Journal of Biodiversity and Environmental Sciences (JBES)
ISSN: 2220-6663 (Print) 2222-3045 (Online)
Vol. 8, No. 6, p. 87-100, 2016
http://www.innspub.net

INNSPUB
RESEARCH PAPER

OPEN ACCESS

Land use change detection using GIS and RS techniques casestudy: The South east of Zayanderood Basin, Esfahan, Iran

Vali Abbas Ali[1], Erahimi Khusfi zohre[2*], Khosroshahi Mohammah[3], Ghazavi Reza[4]

[1,2]*Department of Desert, Faculty of Natural Resources and Earth Sciences , University of Kashan, Iran*

[3]*Research Geographer, Research Institute of Forest and Rangeland, Tehran, Iran*

[4]*Department of watershed management, University of Kashan, Iran*

Article published on June 11, 2016

Key words: Change detection, Land use/Cover, Remote Sensing, GIS, Supervised Classification.

Abstract

Satellite images and geographic information system (GIS) are important data resources for the dynamic analysis of landscape transformations. The application of these data made possible to monitor the changes in different land uses in less time, at low cost and with better accuracy. In this study, Land use/ Land cover changes was investigated using of Remote Sensing and GIS in the south east of Zayanderood watershed. Multispectral satellite data acquired from images of Landsat satellite for the years 1998and 2013 was used. Processing operations was performed using ENVI4.7 software. Supervised classification-maximum likelihood algorithmwas appliedto detectland cover/land use changes observed in the study area. Studywatershed wasclassified into eight major land use classes *viz.*, Vegetation, Agriculture, Gavkhouni Wetland, Settlement area, Sand dune, Salt land, Bare land and Poor pastureland. The results indicate that over 15 years, agriculture, poor pastures, vegetation and Gavkhouni wetland have been decreased by 1.84% (326.42 km2), 1.11% (319.88 km2), 0.21%(36.4km2) and 0.14% (25.14 km2) while Settlement area, salt land, sand dune and bare land have been increased by 2.07% (366.2 km2), 0.97% (171.6 km2), 0.56%(98.4km2) and 0.4%(71.57km2), respectively. These land cover/use variations lead to serious danger for watershed resources. Therefore, an appropriate watershed management plans and conservation strategiesare required in order to protect these valuable resources or else they will soon be diminished and no longer be able to perform their function in socioeconomic development of the area.

