

New study on the variations of Landover type area using satellite data under management area near Caspian Sea

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Present study is to prepare the forest vegetation map using remote sensing techniques and the images of ETM⁺ sensor of 2000 and LandSat and related to 2013. Results of numeral classification of picture of studied area to develop the land use map using maximum like hood classifier by contributing various bands set indicated that in the best case, general accuracy of image classification in the images of 2000 and 2013 was 0.95 and 0.85, respectively and kappa statistics was 0.86 and 0.84 , respectively. Further, study results indicated that forest vegetation reduction rate was 635.319 hectares.

[**Key words** : Roodsar forests , variation detection, maximum like hood , management area]

Introduction

One of most important ways to extract the information for drawing the maps is utilizing the satellite images. In this regard, performed a case study on the forests of (Armardeh), Baneh city, with 19964 h^{-1} area to examine the forest-wide changes and to map the forest changes for 1978-2002 period¹. For this purpose satellite images of EMT⁺ and IRSP6 and relationship of 5 factors including the slope, direction, altitude from sea level, distance from rural centers and roads with forest level changes was studied. In a study titled: (study on the feasibility of mapping the beech type using the data obtained by EMT⁺) by performing suitable processing and clarifications, the satellite image classification with original and artificial bands achieved through proportioning, performed the conversion of major components and merging² and Maximum similarity classification was performed. Analysis of major components was performed based on the bands with high correlation based on the calculation of correlation in the desired range. Eventually the map achieved through the classification was attained with total accuracy of 51% . Analyzed the changes and classification of the band surface vegetation in Minnesota using multispectral images of Landsat, and studied the trend of land use changes around the urban

areas³. In this study on a region with approximately 7700 km area, LandSat images of the years 1986, 1991, 1998 and 2002 were used. Maximum likelihood algorithm was used to classify the satellite images including 7 major bands and 3 bands obtaining by the Taseld Cap operation. Satellite images were classified to 7 class including forest, agriculture, pasture, urban areas, water body, wetland, and rocky areas. Results of this study indicated a 70000 h^{-1} increase in urban areas during 16 years which are including 75% forest and 13.6% areas converted from other land uses⁴. In a study titled (classification of multi band satellite images for data collection and mapping the vegetation), utilized the principal components analysis method to decrease the lack of correlation between satellite images⁵. General accuracy of this classification was estimated as 80.63%. This conclusion was considered suitable for classification of the studied area vegetation using principal components analysis.

Materials and Methods

Study area in present study was catchments area of Khoskeh rood river in Roodsar city (Figure 1).

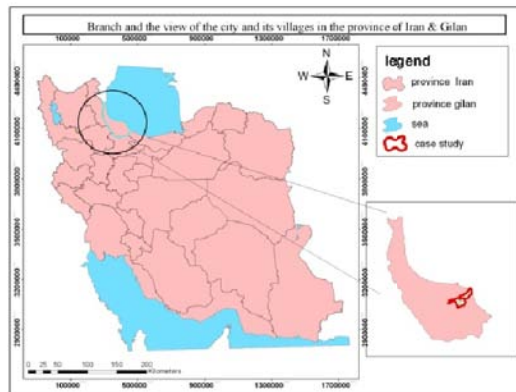


Fig1 Study area in Iran and Gilan

Images utilized in this project are the images of Landsats for Khordad 9, 2013 and the second images of Landsat 7 related. April (2000). In present study, for geometric correction of images, it was attempted to extract the flood ways and tracks from 1:2500 scale maps of surveying organization and adjusting them to the images receiving from Gilan institute for the rice research. Then, control points were randomly taken across the area. Due to the fact that the images taken by rice institute were georeferenced, very small geometric error was observed in the pixels. Due to suitable resolution power of PAN band of Landsat satellite (15m), firstly, images of

this band were corrected compared to 1:25000 scale images (Figure 2). Then other image bands of the year 2013 and image bands of the year 2000 were corrected using image to image technique. For geometric correction of panchromatic band 20 points of ground control of flood ways and tracks were selected. RMSE error of this band was 0.19. In both steps, polynomial transformation technique and nearest neighborhood technique were used for resampling. This technique is amongst most popular techniques for resampling. Among most important merits of this technique are: high speed and transferring the major numeral digits and not creating new numeral digits. In the nearest neighborhood technique, actually any calculation is not performed and only grayscale rate of a pixel nearest to the point position in the image is selected (Figure 3). Since this technique doesn't perform specific calculations, it is considered as the most fast resampling technique and makes use of real values of the image, and doesn't produce unreal numbers⁶. It is worth mentioning that total RMSE error for the images of the year 2000 was 0.25 and for the images of the year 2013, it is 0.4.

