surveying mountain pine beetle damage of forests: A review of remote ... [6] Investigating the possibility of recognizing the distribution of crown princely trees using images with ... [7] Classification of forest types and estimation of its quantitative characteristics using satellite data in arid and ... [8] Estimation of Zagros forest conservation characteristics using combination of satellite images and aid data (Case study of forests around Ilam city) ... [9] Investigating the capability of Landsat7 satellite data to estimate coverage and plant production ... [10] Investigating the capability of satellite data with different spatial resolution with emphasis on spectral indices in the separation ... [11] Investigation of desertification and land degradation of Damghan plains using satellite ... [12] Preparation of rangeland vegetation map using IRS-LissIII satellite ... [13] Investigation of LissIII Data capability for mapping Map of Zagros forests ... [14] Investigating satellite data capability in mapping the canopy cover percentage of arid and ... [15] TM imagery capability in detecting burned forests ... [16] Environmental impact exposure development using satellite ... [17] Classification of forest areas of Golestan province by maximum ... [18] Investigation of IRS-P6-LISS-IV image capability for storing pistachio wildlife ... [19] Investigating the possibility of tree crown degradation by using Quick Bird satellite ... [20] Investigation of the relationship between diameter and height of trees with ... [21] Detection of forest decline using IKONOS sensor for cork oak ... [22] Preliminary study on the drying of Iranian oak trees ... [23] Evaluation and comparison of the supporting machine carriers with linear, polynomial and radial kernels with artificial ...

Introduction

Forests are of great importance to human life and play an important role in climate regulation and soil conservation, covering about 25% of the Earth's surface [1]. Zagros forests, classified as semi-arid and semi-Mediterranean climate, with 5 million hectares account for 40% of total Iran's forests [2], play the most important role in water supply, soil conservation, climate modulation and economic and social equilibrium throughout Iran [3]. These forests with one-fifth of Iran's land, are occupied by one-third of Iran's population and have guaranteed survival and sustainability of soil and water of the country [4]. Obtaining accurate quantitative information of these forests is very valuable for proper management and preservation of these resources [5]. Quantitative characteristics of forest stand such as volume, average diameter, and height, the number of trees per hectare, amount of tree canopy, cross-sectional area, and age are important data for assessing forest resources. Management of natural and human resources requires accurate and efficient methods [6]. Alternative methods with lower costs and acceptable accuracy levels from various scientific achievements are always preferred [7]. Due to increasing remote sensing and geographic information system improvements, exploiting these methods can be considered as a suitable option to provide spatial and descriptive information [8]. Tools and auxiliary techniques, like digital satellite data, in conjunction with ground measurements, are used by natural resource management specialists to provide information such as coverage and plant production on these resources [9].

Over the past three decades, vegetation indices have been widely used in natural resource surveys and vegetation monitoring on small scale to regional and global scales [10]. In different regions, different indices according to the earth's surface specifications and the number of tree canopies, are used to describe vegetation [11]. Therefore, it is important to use vegetation indices when examining the status of tree canopies.

Based on the above-mentioned information, one of the applications of remote sensing and satellite images are classifying tree canopies and categorizing them for different regions. Extensive research has been done to investigate tree canopies by using satellite imagery and evaluating the capability of images in different regions [12-17]. In this regard, Noorian and Shataee examined the ability of satellite data with different spatial resolutions, with emphasis on spectral indices in the separation of pure forestry forests in the Shastkolateh of Gorgan forest concluded that the use of Quickbird satellite data is more appropriate than ASTER and TM data in differentiating different phenomena [10]. In a research study entitled IRS-P6-LISS-IV image capability to prepare a large map of wild pistachio forests in Khawaja-Kalat Khorasan forest, Hosseini *et al.* indicate that due to the inadequate outcomes, these data are not suitable to produce a large map of wild pistachio forests [18].

In a study in Golestan province, Barazmand *et al.* examined the possibility of Quickbird satellite imagery usage with various vegetation indices such as NDVI and TNDVI to recognize tree canopies morbidity. The results of this study display that it is not possible to identify all broad-leaved trees by using these images due to the reflection of the crown cover of shrubs and plants, and low contribution of the dried branches in reflection [19]. Bruce *et al.* studied the capabilities of the IKONOS 2000s and aerial photographs of 1988 in the ecological diversity of rainforest and land use classification, as well as determination of the damaged crown trees in a surface of about 600 hectares and concluded that satellite images with high spatial resolution could be useful in measuring the growth, tree position and mortality during a period [20]. Heikki studied quantitative and qualitative evaluation of forest characteristics in Suonenjok region, Finland, by using high-resolution IKONOS images. The results of this study indicated that IKONOS data had desirable accuracy to estimate the qualitative characteristics [3]. In examining the precision of the IKONOS images in determining the dieback of oak trees in southern Spain, the results of Cano *et al.* showed that there is a correlation of 0.85% between the results of the satellite data interpretation and the reality, which is proved these Images can be useful to check oak tree dieback [21]. In a literature review by Wulder *et al.*, the capability of various satellite data in estimating pine forest pest damage was investigated. The survey results show that images with average spatial resolution can produce a large-scale forest damage map with a total accuracy of 70 to 75%.

