

Vegetation canopy covers evaluation of arid areas using IRS images

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Abstract - The evaluation of vegetation covers using conventional methods is difficult over arid areas due to several reasons such as lack of the suitable roads to these regions. Moreover, this task is time-consuming. For these reasons, remote sensing has been considered as an economic alternative for conventional field work. In this study, the feasibility of using IRS images in vegetation cover evaluation of rangelands has been investigated. For this purpose, vegetation types of a part of arid rangelands in Semnan province, Iran, was classified using topographic maps. Then required information related to vegetation canopy cover of different types was collected along with two linear 50 meter transactions. At the end, the statistical relationship was assessed between different indices extracted from the multispectral bands and the collected field data was assessed. The results demonstrate the moderate capability of these images to produce vegetation cover map over arid rangelands.

Keywords: Vegetation, arid area, Canopy cover, IRS image, Iran.

1. INTRODUCTION

Sustainable range management needs to accessing data by fast and suitable methods. The evaluation of vegetation canopy covers using conventional methods is difficult over arid areas due to several reasons such as lack of the suitable roads to these regions. Detection of Rangelands canopy cover can influence local planning and natural resource management. Moreover, this task is time-consuming. For these reasons, remote sensing has been considered as an economic alternative for conventional field work. Remote sensing data are related strongly to different canopy variables (Chaurasiaa et al. 2006) and requires founding statistical relationships between Satellites data and ground truth. Many investigation tested remote sensing ability and have treat this techniques to obtain land use and land cover map. (Gautam and Channaich (1985), Karteris (1990), Lillesand and Kiefer (1994), Rondeaux et al. (1996), Ikeda et al. (1999), Moleele et al. (2001), Farzadmehr et al. (2005), Shataee & Abdi (2007), Amini et al. (2008), Abdollahi et al. (2008), Daryokvandy et al. (2009), Arzani et al. (2009). Tapiador & Casanova (2003) used IRS-1D for the regional planning directives in Segovia, Spain. Hosseini, et al., 2005, used IRS-Pan images for Land use mapping in Maybod area, Iran. The increasing use of remote sensing has proved it to principal method of mapping and monitoring however multispectral images have been of limited use in mapping variations in vegetation cover in arid and semiarid regions (Smith et al, 1990). The purpose of our study was to Evaluate the suitability of Indian Remote Sensing (IRS) satellite data for prediction of canopy cover for arid and semiarid Rangelands in semnan.

2. MATERIALS AND METHODS

The study area was carried out in the Semnan Province, in the north of the Iran, extends between 34° 17' to 37° 30' N latitude and 51° 58' to 57° 58' E longitude. The province of Semnan stretches along the Alborz mountain and borders to Kavir-e Hajaligholi desert in its east and Dasht-e Kavir in southern parts, As we see in Figure 1. The climate in the study area is classified as arid, with cold winter and hot dry summer, the

amount of annual rainfall is 103 mm, in center. The most of the precipitation falls in spring. The dominant land use is poor range and a small area is field crops and pistachio garden.



Figure 1. Location of the study area on Iran map

2.1 Field data acquisition and post-processing

Vegetation types was classified using topographic maps. From early September to late November of 2007, field data were collected in 125 Sites, Figure 2 shows the site position on the false color composite IRS image. Two linear 50 meter transects were selected by randomized method in each site, along the two major axes. the locations were recorded with GPS, also plant canopy covers were measured. Coordinates of transects were used to make a GIS layer in all study sites.

2.2 Image preprocessing

Data in this study, are composed of digital topographic at the scale of 1:25000 (Iran National Cartographic Center (NCC)) and remotely sensed data from Indian Remote Sensing (IRS LISS-III) satellite image (path 72/row 45), from 25th October 2007, with a spatial resolution of 23.5 m, Sub scenes encompassing the study area was extracted from image. The software's such as Idrisi 15, ArcGIS 9.3, were used. Image

was georeferenced to the WGS 84 datum and UTM Zone 39 coordinate system. i Geometric correction was performed by 77 ground control points (GCP) taken at roads crossing and waterways, using GPS and maps, with precision of less than one pixel. Spectral vegetation indices were calculated to build statistical Regression which relates satellite data to field canopy cover. The list of index has been shown in table A.