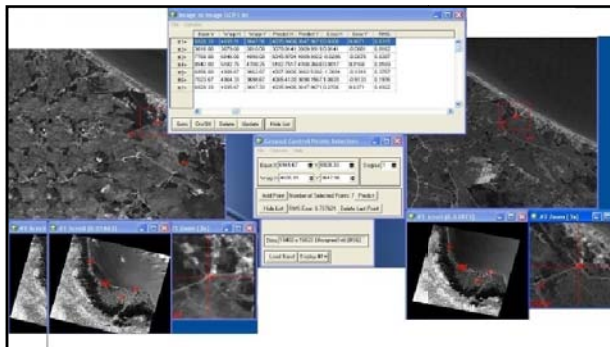


Fig 2. Selection of GCP points on the PAN georeferenced and non-georeferenced images and its processing using the software with image to image technique.

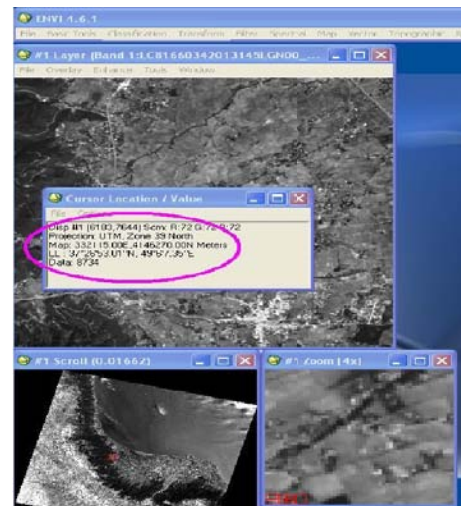


Figure 3. Geo referenced image

Desirable index factor (DIF) (Chaves et al., 1986:460) is used to define the best band combination. OIF rate based on the variance and correlation between various bands is given by:

$$(1) \quad OIF = \frac{\sum_{j=1}^3 SD_j}{\sum_{j=1}^3 |CC_j|}$$

Where OIF is desirable index factor, $\sum_{j=1}^3 SD_j$ is the sum of standard deviations of 3 bands and $\sum_{j=1}^3 |CC_{jl}|$ is the sum of the absolute value of correlation coefficient between 2 bands among 3 bands.

The more is the difference of spectral reflection between the bands, the higher will be the possibility for resolution of the topologies and phenomenon will high precision. The best band combination in this study for EMT+ images of the year 2000, was the combination 347 and combination 368 was selected for Landsat 8 images(Figure 4 ,Figure 5).