They also indicated high-resolution spatial images can provide a forest health map with an overall accuracy of 71 to 92%, depending on the various degradation classes [5].

Therefore, the aim of this study is to investigate the capability of Quickbird satellite imagery with high spatial resolution, in separating tree canopies from no tree areas in the forests of DashteBram, in Fars province.

Materials and Methods

Study area: The study area is located in Kohmareh of DashteBarm of Kazeroun in Fars province with the area of 5,106 hectares and in the geographical range of 51°.49'.36" to 51°.55', 37" eastern longitude and 29°.31'.14" to 29°.36'.34" northern latitude (Figure 1). The minimum altitude in this area is 1200 meters and its maximum is 2900 meters above the sea level. The dominant geographic direction is south and southwest. The average annual rainfall is 696mm, and most rainfall is from the rain in the winter. The wet period of the year is from November to April, and other months include the drought period. The minimum temperature is reported around 2°C and its maximum recorded is 45°C in the region [22]. Land types in this area consist of mountains type with 5 parts of the land unit, hill type with 3 parts of the land, pebble-shaped floating trenches with 3 components and pebble-shaped floating alluvium with 3 units from the total 14 elements of the identified land areas. The dominant geological formation in this area is Jahrom Asmari lime. In this area, Iranian oak trees (*Quercus Brantii*) are the dominant species and shrubs species such as almonds are also found in the region and in the altitudes. The trees in this area have been affected by the decay of oak trees since 2009, and a significant percentage of them are dead (Figure 1).

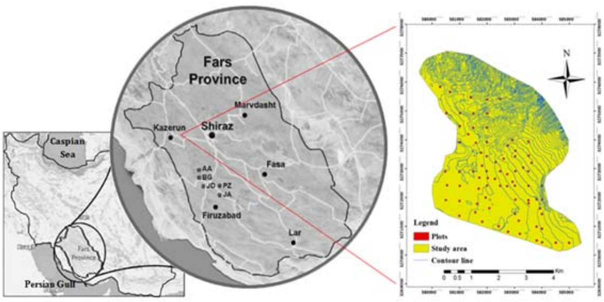

Figure 1) Location of the studied area in Kazeroon, Fars Province, Iran

Research data: In this study, the Quickbird satellite image of July 1, 2005, was used with a spatial resolution of 2.4 meters for multi-spectral bands and a 0.61-meter panchromatic band that had previously been geometrically corrected.

Research Methodology: After visiting the study area, in the ARCGIS 9.3 software environment, 20m by 20m square were plotted with 500 meters distance from each other. As per Figure 2, 79 plot samples were planted with 400 square meters in the study area (Figure 2). First, to ensure correction of the image, small areas, roads and communication paths in the area were taken and thrown on to the image. By doing this, it was determined that the image used had already been a geometric correction. Then, the multi-spectral and panchromatic strips of the image were combined with the Brovy method in ENVI 4.3 software. Samples were combined with a color image with a spatial resolution of 0.61 meter to improve the multi-spectral bands and visual perception of the samples. In the plots, tree canopies and no tree canopies have been taken as polygonal. Then, 80% of the samples were used as a training sample and the remaining 20%, as a test sample to categorize two classes of tree canopies and no tree canopies areas and imported in ENVI 4.3 software for classification. In order to investigate the capability and improvement of the classifications, indicators such as NDVI, GNDVI, RVI, and partial component analysis (PCA) are constructed in ENVI 4.3 software and integrated with HIS method (Table 1).