***Corresponding Author:** Erahimi Khusfi zohre ✉ Zohreebrahimi2011@gmail.com

Introduction

Monitoring land use/cover change has become an important subject of research due to impact ofthese changes on the atmosphere; world climate; global fluid system and sea level(Meyer and Turner, 1994).Several researchers were determined the changes associated with land cover and land use properties using multi-temporal datasets (Ahmad,2012; Seif and Mokarram,2012; Zoran, 2006; Butt *et al*.,2015). Study of the temporal change of earth surface lead tobetter decision making to combat the negative effects of the land change, understanding relationships and interactions between humanand natural phenomena, consequently to better management and use of natural resources (Turner and Ruscher,2004). The main objective of change detection is to recognize those areas on digital images that characterize change features between two or more imaging dates (Sader and Hayes, 2001; Seif and Mokarram, 2012). Remote sensing and Geographical Information Systems (GIS) are effective tools to produce more accurate land-use and land-cover maps on the spatial distribution of land use/land cover changes over large areas (Carlson and Azofeifa, 1999; Zsuzsanna *et al*.,2005; Ahmed and Ahmad,2014).GIS supplies a flexible environment for storing, displaying and analyzing digital data necessary for change detection (Demers,2005). The spectral resolution, repetitive coverage, synoptic view and real time data acquisition of satellite images are the most important reasons for their use. Landsat images have been broadly employed in the classification of different landscape components at a larger scale (Ozesmi and Bauer, 2002).Change detection is useful in many applications such as rate of sand dune development, deforestation, salinization, coastal change, land use changes, habitat fragmentation, urban sprawl, and other cumulative changes. Numerous techniques and algorithms have been improved for change detection including, image differencing ,image regression, image rationing, vegetationindex differencing, change vector analysis, principal components analysis(PCA), tasseled cap(KT),spectral/temporal classification, post-classification comparison, unsupervised change detection, supervised classification and background subtraction (Singh,1989 ;Jensen,1983).Among these techniques, variousresearches have been studiedland use/land cover change detection usingremotely sensed images.Ahmad *et al.* (2016) have been assessed pattern of land cover change in the National Capital Territory of Delhi using Landsat images from year 2001 to 2011. Their results showed that growth of built-up area is higher in marginal districts, whereas relatively low along the MRTS (both metro lines and stations).Rawat and Kumar(2015) examined land use/cover change using remote sensing and GIS techniques in India during the last two decades. They indicated that vegetation and built-up land have been increased by 3.51% and 3.55% while agriculture, barren land and water body have decreased by 1.52% ,5.46% and 0.08% , respectively. Impact of land use dynamics on Zhalong wetland in China was studied using remote sensing data of Landsat MSS/TM (Na *et al*., 2015). They found that the construction of a reservoir and water diversion engineering has transformed the wetland hydrological conditions and declined the spatial distribution of the marsh landscape.Land use transition in unsustainable arid agro-ecosystemswas evaluated using remote sensing tools in northwestern Mexico over 22 years(Raul Romo-Leon *et al*.,2014).Decreasing in agricultural land and conversion to alternative economic activities, with aquaculture increasing from 0 to 10,083 ha during study period (1998-2009) was reported. Wasige *et al.* (2013) have applied the combination of ancillary data and satellite imagery in Kagera basin of lake Victoria for quantifying the land use and land cover changes between 1901 and 2010.Liao *et al.* (2013) have examined the correlation between land use change and green house gases (GHG) emissions and also studied the driving forces of land-use change and GHG emission increments using an aerial photographs and SPOT-5 satellite images from 1996 to 2007. Amin *et al.* (2012) have carried out a study on land use/land cover mapping of Srinagar city in Kashmir Valley using geospatial approach. They found that the Srinagar city has endured significant changes during 1990 to 2007. The analysis also proved that changes in land use pattern have resulted in the loss of forest area, open spaces, etcSpatial evaluation of land use changes over a period of 27 years(1984-2011) was studied in Urmia city in Iranusing remote sensing (Roostayee *et al.*,2015) . Results of this study shows that built up area has sharply increased due to construction of new buildings in agricultural and vegetation lands. Dadras *et al.*(2015) used aerial photos and satellite images of 5 periods, (1956–1965, 1965–1975, 1975–1987, 1987–2001, 2001–2012) to determine the process of expansion of the urban boundary of Bandar Abbas city. The capability of the aerial photos and satellite imagery for spatio-statistical modeling of urban geographical studies was emphasized. Sabet Sarvestani *et al.*(2011) investigated the urban growth in the city of Shiraz during three decades (from 1976 to 2005) using remote sensing and geographic information system. Cetin (2009) has evaluated the impact of urban expansion in Kucukcekmece Lagoon using CORONA and land sat TM satellite images. Saadat *et al.* (2011) presented a new protocol for LULC classification for large areas based on readily available ancillary information and analysis of three single date Landsat ETM+ images. Three Landsat imagery (1987, 1995, 2005) and LISS III satellite data for the year 2010 were used for assessing the changes trend of land cover in Hamoon wetland (Mousavi *et al.*,2014). Solaimani *et al.* (2009) have studied land use variations on soil erosion process in Neka watershed, using geographic information systems. Results of their study showed that the alteration and reformation of the land use could be effective process in order to decreasing the erosion rate.

In the present study, We utilized Land sat satellite imageries of 1998 and 2013 in order to 1)assess the trends of land use change in the south- east of Zayandehrood watershed 2) identify, quantify and classify the nature, magnitude and direction of landuse changes within the period of study.

Material and methods

Study area

The study site is the south east of Zayandehrood basin located in the south-west of Esfahan Province , Iran(31° 30' - 33° 30' latitude and 51° 30' - 53° 30' Longitude).

