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Research Article

CONFIDENCE RANGE ASSESSMENT OF PROCESSING CLASSES BY JENSEN, FOODY AND DELLEPIANE METHOD IN SATELLITE IMAGERY (CASE STUDY: TANG-BASTANAK WATERSHED OF SHIRAZ, IRAN)

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ABSTRACT
The best combination of band is selected using of LANDSAT and IRS images and geometry errors corrected, radiometry and imaging the season difference, and it was prepared land use map of Tang-Bastanak Shiraz Using maximum likelihood algorithm and supervised classification of 1988 and 2005. The maps accuracy was calculated with totality accuracy test (Dellepiane method) and Kapa statistics (Foody method). Statistical analysis for the processing classes confident range at levels 1 and 5percent indicated by Jensen method that Irrigated culture classes for 2005 are 90.7 and 91.02 percent, respectively and for dry land under-stage forest 56.38 and 58.06 percent respectively is as the highest and lowest of confidence level. The above statistical levels, based on 1988 maps for irrigated farming classes 92.7 and 93.1 respectively and dry land under-stage forest with 55.88 and 58.47 percent have the highest and lowest confidence percent ,respectively .Prepared maps accuracy has been acceptable considering to the correctness test and confidence range percent.

Key Words: *Confidence Minimum, Land Use Change, Satellite Imagery, Accuracy Assessment, Digital Classification*

INTRODUCTION

Increasing growing of population Increases pressure on natural areas and unessential utilization and land use change has caused the destruction of ecosystems (Lu &Weng, 2007). Land use change may occurs due to factors such as drought, fire, flood, volcanic and human activities such as livestock grazing, urban development, farming and natural resource management. Land Use Change usually occurs in the conversion and change. Land conversion (deforestation, urban and agricultural land development) can be traced the satellite images, directly (Ustine, 2004). However, changes within the same user such as changes caused by over-grazing livestock, cutter-plant and other plants are usually using of remote sensing technology barely detectable (Lefsky,2003 , Ustine,2004). In the assessment of social and economic impacts on natural habitats, using of time-series images is a common method in the estimation of land degradation (Ghorbani, 2007, LU & Weng, 2007). Evaluation and spectral reflection characteristics study of different wavelengths may be possible to resolution of land use different classes (Ghorbani, 2006a, Ghorbani, 2007, Ahani, 2005).

Spectral reflect changes forest to non-forest t habitats, including features that indicate the land use type and amount of vegetation changes (Luetal, 2004). Assessment of processed classes from the satellite images and confidence percent presents using of statistical tests satisfactory results (Ahani,2005). to reduce the harmful effects are needs to Assessment of land use changes, planning and land management, using of remote sensing technology in wide fields, high precision and low cost. To identify such areas

may be possible to reformation and reclamation them. The land use map, particularly time series maps, can give a precise evaluation of lands change and degradation in land use planning. In addition the use of RS and the alteration of spectral reflection of forest vegetation to non-forest vegetation are among the features that indicate the type of utilization and the degree of alteration in vegetation. The purpose of this study is to estimate of land uses changes using satellite images and calculation of the confidence to processed classes during18 years. In this paper for land use mapping of Tange-Bostanak watershed in Fars province images of Landsat 4 (TM) and IRS p6 were used. According to the sensor differences, initially geometric and radiometric corrections as a pre image processing were considered. Some more preprocessing such as image acquisition times, band combinations using Optimum Index Factor, Matrix Variance – Covariance Analyses among different bands were also considered. Land use maps using supervised classification (Maximum Likelihood) for 1988 (past land use) and 2005 (present land use) for change detection (between 18 yeas) were produced. The accuracy of the produced maps using overall accuracy and Kappa statistic were calculated. Also the purpose of the present study was to find band with high co- variance. In other words, the more the difference between the spectrum reflection among the bands, the more possibility of differentiating between the faults and phenomena with a high precision

MATERIALS AND METHODS

Tang-Bastanak basin is located in Fars province with area of 73.81 square kilometers, about 80 km North West Shiraz city. It has been lie in the 52˚ 03′ 43″ to 52˚ 13′ 36″ E and 30˚ 16′ 33″ to 30˚ 25′ 18″N.