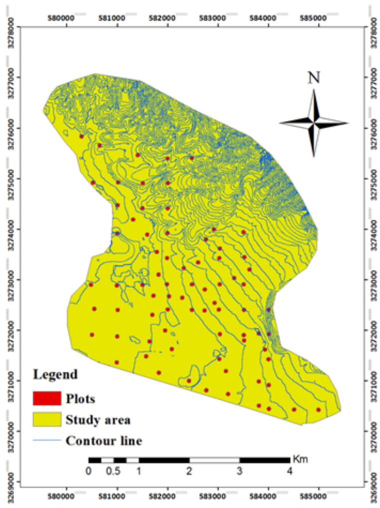

Figure 2) The studied area and the position of the plots

Table 1) The set of used indicators

Processed bands	Description
NDVI	$NDVI = \frac{NIR - RED}{NIR + RED}$
GNDVI	$GDVI = \frac{NIR - GREEN}{RED + GREEN}$
RVI	$RVI = \frac{NIR}{RED}$
PCA	The result of decomposing the main components for the three visible image bands Quickbird.

The classification was performed on the original image and the processed bands with two algorithms Support Vector Machine (SVM) and maximum performance, in which tree canopies and no tree canopies areas have been separated. Finally, for the purpose of checking the accuracy of the classification, the classification assertion was evaluated using test samples.

Findings

Resolution results of the training samples of plot sites, based on the Jeffrey-Matocity criterion and converted divergence, was 1.755 and 1.992 respectively (Table 2). These results show the degree of differentiability of the samples. The closer the result to 2, the higher the resolution.

Results of the accuracy assessment of the classified image of two classifications of tree canopies and no tree canopies areas with maximum likelihood method showed the overall accuracy and kappa coefficient for the main bands are 94.478% and 0.879 respectively and for the processed bands are 94.274% and 0.875% (Table 3) accordingly.

Also, the results of two-class classification with SVM show that the overall accuracy and Kappa coefficient for the main bands were 94.478% and 0.877%, respectively, and for processing, bands are to 94.683% and 0.882 (Table 4).

In Figure 3, the best classification images produced from maximum likelihood and support vector machine algorithms are presented (Figure 3).

Table 2) Results of tree and non-tree differentiation based on Jeffrey-Matocity criteria and converted divergence

Criterion/Floor	Jeffrey-Matocity	converted divergence
Non-tree/tree	1.755	1.992

Table 3) Validation results of the main and processed bands with the maximum likelihood method

	Original bands	Processed bands
Overall accuracy (%)	94.478	94.274
Kappa coefficient	0.879	0.875

Table 4) Validation results of the main and processed bands with the support vector machine algorithm

	Original bands	Processed bands
Overall accuracy (%)	94.478	94.683
Kappa coefficient	0.877	0.882

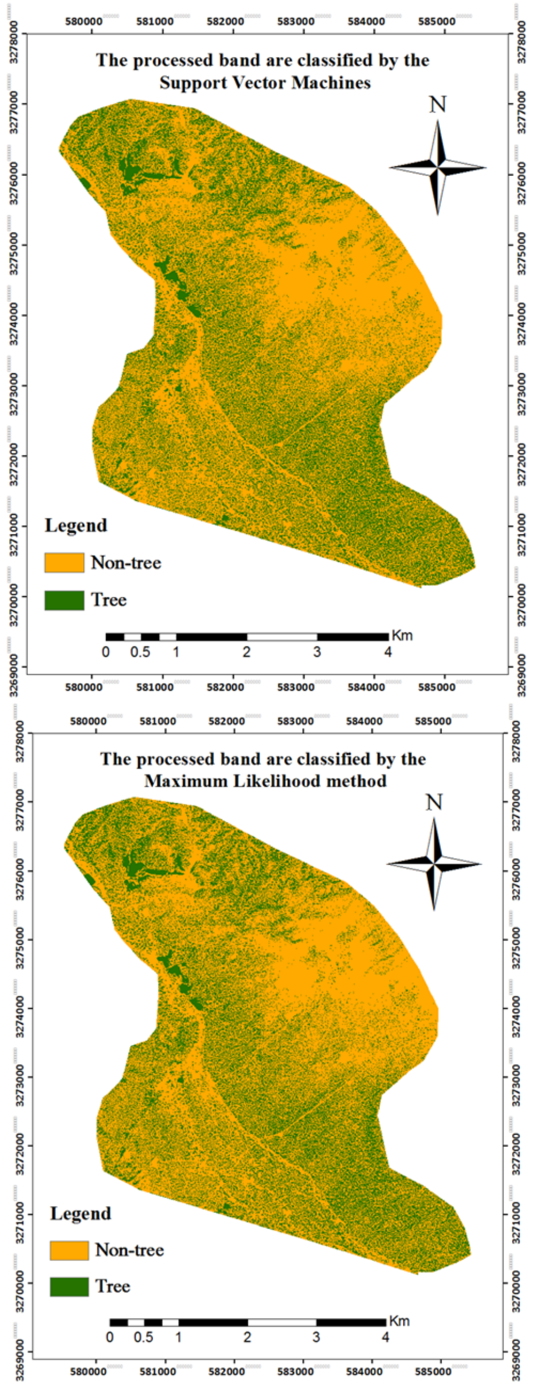

Figure 3) The best two-class classified images with maximum likelihood and support vector machine algorithms