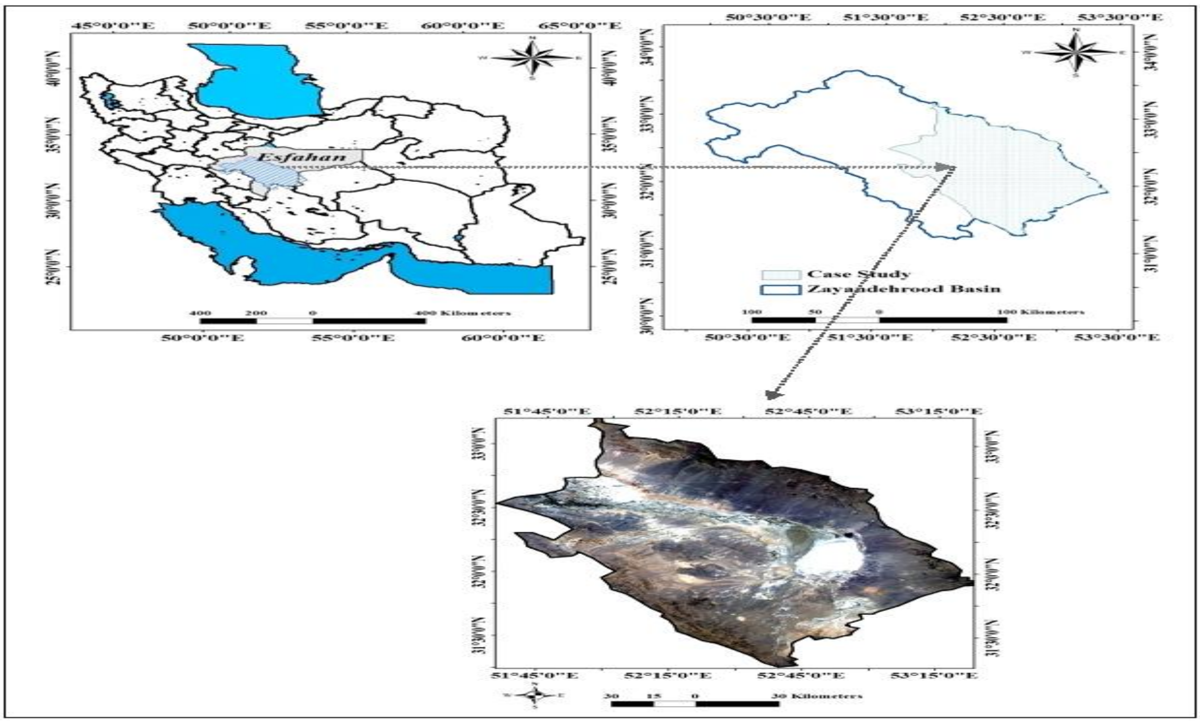

Fig. 1. Geographical location of the study in the South-East of Zayandehrood Basin, Iran.

The region covers an area of17771 Km²with a mean annual rainfall of 90 mm, a mean annual potential evapotranspiration (PET) of 3200 mm, and a mean annual air temperature of 20 °C. The average elevation of the study area is 1535.2 m above sea level. Low annual rainfall and an extremely hot weather during spring and summer make the study area as an arid area. Fig. 1 indicates geographical location of the study in Esfahan province and Iran.

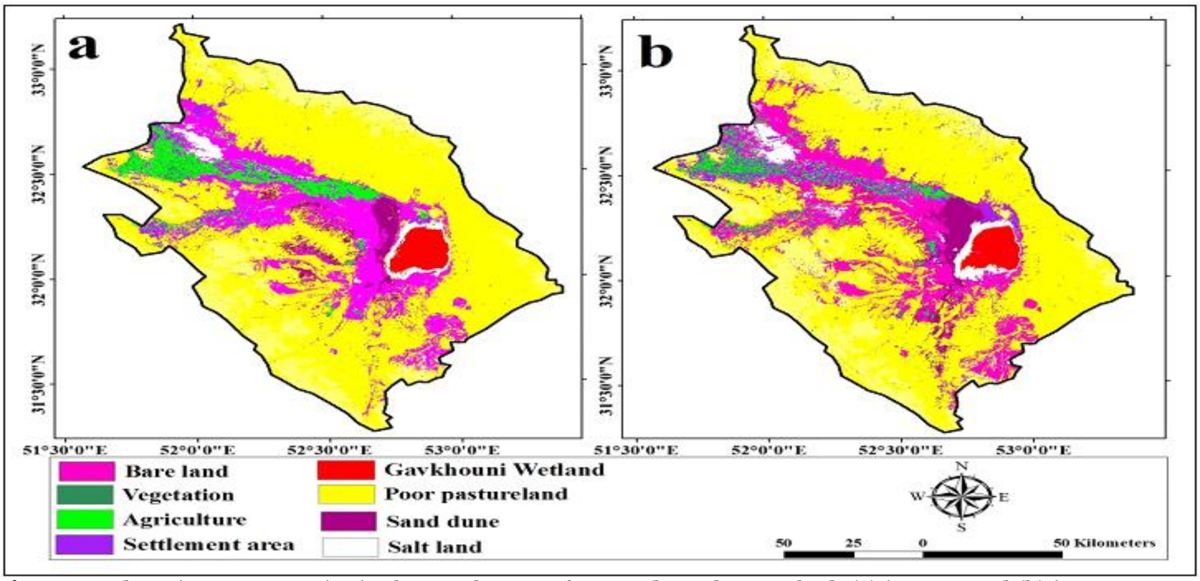

Fig. 2. Land use/cover categories in the South-East of Zayanderood watershed; (a) in 1998 and (b) in 2013.

Data collection

Based on the availability and suitability in reducing seasonal changes, Landsat satellite imageries of 1998and2013(Path: 163, Row:137) were acquired from earth explorer site (http://earthexplorer.usgs.gov/) Ancillary data included 1:25000 topographic map, 1/20000 aerial photographs from the year 1999 , road maps and river were also utilized as guide for field navigation to pick ground control points(GCP).Point reference data obtained by Geographical Positioning System (GPS) during fieldwork in August 2013 were used for image classificationand overall accuracy assessment of the classificationresults.

Table 1. Satellite data specifications.

Data	date of acquisition	Band	Resolution	Wavelength (μm)	Description
Landsat 5 TM imagery	15/08/1998	1	30m	0.45-0.52	Blue
		2	30m	0.53-0.61	Green
		3	30m	0.63-0.69	Red
		4	30m	0.78-0.90	NIR
		5	30m	1.55-1.75	SWIR
		6	60m	10.4-12.5	TIR
		7	30m	2.09-2.35	SWIR
Land sat 8(LS OLI/TIRS)	24/08/2013	1	30m	0.433-0.453	Coastal aerosol
		2	30m	0.45-0.515	Blue
		3	30m	0.525-0.6	Green
		4	30m	0.63-0.68	Red
		5	30m	0.845-0.885	NIR
		6	30m	1.56-1.66	SWIR1
		7	30m	2.1-2.3	SWIR2
		8	15m	0.5-0.68	Panchromatic
		9	30m	1.36-1.39	Cirus
		10	100m	10.6-11.2	TIR1
		11	100m	11.5-12.5	TIR2

Table 1 indicates the characteristics of the satellite data obtained for change analysis ENVI4.7 and Arcgis 10.1 software programs also wereused for processing of data and various outputs.