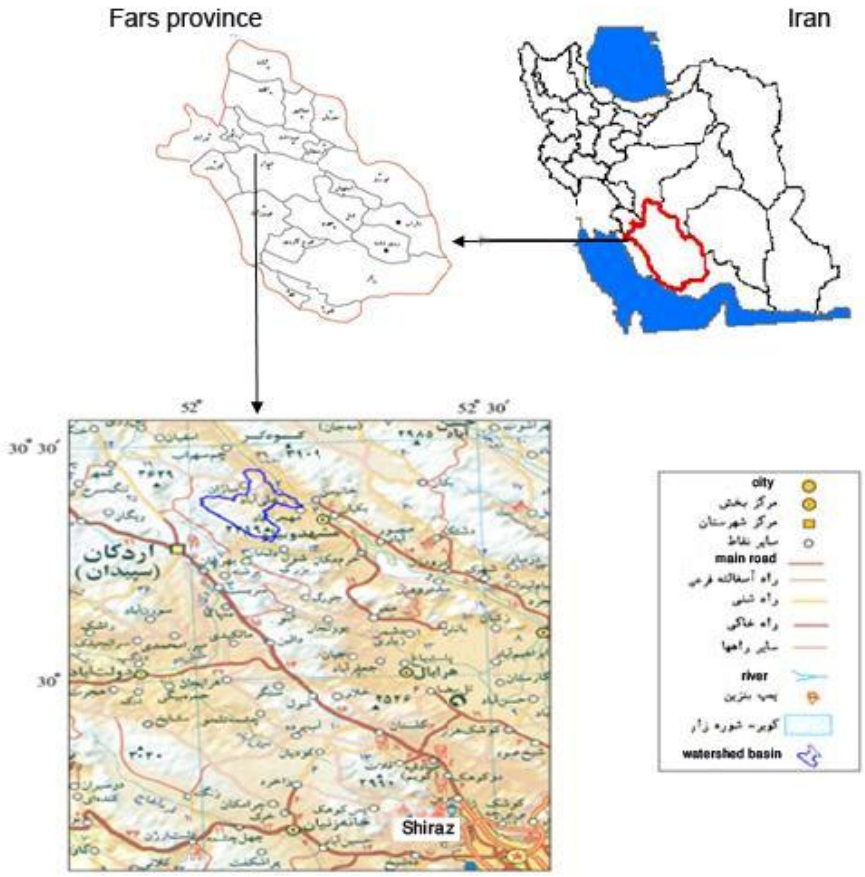

Figure 1: Location of study area in Fars province

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In this study Landsat 4satellite images (TM / 20 May (1988)) and IRS (P6 –July, (2005)) selected for land uses maps preparation In past and present times and it was used after resampling operations. A topographic digital map of 1:25000 (hydrography network and road network) was used to the geometry error correction. Minimum of ground control points were estimated based on the Velberg method polynomial functions degree for the location correct (Wolberg, 1990) (equation 1).

$K = (N+1)(N+2)/2$ Eq. (1)

Where: K: required point's minimum and N: level of polynomial function.

Respectively, 17 and 14 point were determined to a place correction using of the ground control points and Affin equation is a linear function for images of TM- and P-6.