Discussion

In this study, Quickbird satellite imagery (2005) using polygonal samples with maximum likelihood and Support Vector Machine algorithms (SVM) was investigated. By comparing the classification results of the main and processed band images, in maximum likelihood algorithm, the best results are obtained by the main bands with an overall accuracy of 94.478 and a Kappa coefficient of 0.879. Also, in Support Vector Machine algorithms (SVM), the processed band had the best results with an overall accuracy of 94.683% and a kappa coefficient of 0.882.

By comparing the results of two classification methods, the support vector machine algorithm yields the best results as this method, with small training samples, can accurately represent the classified image [23]. According to the overall accuracy and Kappa coefficients for both classification and for other images used in the high classification are of an acceptable level that can be considered with due regard to the importance and importance of work, all of them for the classification of areas with tree cover and non-Use the tree. The reason for this is the relatively high spatial resolution of the Quickbird satellite image.

However, the difference in the accuracy of the evaluated images for both algorithms used in this study is negligible, which can be attributed to the spatial resolution of the Quickbird satellite image in the separation of phenomena.

Based on the above, the Quickbird satellite image has a high ability to separate tree canopies from no tree canopies areas. Also, this result is in good agreement with the result of Noorian and Shataeejouibari´s study, in the suitability of Quickbird satellite data in differentiating various phenomena with ASTER and TM data [10]. Moreover, this study closely matches the previous research results of Bruce *et al.*, Heikki, Wulder *et al.* and Cana *et al.* studies in which they used images such as IKONOS with resolutions close to the Quickbird satellite imagery, with satisfactory and acceptable results [20, 21, 3, 5]. But the results of this study do not meet the results of research by Hosseini *et al.*, who used similarly to Quickbird image, and concluded that IRS-P6-LISS-IV image to produce the forest map of wild pistachio spruce in Khawaja-Kalat Khorasan forest, due to the lack of descriptive classification results [18]. Additionally, this result contradicts the results of Barazmand *et al.* in Golestan province, investigating the possibility of recognizing tree canopies dieback by using Quickbird satellite imagery, and finding that this image cannot properly distinguish tree's dieback [19]. The reason for this can be seen in the difference between the studied area and the vegetative conditions of the two regions. Because in the northern forests of Iran, dry trees cannot be separated with acceptable precision due to the presence of shrubs and grasses on the forest floor.

Conclusion

Overall, the results of this study show that the Quickbird satellite image is suitable for separating tree canopies and no tree canopies areas in Zagros forests and similar areas. This is due to the spatial resolution of the image (2.4m), reducing the tree canopy and no tree canopy pixel interference, and increasing the precision of classification. This research also showed that the usage of processed bands and main bands in both maximum likelihood and support vector machine (SVM) algorithms can be used due to the closeness of the validation result. However, to improve the Quickbird satellite imagery and images with similar spatial resolution, spot samples are recommended instead of polygonal samples to distinguish between different phenomena. In the end, the usage of these images to examine the distribution of single-tree species provides more acceptable results.

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References

1- Mosaddegh A. Forestry. 2nd edition. Tehran: Tehran University Press; 2002. p. 481. [Persian]

2- Erfanifard S, Zobeiri M, Feghhi J, Namiranian M. Determination of the appropriate area and shape of the sample plot in the canopy estimation using forest simulation in Zagros. Iran J of Forest Poplar Res. 2006;15(3):278-88. [Persian]

3- Hekkila J, Nevalanen S, Tokol A. Estimating defoliation in boreal coniferous forests by combining Landsat TM, aerial photographs and field data. Forest Ecol Manag. 2002;158(1-3):9-23.

4- Amini MR, ShataeeJouibari Sh, Ghazanfar H, Moaieeri MH. 2008. Investigation of changes in range of Zagros forests using aerial photographs and satellite images (Case study: Armand Baneh forests). J Agricult Sci Nat Resour. 2008;16(3):431-43.

5- Wulder MA, Dymond CC, White JC, Leckie DG, Carroll AL. 2006. Surveying mountain pine beetle damage of forests: A review of remote sensing opportunities. Forest Ecol Manag. 2006;221(1-3):27-41.