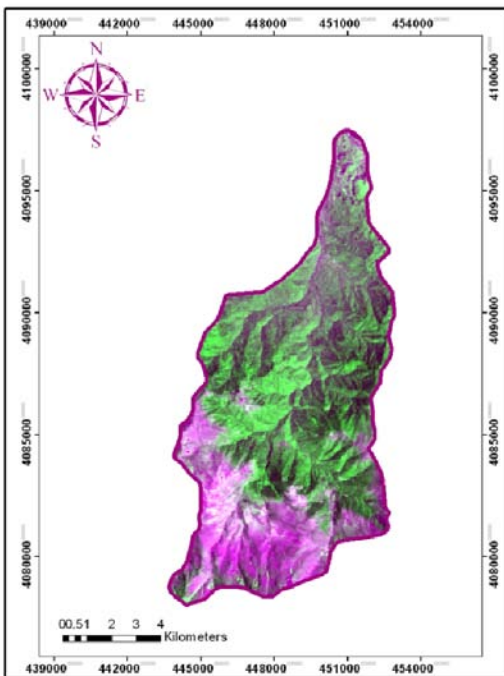


Fig 4. Band combination 347 in the images of the year 2000

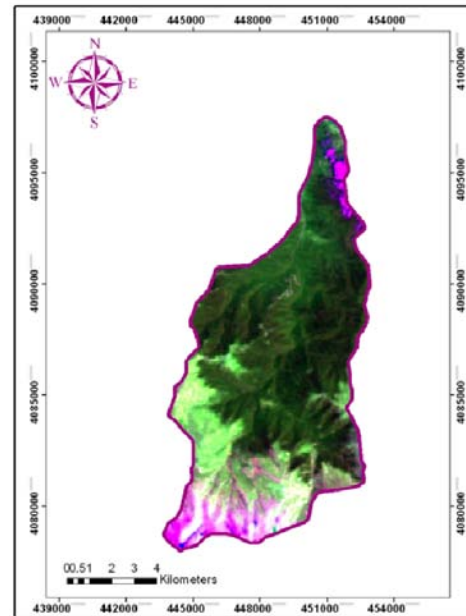


Fig 5. Band combination 367 in the images of the year 2013

Supervised classification technique was used for classification. In this technique training regions as the classification reference⁷. Classes were selected using the maps available from studied area and consulting to the related experts. Selection of desired classes must be performed with caution and always it must be considered that there is fundamental difference between the classes selected by interpreter and the classes resulting from remote sensing data (spectral classes). This stage is very important where interpreter must resolve the problem due to the spectral classes and information classes through trial and error, tests and suitable definitions of the classes⁸.

Then using maximum likelihood classification technique, land use maps of the years 2000 and 2013 were prepared. Stated that in this technique which is more precise than other available techniques, quantitative value of variance and correlation of spectral values of various bands are calculated for sample areas⁹. This property is used to relate a non-classified pixel to one of spectral groups or samples. In other words, variance matrix and mean Vector which themselves define the variance and correlation of spectral values, are used to study how to distribute the spectral values and statistical likelihood of relationship of a pixel to one of sample groups.

Results

Evaluation points were used to evaluate the validity of the results of satellite image classification. Kappa coefficient, general validity, user validity and producer validity were used to evaluate the results. Validity of classification maps of the year 2000 and 2013 was estimated using combined variance-covariance matrix¹⁰, after classification and extraction of forest use strata from ENT+ images. In present study, general validity and Kappa coefficient were used to evaluate the prepare strata.

In tables 1 and 2, rows represent the control or test pixels taken across the area. In fact, in the training faze of classification half of the ground realities achieved by GPS from various areas in the field operation or through visual interpretation and using high resolution images and available maps. Other halves of data were used in supervision and evaluation of classification precision. The reason to use the ground realities in this way is to prevent the optimum in the evaluation results. Diameter of this matrix including the number of correctly classified pixels and the elements outside the matrix in the rows represents the incorrectly classified pixels which during the classification were wrongly removed from the major class and allocated to other classes. These errors are called errors of omission or exclusion.

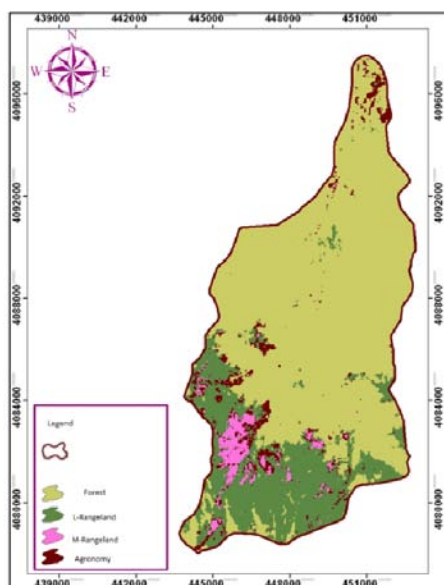


Fig6. Land use maps of the year 2000 using maximum likelihood classification technique