For above aforementioned images, Root Mean Square Error (RMSE) was determined 0.307 and 0.106, respectively. The Equalization Histogram algorithms were used based on Equation 2to radiometric correction and radiometric errors corrected.

$$Y = \frac{X - X_{min}}{X_{max} - X_{min}} \times 255 \qquad \text{Eq.2}$$

Y=output brightness levels Number, X = input brightness levels number,X_{min} = minimum brightness levels number, X_{max}= maximum brightness levels number. The most common method of selecting the best bands of all bands is using the statistical properties of training area. (Alavi panah, 2003, Dysfani najafi, 1998,Lefsky,2003). For this purpose, the optimum index factor (Chazez, 1982) was used (equation 3). In this study, the band combines that had the highest levels was selected a favorable index factor as the best combination.

$$OIF = \frac{\sum_{j-1}^{3} SDi}{\sum_{j-1}^{3} |CCj|} \qquad \text{Eq.3}$$

Where

$\sum_{j-1}^{3} SDi$: Standard deviation total of three bands, $\sum_{j-1}^{3} |CCj|$: sum of correlation coefficients absolute between the two bands of three Bands. Training areas were prepared after selecting the best band combination. In samples selection are often collected from homogeneous areas to be compared image pixels spectral values with training examples and thus, the pixels can be placed in classes of resolution. According to available information from case study, land use map were prepared for case study, duration of between the years 1988 to 2006, using of training areas preparation of the region with assisted Global Positioning System (GPS) and Supervised classification with likelihood maximum method. Prepared layers accuracy was estimated using a mixed matrix of variance - covariance (Stehman, 2004). The overall accuracy Assessment was calculated from the proposed method Dllapiane and Smith (Dllapiane & Smith, 1999).

Eq.4

$$OA = 1/_{N(\sum P_{ii})}$$

Where:

OA : Overall accuracy: test pixels total number,$\sum P_{ii}$: classified correctly pixels total.

For the evaluation of Kappa coefficient was usedof Foody proposed method (Foody,1992) (Equation 5).

$$K = \frac{OA - \frac{1}{q}}{1 - \frac{1}{q}} \qquad Eq.5$$

Where: K : kappa coefficient, q : pixels are not classified correctly.

Finally, confidence range the class classification based on Jensen method (Jensen.2005) in the statistical levels of1 and 5percentwereestimatedbased onEquation6

$$S = P - Z\left(\frac{PQ^{0.5}}{N}\right) + \left(\frac{50}{N}\right) \qquad Eq.6$$

Where:

r: Statistical percent levels, P: correctly classified samples percentage , Q : incorrectly classified samples percentage by the relationship $Q = (100 - P)$ was estimated. N : Number of samples, Z = values of converted r is obtained based on z table that it was estimated from $Z = (100 - r) / 100$, S : Confidence Minimum percent.

RESULTS AND DISCUSSION

Preprocessing images

Geometric correction is one of the primary basics using of satellite imagery and it considers the image pre-processing steps. Selection of method related to region topography, the required parts number minimum and its accuracy. Use the Affine equation is more favorable in geometric correction, because of estimate the main components four of position, points scale, elongation and them rotation (Mather,2005). Since the atmosphere on shorter wavelengths of $0.5\mu m$ and longer wavelengths have the highest and the least effect, respectively. Also, atmospheric dispersion is due to low of images contrast (Ahani, 2005, Lu & Weng, 2007),to solve the problem Was used of Histogram Equalization. Because it can be realized the distribution of information extend in any event