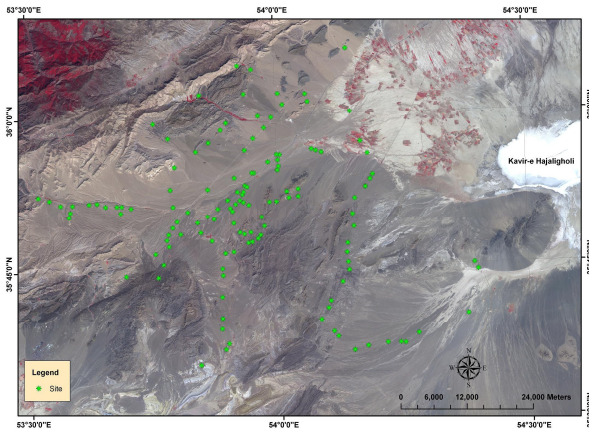


Figure 2. Location of the study sites on the false color composite Image (IRS satellite Image)

Table A. Spectral vegetation indices

SVI	Descriptions
Ratio	-
NDVI	Normalized Difference Vegetation Index
RVI	Ratio Vegetation Index
NRVI	Normalized Ratio Vegetation Index
TVI	Transformed Vegetation Index
CTVI	Corrected Transformed Vegetation Index
TTVI	Thiam's Transformed Vegetation Index
AVI	Ashburn Vegetation Index
SAVI	Soil-Adjusted Vegetation Index
Green	IRS Green band
Red	IRS Red Band
NIR	IRS Near-infrared band
SWIR	IRS Middle infrared band

IRS band and SVI pixels were overlaid with elements of the sites and the values have been extracted in the place of the corresponding sites. Because provide a direct measure of canopy cover, regression equations have been established between IRS band and vegetation indices to field measured canopy cover. canopy cover were used as dependent variables in regression models that predicted field data, model is then used to predict the observation (29 sites canopy cover data) that was left out by random sampling without replacement. Accuracy assessment has been assessed by comparing cover predicted from regression for each pixel with ground truth vegetation cover. Finally the applied regression model to the images generated the map that states the vegetation cover percentage of the region. Minitab 13 software were used to perform preliminary statistic and checked for regression analysis.

3. RESULTS AND DISCUSSION

The Maps resulted from NDVI, SAVI and AVI vegetation indexes are shown in figure 3.

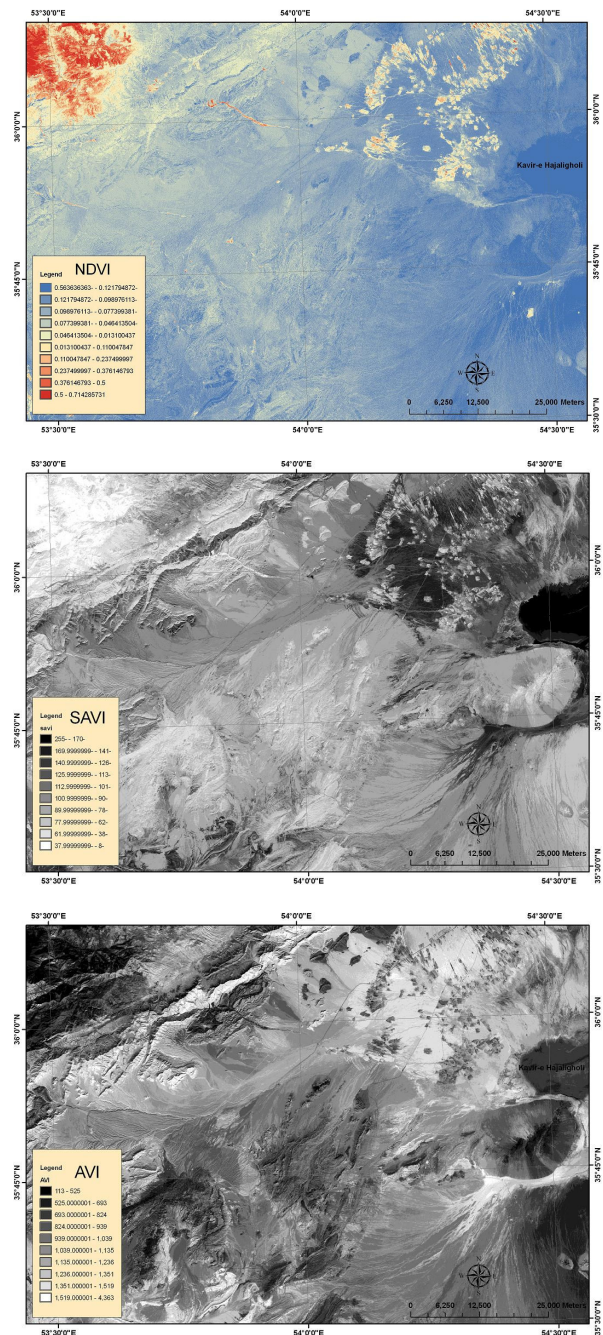


Figure 3. maps resulted from NDVI, SAVI and AVI vegetation index.

Correlation of field measured vegetation canopy cover with IRS images and Spectral vegetation indices has been shown in table b, that the results indicate significant correlations ($p < 0.01$) between them. Among the index, NDVI and Ratio presented stronger statistical correlations whit canopy cover than the other indices, having the correlation coefficient of 0.58. Results of cross-validation for Regression models between canopy cover and Spectral vegetation indices are given in Table c. Relationships between some indices and measured canopy cover are given in Figure 4. Estimated vegetation cover by regression models in left sites and measured canopy covers has been compared in Figure 5.