Image pre-processing and classification

In orderto preserve the original image radiometry,Land sat images were resampled to 30*30 meter pixel size using nearest neighbor resampling method (Serra *et al.*,2003).For geometric correction of images, 35 pairs of ground control points were pickedat road intersections, river confluence from the road and river digital maps respectively. The first degree polynomialfunctions were applied and geo-referencing process successfully yielded with total root mean square of 31%.Afterwards, the Landsat 8OLIsatellite image was also co-registered to the geo-referenced TM 1998.

Table 2. Indices used for better classification in the study area.

Equation	description	Reference
$OIF = \frac{\sum_{i=1}^{3} \sigma_i}{\sum_{j=1}^{3} \lvert R_{i,j} \rvert}$	σi: standard deviation of the first band i Ri,j : absolute value of correlation coefficient of i , j band	Chavez *et al.* (1982, 1984)
$NDVI = \frac{NIR - R}{NIR + R}$	NIR: Near Infra Red band R: Red band SWIR: Short Wave Infrared	Rouse *et al.* (1973)
$NDSI = \frac{R - NIR}{R + NIR}$		Tripathi *et al.* (1997)
$NDWI = \frac{NIR - SWIR}{NIR + SWIR}$		Gao (1996)

Table 3. Values of Transformed Divergence method for year 1998 and 2013.

Land use Categories	TD (1998)	TD (2013)
Agriculture and settlement	1.97	1.987
Agriculture and poor pastureland	1.98	1.997
Agriculture and bare land	1.99	2.000
Agriculture and Sanddune	2.00	2.000
Agriculture and salt land	2.00	2.000
Agriculture and Gavkhouni lake	2.00	2.000
Agriculture and vegetation	1.92	1.444
Gavkhouni lake and bare land	2.00	1.999
Gavkhouni lake and Sanddune	2.00	2.000
Gavkhouni lake and salt land	2.00	2.000
Gavkhouni lake and poor pastureland	2.00	2.000
Gavkhouni lake and settlement	2.00	2.000
Gavkhouni lake and vegetation	2.00	2.000
poor pastureland and bare land	1.75	1.951
salt land and bare land	1.75	1.747
salt land and poor pastureland	2.00	1.999
salt land and Sanddune	2.00	2.000
salt land and settlement	1.99	1.998
salt land and vegetation	2.00	2.000
Sanddune and bare land	1.86	1.968
Sanddune and poor pastureland	1.90	1.982
Sanddune and settlement	2.00	1.995
Sanddune and vegetation	2.00	2.000
Settlement and bare land	1.89	1.922
Settlement and poor pastureland	1.92	1.958
Settlement and vegetation	2.00	2.000
Vegetation and poor pastureland	2.00	2.000
Vegetation and bare land	2.00	2.000

The sub-setting of satellite images was performed for extracting study area from both images. The Dark Object Subtraction (DOS) method has been used tocancel out the haze component caused by additive scattering from remote sensing data (Chavez., 1988). For better classification, a variety of techniques such as Optimum Index Factor (OIF), Principal Component Analysis (PCA), Tasseled-cap, Normalized Difference Water Index (NDWI),Normalized Difference Salinity Index (NDSI) and Normalized Difference Vegetation Index (NDVI)were applied.

Table 4. Classes delineated on the basis of the fieldwork and supervised classification in the study area.

Class name	Class features
Vegetation	Regions with canopy vegetation cover more than 60% and close to wetlands and river
Agricultural land	Land planted with wheat, cotton,vegetation and gardens and follow lands
Settlements area	Buildings, transportation , industrial centers , roads, commercial
Gavkhouni wetland	A natural ecosystem, with an area of 470 Km, is located atthe end of the Zayanderud River in the Zayanderud basin
Sand dune	Hill or ridge of sands in the Varzaneh Desert and the nearby Gavkhuni wetland
Salt land	Lands with accumulation of Large amounts of soluble salts in the soil surface and poor drainage
Poor pasture	Regions with rangeland and canopy vegetation cover less than 20%
Bare land	Lands without canopy vegetation

Supervised classification method with maximum likelihood algorithm was applied in ENVI 4.7 software for identifying the land use classes. Ancillary data(GCPs) in August 2013 were used as the training samples and then both images were classified. Transformed Divergence (TD) method was used to evaluate classification accuracies. The Transformed Divergence separability measure yields real values between 0 and 2, where 0 indicates complete overlap between the signatures of two classes, and 2 indicates a complete separation between two classes. Larger separability values indicate better classification (Dutra and Huber., 1999; Tso and Mather1999; Mohd and Kamaruzaman., 2008; Gambarova *et al.*,2010).To improve classification accuracy and reduction of misclassifications, smoothing of classified images was performed by applying a 3*3 majority filter (Lillesand and Kiefer,1994).