The phenomena variety study, increasing of contrast and to the similarity and overlapping of information extend in bands (Alavi panah,1998, Mather,2005). Since, an elongation is nonlinear in Histogram Equalization, the pixels have located with new digital arrangement (between 0-255) and so the contrast increased between peak and tail of used images spectral curves. Therefore, it provides using this algorithm a distribution of pixels into separate groups. So, contrast increases and decreases in the graph peak area and in the tail, respectively. Wavelengths of satellite images are positive or negative correlation. Correlation between image bands, show the common information, it is meaning that if there is more information how correlation is more common between the bands. (Ahani, 2005; Ghorbani,2006b; Haung *et al.*, 2002; and Mather, 2005). While, the purpose of this study was to find bands that have a high covariance. In other words, what a difference in spectral reflectance is more between bands, it would be possible the phenomena and feature separation allowance with high accuracy (Ahani, 2005). The result of the desired index factor in TM sensor with wavelengths of $0.76 - 0.9\mu m0.63 - 0.69\mu m$ and $0.52 - 0.6\mu m$ and the sensor P - 6 with wavelengths of $0.78 - 0.89\mu m$, $0.61 - 0.68\mu m$ and $0.5 - 0.59\mu m$ were determined as the best band for band combination, respectively. The image pixel spectral values is compared with Training area using the software in data classification .so, they were studied the pixels in separate able classes. Digital classification is based on spectral differences of various features on spectral different bands. However, this does not mean that a feature is separable on specific each band. For this purpose, many researchers (Ojigi, 2006; Mundia, 2005; Mather, 2005) have used supervised classification method. similar Maximum likelihood algorithm has been the most common classification method in most studies (Darvish sefat, 1997; Lu & Weng, 2007). The main characteristic of this method is based on statistical parameters such as mean and standard deviation in a band multidimensional space and calculating the probability of each pixel belonging to different classes the pixel is assigned to a class that it is the most probability. Since the using of this algorithm is based on an image values normal. Therefore, it were tried to reducing the standard deviation than classes average and also classes mean increase from each other in training sample selection and the select samples of

homogeneous are as with smaller levels, large numbers with the proper distribution and Isomorph (uniform) of the samples within each classes as possible to help classes better resolution.

Prepared maps Accuracy Survey

Verification study is meaning to produce map conformity assess the result of classification. The overall accuracy is a classification accuracy valuation measure and it proposed using Dlapyan and Smith (Dellapiane & Smith,1999) the mixed matrix estimates the sum of pixels classified correctly divided to sum of image pixels and therefore, this criterion (measures) would be as the produced layers overall accuracy .also, the kappa statistic coefficient measures the accuracy of the map. This coefficient indicates the classification agreement with ground truth and it is varies between zero to one.one Number represents one hundred percent agreement layers with the ground truth. According to published sources (Montserud & Leamans,1992) Kappa coefficients greater than 0.7 gives very good accuracy and less than 0.4 gives poor accuracy. In this study area, this coefficients was estimated for kappa statistics and an overall accuracy, , 0.83 and 0.84 in1988 ,0.85 and 0.87 in 2005 respectively. Consequently, the results of this classification using satellite images are good accuracy in case study related to the produced information. Therefore, image data comparison Show destruction and significant changes in Tang Bastanak watershed during18 years. This destruction has occurred widely in Arid and dry lands especially, Which it is conflict with sustainable development. On the other hand, referring to these results can be concluded that the use of multi-band satellite imagery such as SPOT, Landsat and Spot can be surveyed similar land resources changes in Tang Bastanak Eco- region. Also, it was be noted that the images resolution can not surveyed within the land use changes and if we used high resolution images and hyper spectra, perhaps it would be possible.

Table1: Confidence minimum assessment processing levels (1% and 5%)

Confidence minimum assessment table processing levels				
	Confidence percentage minimum – IRS(2005)		Confidence percentage minimum-Landsat4 (1988)	
Land use type	Statistical levels 5%	Statistical levels 1%	Statistical levels 5%	Statistical levels 1%
Bare land	83.4	82.28	66.07	62.83
Rock outcrop	85.2	84.18	93.1	92.7
Dry Farming understory Forest	58.6	56.38	58.47	55.88
Dry land	85.1	84.4	75.09	74.08
Garden	80.8	79.7	82.45	81. 4
Moderate Rang Understory Forest	87.06	86.57	87.1	86.6
Poor Rang Understory Forest	81.23	80.66	83.7	83.2
Residential area	73.55	71.81	84.7	83.3
Moderate Forested Rang	76.22	75.37	84.5	83.95
Poor Forested Rang	77.8	76.74	87.4	86.79
Irrigated Farming	91.02	90.7	90.3	89.9