6- Barazmand S, Shataeejouibari Sh. Investigating the possibility of recognizing the distribution of crown princely trees using images with high spatial resolution (Case study area of educational and research forest of Dr. Bahramnia) [Dissertation]. Gorgan: Gorgan University of Agricultural Sciences and Natural Resources; 2009. p. 92.

7- Naseri, F. Classification of forest types and estimation of its quantitative characteristics using satellite data in arid and semi-arid forests [Dissertation]. Tehran: University of Tehran; 2003. p. 155. [Persian]

8- Afshar S, ShataeeJouibari Sh. Estimation of Zagros forest conservation characteristics using combination of satellite images and aid data (Case study of forests around Ilam city) [Dissertation]. Gorgan: Gorgan University of agricultural sciences and natural resources; 2012. p.86. [Persian]

9- Farzadmehr J, Arzani H, Darvishseffat AA, Jafari M. Investigating the capability of Landsat7 satellite data to estimate coverage and plant production (Case study: Hana-Semirom Semi-Steppe area). Iran Nat Resour J. 2004;57(2):339-52. [Persian]

10- Noorian NA, Shataeejouibari Sh. Investigating the capability of satellite data with different spatial resolution with emphasis on spectral indices in the separation of pure forest stands. J Sci Technol Wood For. 2014;21(3):149-66. [Persian]

11- Alavipanah SK, Ehsani AH, Omidi P. Investigation of desertification and land degradation of Damghan plains using satellite, multi-time and multi-spectral data. Biaban. 2004;9(1):143-50. [Persian]

12- Alishaharatbani F, Arzani H, Hosseini SZ, Babaeekafaki S, Meerakhorloo Kh. Preparation of rangeland vegetation map using IRS-LissIII satellite images (Case study: Sorkhabad Basin of Mazandaran). Q J Res Range Desert Iran. 2013;20(3):454-62. [Persian]

13- Barzafkan AA, Pirbavaghar M, Fathi P. Investigation of LissIII Data capability for mapping Map of Zagros forests (Case study: Marivan forests). Forest J Iran. 2014;6(4):378-401.

14- Rahdari V, Safyanian A, Khajehdiin SJ, Najafabadi SA. Investigating satellite data capability in mapping the canopy cover percentage of arid and semiarid regions (Case study: Muteh wildlife refuge). Environ Sci Technol. 2010;15(4):43-54. [Persian]

15- Rahimi HA, Peerbavaghar M, Ahmadi M, Amini MR. 2014. TM imagery capability in detecting burned forests (Case study: Qourigaleh region in Kermanshah province). Forest Poplar Res Iran. 2014;22(3):485-95.

16- Roodgarmi P, Khorasani NA, Monavvari SM, Noori J. Environmental impact exposure development using satellite images and measurement techniques. Environ Sci Technol. 2007;11(1):161-72. [Persian]

17- Salmanmahini AA, Nadali A, Feghhi J, Riazi B. Classification of forest areas of Golestan province by maximum likelihood using satellite image ETM+2001. Environ Sci Technol. 2007;14(3):47-56. [Persian]

18- Hosseini FS, Darvishseffat AA, Zargham NA. Investigation of IRS-P6-LISS-IV image capability for storing pistachio wildlife forests (Case study: KhajehKalat Forest in Khorasan). Forest J Iran. 2012;4(4):311-20. [Persian]

19- Barazmand S, ShataeeJouibari SH, Abdi O. Investigating the possibility of tree crown degradation by using Quick Bird satellite imagery images (Case study: Shastkolteh forest in Gorgan). J Forest Poplar Res Iran. 2011;19(4):466-77. [Persian]

20- Hosseinzadeh J, Najafifar A. Investigation of the relationship between diameter and height of trees with dry matter distribution in Ilam forests. J Sci Technol Wood For. 2015;23(2):75-87. [Persian]

21- Cano F, NavaroCerriilo RM, Garcia Ferrer A, SanchézdelaOrden S. Detection of forest decline using IKONOS sensor for cork oak (*Quercus suber L.*) Woods in South Spain. Geocarto Int. 2006;21(3):13-8.

22- Hamzehpoor M, Kayadakiri H, Bordbar SK. Preliminary study on the drying of Iranian oak trees in Bam Kazeroun Plain. Iran J Res Poplar. 2010;19(2):352-63. [Persian].

23- Fathizadeh H, Safari A, Bazgir M, Khosravi GhR. Evaluation and comparison of the supporting machine carriers with linear, polynomial and radial kernels with artificial neural network for classification of land use. Q J of Iran Derby Desert Res. 2015;23(4):729-43.