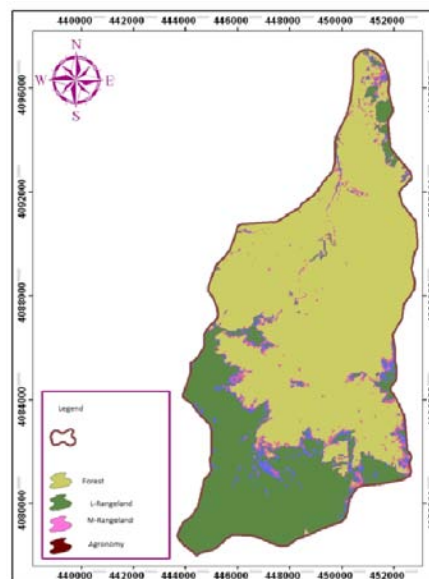


Fig 7. Land use maps of the year 2013 using maximum likelihood classification technique

Classification accuracy of each class is achieved through dividing the number of correctly classified pixels (in diameter) on the total number of control pixels (sum of the row) in each class which also is called producers accuracy (Figure 6, Figure 7). Elements outside the diameter of matrix in the column represent the ground realities pixels entered wrongly to the class of related column during the classification process and in fact it belongs to the classes of their corresponding rows. These errors are called errors of commission or inclusion. Reliability of each class of classified image is achieved through dividing the correctly classified pixels of that class (in diameter) on the total number of pixels (sum of columns) classified as that class in the correctly classified image, which is called users Accuracy (Table1, Table2).

Table 1 kappa coefficient and general accuracy of ETM⁺ image of the year 2000 of maximum, like hood technique

Kappas coefficient (%)	General Accuracy
0.86	0.95

Table 2 kappa coefficient and general accuracy of Landsat image of the year 2013 of maximum like hood technique

Kappas coefficient (%)	General Accuracy
0.85	0.84

Distribution of land use rates for the years 2000 and 2013 in the maximum like hood classification indicated that the area of the forest in the region has decreased 635.319 h^{-1} and the area of dense and semi dense pastures was increased(Figure 5,6). It's worth mentioning that according to the studies performed in the region , parts of the pasture had negative tendency. Thus it can be stated that the forests o this region also in this classification technique were destroyed. Table 3 Land use rates distribution for the years 2000 and 2013 separately (in the maximum like hood classification)

accuracy both in respect of total accuracy and kappa statistics relating to the produced data. In addition , the results indicated that a great part of pasture area of the region are of forest origin and natural land use change in the region and diverse land use led to its conversion to other land uses.

Table3 Land use rates distribution for the years 2000 and 2013 separately

Land use changes rate		Image of 2013		Image of 2000		Class of lands
Area(%)	Area (h^{-1})	Area(%)	Area (h^{-1})	Area(%)	Area (h^{-1})	
-6.21	-635.319	64.66	6727.022	70.87	7372.341	Forest
6.5	679.376	28.45	2964.571	21.95	2285.195	L rangeland
0.45	47.8161	3.44	358.5775	2.99	310.7614	m-rangeland
-0.74	-74.8381	3.45	358.7789	4.19	433.617	Agronomy
-	-	100	10417.6471	100	10417.6271	

Remote sensing and geographic information system technology are among the efficient, preferred technologies to study the environmental changes are resources management providing updated information for managerial purposes. Having update statistics and data is the prerequisite of correct management in the natural arenas. One of the basic of natural resources managements is the information's related to the land use changes maps. Taken the great cost required and not updating of map drawing by land operation , in recent years, using satellite images is considered as a technique for this purpose. Results of numeral classification of studied area image to dram land use map using maximum like hood classifier with inclusion of various band sets indicated that in the best case, general accuracy of image classification in ETM⁺ neural network for the year 2000 and Landset and for the year 2013 was estimated 0.95 and 0.85 and kappa coefficient was 0.86 and 0.84 respectively. By referring and comparing with references ^{11, 12, 13, 14} explaining that general accuracy and kappa coefficients larger than 0.7 are very good in respect of accuracy and lower than 0.4 is weak, results achieved through classification of land uses using satellite images in khoshkerood area of Rodsar city had a good

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