The results showed that the barren land has increased from 0.0 5/% of the basin to 0.21% and dry land increased from 0.51 % to 1.65% area, if we consider the dry land forest under stage,0.002% to 0.51% of the basin and these analyzes indicate that the growth of barren land and dry land farming. However, in forested areas, especially forest with moderate rangeland under stage has been reduced from 40.7% to 12.33% watershed area, which it reduction of the area surface equivalent to 27.74% of watershed surface equivalent to 2267.38ha of the watershed. The moderate wooded pastures have estimated from 4.06% to 3.61% of the basin that it indicates the negative rate. The negative rate of 0.45% of watershed area equivalent to 36.38 ha of the basin. Against the pasture area reduction with moderate vegetation cover

Table 2: Distribution of land use area to each type of satellitein1988 and2005

	Landsat 4 in 1988, IRS (p6) 2005		Land use changes
Land use type	Area (Percent)		Area (Percent)
Bare land	0.21	0.05	0.16
Rock outcrop	15.16	15.16	0
Dry Farming understory Forest	0.51	0.002	0.508
Dry land	1.56	0.51	1.05
Garden	0.54	0.06	0.48
Moderate Rang Understory Forest	12.33	40.07	−27.74
Wake Rang Understory Forest	43.28	20.77	22.51
Residential area	0.64	0.24	0.4
Moderate Forested Rang	3.61	4.06	−0.45
Wake Forested Rang	0.75	0.39	0.36
Irrigated	21.34	18.64	2.7
Total	100	100	−

have been converted to forest with poor pastures under story So, poor pasture area have become 0.39% to 0.75% of the basin and forest with poor pasture under story 30.77% to 28/43% of the basin. In 1988, the highest watershed area is dedicated forest with moderate pasture under story and currently, forest with poor pasture under story devoted to highest watershed area and in general, pastures area with moderate vegetation cover has been reduced. The highest area decrease and increase were related to the forest with moderate pasture understory and poor pasture understory, in fact that a conversion has taken place (referred to Table 2 , figures 2 and 3). The accuracy of the produced maps in terms of overall accuracy (OA) and Kappa accuracy, irrigated farming class, with overall accuracy (0.92) and Accuracy of Kappa(0.91)and dry land with overall accuracy (0.72) and Kappa accuracy (0.71) allocated to, most of the amounts and latest of the amounts in 1988. Also, irrigated farming class with overall accuracy (0.92) and Accuracy of Kappa(0.91)and an overall accuracy of irrigated farming the highest grade and for forest with dry farming understory forest with (0.72) for the overall accuracy and (0.71) for the lowest Kappa accuracy is allocated in 2005. Z values in statistical analysis at two confidence levels 1 and 5%, was estimated that r and z using of data transform table defined for the above statistical levels 2.05 and 1.645,respectively. Safety minimum percent Statistical calculation of the land use classes is shown in

Table 1. Irrigated farming classes for the land use layer with confidence level of 1 and 5%, 90.7 and 91.02; also it have 92.7 and 93.1 confidence minimum percent Maximum in 2005 and 1988 years, respectively. The lowest level are confidence minimum in forests with dry land understory at confidence levels 1 and 5% with 56.38and58.6 for 2005year and it indicated at confidence levels 1 and 5% ; 55.88 and 58.47for1988 year. In addition, land use irrigated farming class, after the rocks have the highest confidence minimum at confidence level 1 and 5% with 89.9 and 90.3 for 1988 year and the forest with moderate pasture understory have the highest confidence minimum at confidence level 1 and 5% with 86.57 and 87.06 for 2005. In general, confidence level minimum Average for land use layer at confidence levels 1 and 5% equivalent 80.5% and 81.17% in 1988,and land use layers are equivalent to 78.98 (confidence level:1%) and 79.99 (confidence level:5%) in 2005.

Therefore, suggest for studying the effects of various phenomena to be used of the best band combination indicators, to differences in bands spectral reflect the possibility of separating of features and phenomena is possible with high accuracy and classes are good confidence in processing.