Table 5. Extent and amount of different land use/cover categories in the South-East of Zayanderood watershedin1998 and 2013.

Land use categories	1998		2013		Change 1998-2013	
	Area (km2)	%	Area (km2	%	Area (km2	%
Vegetation	69.49	0.39	33.09	0.19	-36.40	-0.21
Agriculture	789.09	4.45	462.67	2.61	-326.42	-1.84
Gavkhouni Wetland	378.88	2.14	353.74	2.00	-25.14	-0.14
Sand dune	543.88	3.07	642.32	3.63	98.44	0.56
Settelments	560.39	3.16	926.59	5.23	366.20	2.07
Poor pastureland	12162.14	68.65	11842.26	66.84	-319.88	-1.81
Salt land	342.19	1.93	513.82	2.90	171.63	0.97
Bare land	2870.98	16.20	2942.55	16.61	71.57	0.40
Total area	17717.04	100	17717.04	100		

Accuracy assessment

In order todo anappropriate accuracy assessment, the independent data must be considered “truth,” in that they were collected without error(Congalton and Green.,1999).Although the classification data are to be useful in detection of change analysis, it is necessaryto do accuracy assessment for individual classification (Owojori and Xie,2005). The error matrix is the most common method for accuracy assessment. It can help recognize problems with a classification and improve classification by isolating misclassifications of pixels (Senseman *etal.*,1995).The columns of this matrix represent the reference data by category and rows columnsrepresent the classification by category (Janssen and van der Well, 1994). From the error matrix, several measures of classification accuracy can be calculated includes, Kappa coefficient (Eq. 1), errors of omission (Eq.2), errors of commission(Eq.3), user accuracy(Eq.4) and producer accuracy(Eq.5)(Senseman *et al.* 1995). User and producer accuracy are directly related toerrors of commission and omission, respectively (Janssen and van der Wel1, 1994).

$$k = \frac{N\sum_{i=1}^{r} x_{ii} - \sum_{i=1}^{r}(x_{i+} \times x_{+i})}{N^2 - \sum_{i=1}^{r}(x_{i+} \times x_{+i})} \quad (1)$$

Where N is the total number of sites in the matrix, r is the number of rows in the matrix, xii is number in row i and column i, $x{+}i$ is the total for row i, and $xi{+}$ is the total for column I(Jensen, 1996).

Errors of omission= pixels of a known category were *excluded* from that category due to classification error. (2)

Errors of commission= pixels in the classified imageare *included* in categories in which they do not belong. (3)

User's Accuracy (reliability) = 100% - error ofcommission (%) (4)

Producer's Accuracy = 100% - error of omission (%) (5)

Change detection analysis

In order to detectthe quantity ofland use changesover the evaluated period, apost-classificationdetection wascarried out. The classified images were compared usingcross-tabulationanalysis. In this method were determined theextent of alterations from a particular land cover in 1998 to other land cover categoryin 2013. The change matrix extracted from raster attributes of the change map indicated class- to -class transitions observed between two years (Mas *et al.*, 2004).

Table 6. Accuracy assessment for supervised classification of Landsat TM 1998 and Landsat 8 2013.

Cover class	Land sat 5(TM.1998)		Land sat 8(LS OLI/TIRS)	
	Productive accuracy	User accuracy	Productive accuracy	User accuracy
Vegetation	81.97	94.34	81.82	98.78
Agriculture	78.38	78.38	87.86	84.83
Gavkhouni Wetland	91.18	100	91.11	92.13
Residential area	84.38	71.05	81.52	76.53
Sand dune	81.13	100	86.49	100
Salt land	76.83	87.5	88.95	92
Bare land	86.73	70.25	91.3	84
Poor pastureland	89.31	88.64	97.76	94.72
Overall accuracy%	85.1		90.32	
Kapa coefficient%	82		88	

Results and discussion

Land use\land cover classification and accuracy

Five hundred and fifty six training data elements for Landsat 8 (2013) were selected to perform the supervised classification based on the ground truth data obtained by GPS during fieldwork, Google Earth satellite images, topographic maps at the scale 1/25000 and different indices (NDVI, NDSI, NDWI and OIF),in order to perform supervised classification for the Land sat TM(1998), three hundred and sixty nine training data elementswere selected based on the various color composite, indices andaerial photographs from the year 1999 (because of having the date closest to the year 1998). Table (3) indicates the training data quality obtained from Trans formed Divergence (TD) method. Using supervised classification technique, the images of the study area were divided into eight different classes namely vegetation, agriculture, Gavkhouni wetland, residential area, sand dune, salt land, bare land and poor pastureland (Fig. 2 and Table 4). The extent and amount of shifts in the various land cover/use classes were computed for both maps produced (Fig.3,4 and Table 5).