Table b. Correlation between field measured vegetation cover and Spectral vegetation indices (SVI).

index	AVI	SAVI	CTVI
Correlation ^a	0.35	0.46	0.5
index	TTVI	TVI	NDVI
Correlation	0.57	0.57	0.58
index	Ratio	NRVI	RVI
Correlation	0.58	-0.56	-0.57
index	Green	Red	SWIR
Correlation	-0.51	-0.47	-0.39
index	NIR		
Correlation	-0.34		

^aThe Pearson correlation

Rms. errors of NDVI-based canopy cover estimates were found to be slightly better (R^2 33, rms.error 5.17) than estimates based on Ratio (R^2 33, rms.error 5.19) and NRVI (R^2 33, rms.error 5.19) and other SAVI-based canopy cover estimates.

Table c. Result of cross-validation for Regression models between canopy cover and Spectral vegetation indices

Regression model	S ^a	R ² ^b	P<
Cover = 31.5 + 218 NDVI	5.17	33%	*
Cover = - 97.2 +131 Ratio	5.19	33%	*
Cover = 31.5 - 218 NRVI	5.19	33%	*
Cover = - 165 + 276 TVI	5.21	33%	*
Cover = 118 - 88.8 RVI	5.22	32%	*
Cover = 45.2 - 0.37 Green	5.46	26%	*
Cover = - 134 + 228 CTVI	5.44	25%	*

^aRms. Errors, ^bCoefficient of determination, * P< 0.01

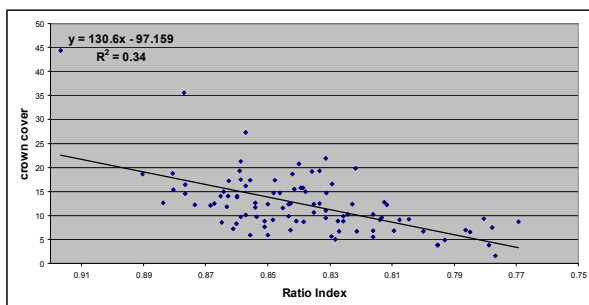
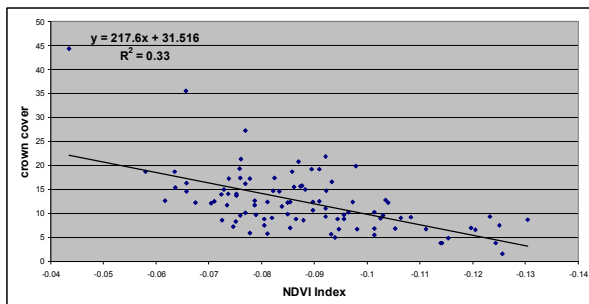


Figure 4. Relationships between NDVI, Ratio Indices and actual canopy cover at different sites.

However SAVI results did not show a perfect agreement estimation, Accuracy assessment suggested that canopy cover estimates from NDVI is the most accurate estimation of cover.

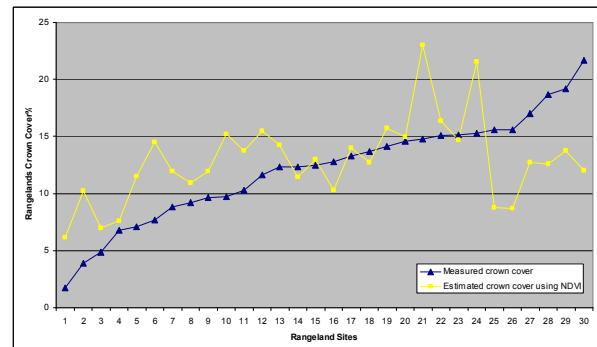


Figure 5. Compare of field-measured canopy cover against estimated canopy cover NDVI-Based.

4. CONCLUSIONS

The capability of Indian Remote Sensing (IRS) satellite images to Estimate rangelands canopy cover of arid area were studied in this research, using of regression analysis in relating SVI to ground data was one of the important goal in this study. The results demonstrate the moderate capability of these images to produce vegetation cover map over arid rangelands. It can be because of poor vegetation cover in desert sites. Similar results were reported by Latifi (2005) and Moradi et al. (2010), who studied the Capability of IRS data for the poor forest cover. SVIs have been at the heart of ecological applications of remote sensing (Cohen and Goward 2004) but Smith et al, 1990, in the semiarid area, measuring sparse vegetation cover and said that it had been difficult to quantify vegetation cover of less than about 40%, owing to the spectral dominance of the background soils and rocks. Boutton and Tieszen, 1983, indicated that remote sensing can facilitate mapping and monitoring sparse vegetation cover more than about 30%, by satellite images. Buyantuyev (2007) emphasized that the low accuracy classification will be improved while that instead of image derive is used spectral library of major desert land covers which is collected. Finally, we conclude that for accurate vegetation canopy cover estimation in arid area, IRS LISS-III image is limited and more research is needed for this propose, but it can use when we need to estimate vegetation cover in the rapidly.

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