CONCLUSION

Geometric correction is one of the first steps in using satellite images and is considered the preliminary step in pre-processing images. The selection of method for geometric correction depends on the altitude of the region – the minimum required points and the minimum intended precision. (Mather, 2005)Using Afain equation is more efficient because of having the four main indicators of location and the point scale, their stretching and twisting. As the atmosphere on the wavelengths shorter than 0/5 µm has the most effect and the higher wavelengths have the least effect and also atmospheric dispersion lowers the contrast in the images (Lu and Wang, 2007) equal rectangles were used to eradicate the problem because it is possible to distinguish the data dispersion spectrum of any phenomenon, the study of the variety of phenomena, the increase of contrast and the similarity and coverage of the data spectrum in the bands by equal rectangles (Mather, 2005). Since the stretch in the equal rectangles is of the linear type, the pixels have been place by new numeric arrangement (255-0), therefore, the contrast and variance between used Peaks and Tails of the image spectrum increased. So preparing the pixel dispersion in separate groups became possible by the use of algorithm. To make variance in the region, the diagram peak was increased and the tail was reduced. The wavelength of satellite images has positive or negative correlation. The existence of correlation among the image bands is an indication of common data. It means that, the more correlation exists among the bands, the more common data exists. (Huang *et al.*, 2002, Ghorbani *et al.*, 2006 b)However, the purpose of the present study was to find band with high co- variance. In other words, the more the difference between the spectrum reflection among the bands, the more possibility of differentiating between the faults and phenomena with a high precision (Stehman,2004). The results of desired indicator factor in the T.m measuring with wavelengths of 0/90 µm -0/76, 0/69 µm -0/63 and 0/6 µm -0/52 and the P measuring factor with wavelengths of 0/89 µm - 0/78 -0/68 µm -0/61 and 0/59 µm - 0/50 with the best band for band combination respectively were chosen. Concerning data classification, it was attempted to compare the spectral values of image pixels with edifying samples using computer software so that such pixels are placed in separable classes. The cases were studied. Numerical classification is based upon spectral differences of different phenomena on various spectral bands. However, it does not mean that each phenomenon is not separable on each specific band. For this purpose, most of the researchers, (Ojigi, 2006, Moundia and Aniya, 2005) have used experimental classification. The maximum probable similarity algorithm has been the most common classification method in most studies (Lu & Wang). The main feature of this method is based on statistical mean and standard deviation parameters in a multi dimensional space of bands and after calculating the belonging probability of each pixel to different classes, the pixel is allocated to a class with the most probability. Since the basis for using this type of algorithm is the normal condition of the image, therefore, the selection of experimental samples, to lower the standard deviation to the class mean and also increasing