The diagrammatic illustration of land use/cover change (Fig 3), Change Detection Difference Map (Fig 4)and magnitude of change in different land classes(Table 5) indicate that bothpositive and negative changes occurred in the land use/coverpattern of the South-East of Zayanderood watershed from 1998 to 2013.The extent of agricultural, poor pastureland , Vegetation and Gavkhouni wetland have been decreased by -1.84%(326. km2), -1.81%(319.18 km2), -0.21(36.4km2) and -0.14%(25.14km2) in study period respectively While the settlement area,salt land, sand dune ,and bare land have been increased by 2.07%(366.2km2), 0.97%(171.63km2), 0.56%(98.44km2)0.54%(96.3km2) and 0.4%(71.57km2) respectively.

Table (6) show the accuracy assessment for supervised classification of Landsat TM 1998 and Landsat 8OLI 2013.

Table 7. Change matrix of different land use between 1998 and 2013 (in km2) in the South-East of Zayanderood. Watershed.

	Year 1998								
Year 2013	Vegetation	Agriculture	Settlement area	Gavkhouni wetland	Sanddune	Salt land	Poor pastureland	Bara land	Row Total
Vegetation	9.19	22.13	0.87	0	0	0.01	0.81	0.12	33.13
Agricultura	34.3	331.33	39.75	0	0	2.67	30.21	24.36	462.62
Settlement	22.14	292.08	206.95	0	1.43	18.04	246.29	139.54	926.48
wetland Gavkhouni wetland	0	0.19	0.01	331.54	0	21.49	0.38	0.15	353.75
Sanddune	0.02	2.08	15.2	0	264.17	0.22	127.38	233.32	642.37
Salt land	0.56	17.53	23.35	45.8	4.23	245.76	19.1	157.44	513.78
Poor pastureland	0.57	17.72	52.13	0	242	0.59	11276.95	252.38	11842.34
Bara land	2.71	106.04	222.14	1.55	32.05	53.42	460.83	2063.67	2942.41
Class Total	69.49	789.09	560.4	378.89	543.89	342.19	12161.95	2870.98	
Class Changes	60.3	457.76	353.45	47.35	279.72	96.43	888.25	807.39	
Image Difference	-36.39	-326.41	366.2	-25.14	98.44	171.63	-320	71.58	

The overall accuracy of the classification image was 85.1% and 90.32% for 1998 and 2013 images respectively. Kappa coefficient was 82% in the year1998 and 88% in the year 2013.Regards to USGS satellite imagery classification scheme, the minimum level of accuracy assessment in the recognition of land use /cover categories from remote sensor data should be at least 85 percent (Weng, 2002; Anderson *et al.*,1971) . The Kappa values greater than 0.80 (i.e. >80%) also represent strong agreement between the remotely sensed classification and reference data (Jensen, 2007). The results indicate that classification accuracy assessment in the present study are acceptable.In 1998 and 2013 classification,range of producer and user accuracies for individual classes was between 76.8% and 97.76%, and 70% and 100% respectively.

Two classified maps were overlaid to create the land use / cover change map, in addition to the transition matrix between 1998 and 2013. The cross tabulation matrix(Table 7) indicate the nature of change of various land use categories(the conversion in the land use classes between the two dates).

The classes defined for 1998 are taken as basis, so the changes for each class turned up as follows:

About half of dense vegetation (49.36% or 34.3 km2) was converted to agricultural land, one third (31.9%) to settlement areas , 4% to bare land and about 1.5% of the class pixels was converted to salt land, poor pastureland and sand dune. Only 13.23% of the pixels classified as vegetation in 1998 do have the same class membership in 2013.For agriculture land class, almost half of the class pixels (42%) were allocated to the same class in 2013, more than one third (37.02%) to the class settlement area and about one fourth (20.46%) shifted to other classes. More than one third of settlement area (37%) was allotted to the same class in 2013, 39.6% of class pixels converted to bare land class and almost one fourth of this land use was altered to the other categories. For Gavkhouni wetland, more than half of the class pixels (87.5%) remained Gavkhouni wetland while 12.09% and 0.41% of the class pixels were transformed to salt land and bare land, respectively. For salt land, bare land and poor pastureland classes, more than half of the class pixels (68.84%, 71.98% and 88.5% respectively) were allocated to the same class in 2013. Therefore, as seen in table (7) the lands converted to agricultural land is mostly lands covered with dense vegetation. This conversion especially occurred in the central section of the case study (Figs. 2,4).This given data expressly state that the increase in agricultural areas mostly result in some dense vegetation areas were removed and converted to agriculture lands in the region.