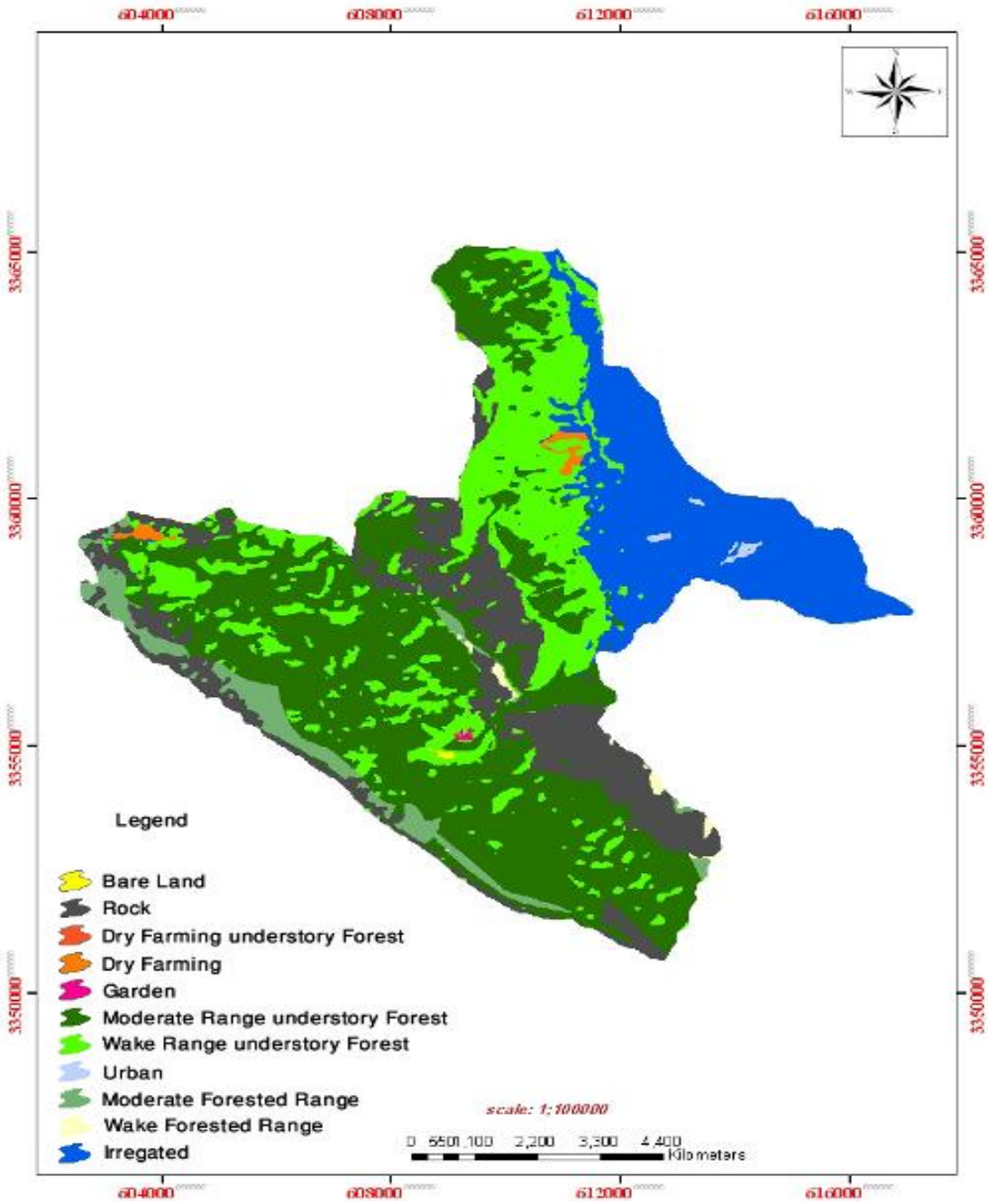

Figure 2: land use map in area of study (1988)

the class mean from each other, it was tried to select the samples from analogous regions with smaller areas, in large numbers, with desirable dispersion and identical shapes in each class to help to a better separation of operational classes. Examining the accuracy of the degree of correspondence resulted from the classification with ground reality. In the total accuracy which evaluating criterion of the classification and is obtained by the random matrix proposed by Dallapiane and Smith (1999) added to the image from total classified correct pixels of all classes added to the image pixels and consequently the criterion can be used for the general accuracy of the produced layer. The Kappa coefficient is also another criterion for the map accuracy. The coefficient indicates the concord of the resulted from the classification with ground reality and fluctuates between zero and one. The number one indicates the hundred percent