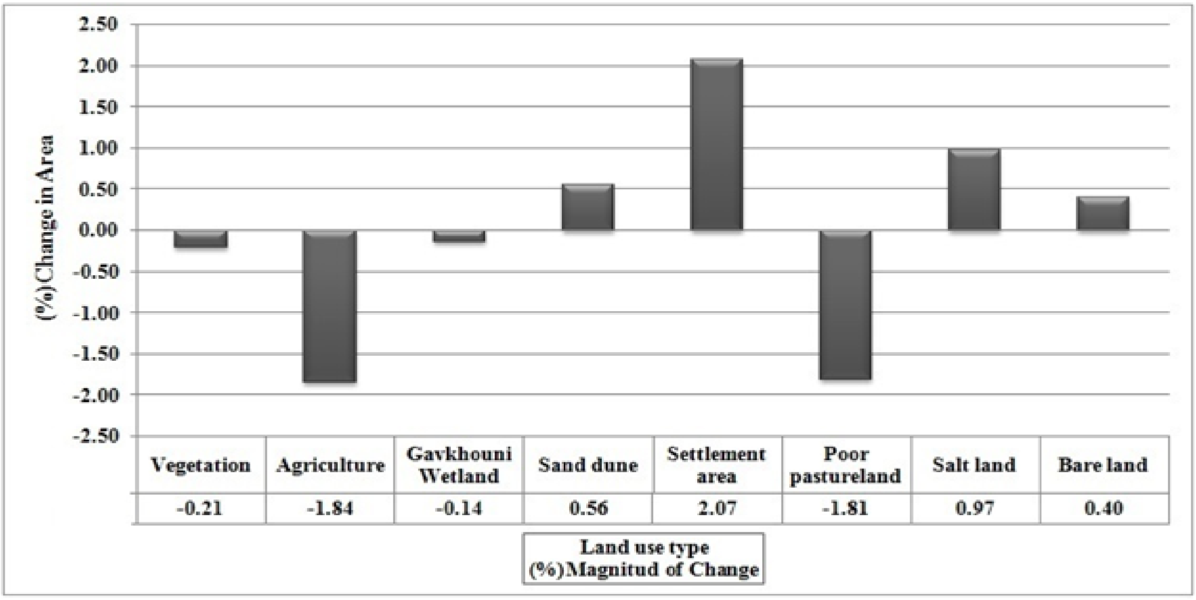

Fig. 3. The change trend of land use/cover categories during 1998-2013 in the South-East of Zayanderood watershed.

A change in the total area of Gavkhouni wetland was also observed. Supervised classification shows that the lake covered 378.88 km² area in 1998 that declined to 353.74 km2 in 2013. So Gavkhouni wetland area was decreased 25 km2 over 15 years. These area converted to the salt land and bare land in the region. Construction of new dams on Zyanderood river, increasing air temperature, decreasing precipitation, expansion of settlement areas especially in the north west of region and increasing water demand are the most important reasons for this change. This phenomenon may be led to produce salt-rich dust. Transformation of dust from dry bed of Gavkhouni swamp into coastalarea can beaffect the local public health, vegetation and soils, which are mostly not adapted to saline conditions.

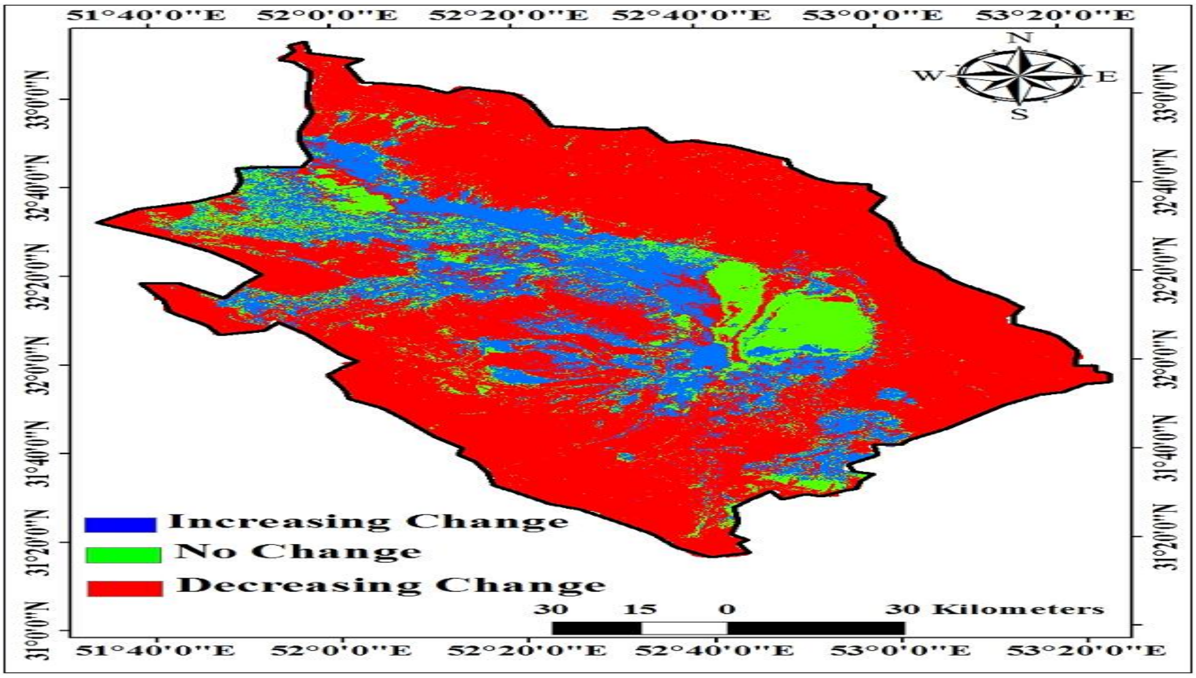

Fig. 4. Change Detection Difference Map of Landsat TM (1998) and Landsat 8-OLI (2013)in the South-East of Zayanderood.