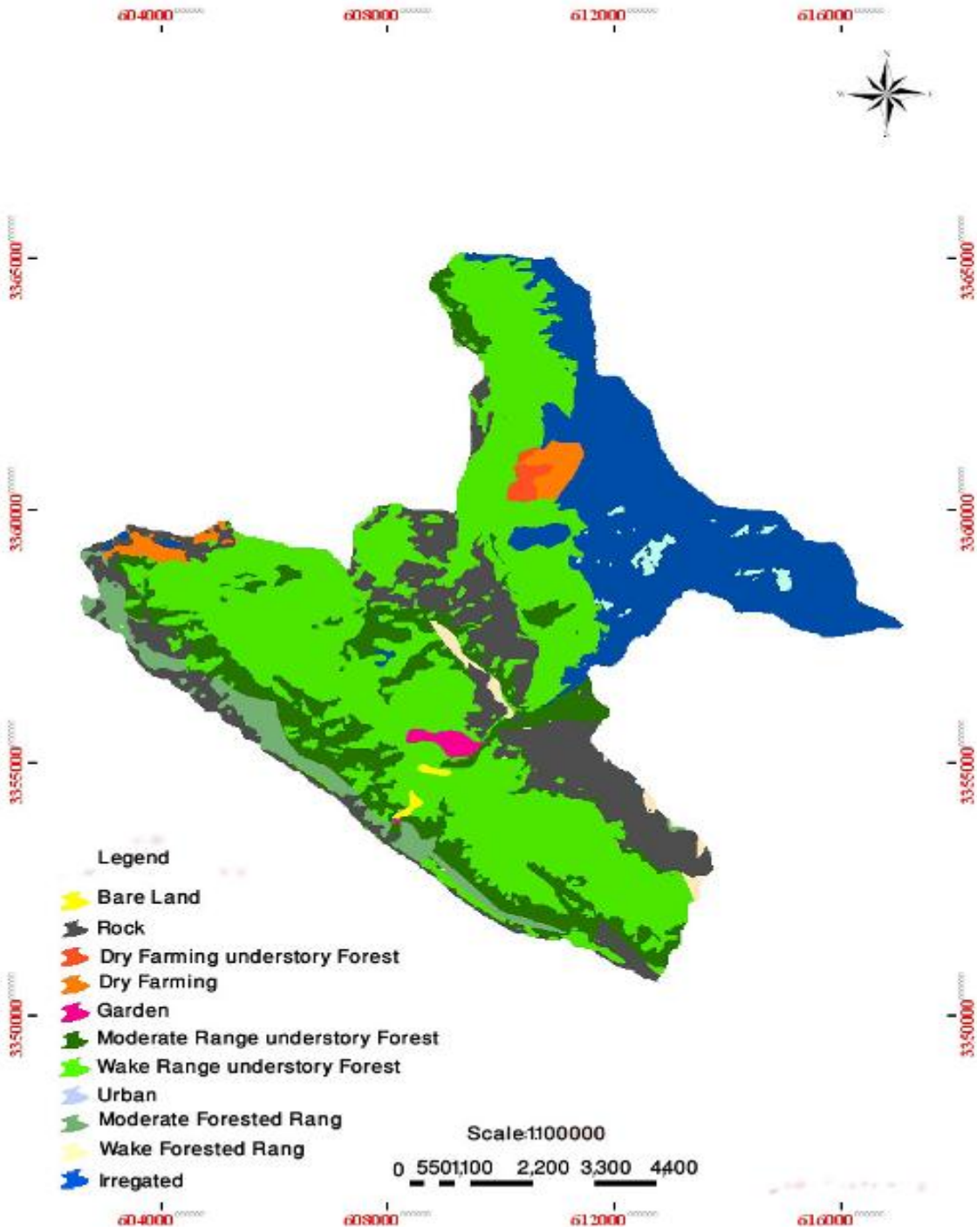

Figure 3: land use map in area of study (2005)

concord in classified layers with ground reality. Using these two methods, the accuracy of the operational layers prepared from the mentioned appraisers was calculated 0/87, 0/85, 0/84, and 0/83 respectively. In this study, instead of high correlation between bands and their variance is used of their covariance parameter, because the bands strong correlation is cause of the integration of information and pixels value in each other and as well, the things visual side and features can not be separated. However, features and

their objects will show much better when a band covariance statistical index to be used and it will more easily and sure, Identifying and separating them from each other. It should be notedto ensure of provides classes' accuracy using statistical properties presents acceptable results and Gensen method has good Confidence, due to the statistical properties of training samples.

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