Sand dunes were extended to the south of region between two dates (fig 4). Dune migration ratewasabout 99 km^2 per 15 years (Table 2). Sand dune area was mostly converted in to bare lands and poor pasture lands (Table 7). This may be due to recent droughts and rising temperatures which have caused reactivation and renewed growth of sand dunes on the lands of the case study.

The growing trend of sand dunes and urban development in Esfahan city has been demonstrated in the previous study (Jebali *et al.*, 2013 ; Alavi, 2012) that the results from theire research are agree with the results from the present study. Also, Suffianian and Madanian (2015) showed that the area of agricultural lands has been increased from 1975 to 2010 Which confirms the results of this research.

Conclusion

Based on the results obtained by employment of Remote Sensing data to achieve the specific research objectives, it is concluded that :

Tthe area of Residential , Salt land , Sand dune and bare land have been increased and an important impact of this expansion was subjected on Agriculture, Vegetation,Pasture and Wetland (lake) classes to desertification.

The area covered by classes of Agriculture , Poor pastureland, Vegetation, dune, and Gavkhouni Wetland have been decreased and decreasing trend in theses LULC categories can be led to decline of soil quality,increase of dust storms and wind erosion in the region.

The expansion of Salt land, bare land, Sand dunes and the decline of Agriculture, Pastureand Vegetation in the study area was mainly due to recent droughts, increasing temperatures, construction of new dams on Zayanderood river and fluctuations of water input into the river in different years.

Hence, an appropriate management of these resources is required because without appropriate management, these important resources will soon be lost or will no longer be able to perform its required function in agriculture yieldand socio-economic development of the study area.

References

Ahmad S, Avtar R, Mahendra S, Akhilesh S. 2016. Delhi ’ s land cover change in post transit era. Cities **50,** 111-118.

Ahmad F. 2012. Detection of change in vegetation cover using multi-spectral and multi-temporal information for District Sargodha, Pakistan. Sociedade and Natureza **24(3),** 557–572.

Ahmed MA , Walid AA. 2014. Integration Remote Sensing and GIS Techniques to Evaluate Land Use-Land Cover of Baghdad Region and Nearby Areas. Iraqi Journal of Science **55(1)**, 184-192.

Alavi N. 2012. Land Use And Land Cover Change Detection In Isfahan, Iran Using Remote Sensing Techniques. Master’s thesis, University of Ottawa, Canada, 134 p.

Amin A, Amin A, Singh SK. 2012. Study of urban land use dynamics in Srinagar city using geospatial approach. Bulletin of Environmental and Scientific Research **1(2),** 18–24.

Anderson JR.1971. Land use classification schemes used in selected recent geographic applications of remote sensing: Photogramm Eng **37(4),** 379-387.

Butt A, Shabbir R, Ahmad S , Aziz N. 2015. Land use change mapping and analysis using Remote Sensing and GIS: A case study of Simly watershed, Islamabad, Pakistan. The Egyptian Journal of Remote Sensing and Space Sciences **18(2),** 251-259.

Carlson TN, Azofeifa SGA. 1999. Satellite Remote Sensing of land Use changes in and around San Jose´, Costa Rica. Remote Sensing of Environment **70,** 247–256.

Cetin M. 2009. A satellite based assessment of the impact of urban expansion around a lagoon. International journal environmental science technology **6(4),** 579-590.

Chavez PS, Guptil SC, Bowell JA. 1984. Image processing techniques for thematic mapper data. Proceedings, ASPRS-ACSM Technical Papers **2,** 728-742.

Chavez Jr PS. 1988. An improved dark-object subtraction technique for atmospheric scattering correction for multispectral data. Remote Sensing of Environment **24,** 459-479.

Chavez PS, Berlin GL, Sowers LB. 1982. Statistical method for selecting Landsat MSS ratios. Journal of Applied Photographic Engineering **8,** 23-30.

Congalton RG, Green K. 1999. Assessing the accuracy of remotely sensed data: (Second edition). Principles and practices. CRC Press Taylor and Francis Group, International Standard Book Number-13: 978-1-4200-5512-2, Lewis Publishers 201 p.

Dadras M, Helmi Zm, Shafri, Noordin A. 2015. Spatio-temporal analysis of urban growth from remote sensing data in Bandar Abbas city, Iran. The Egyptian Journal of Remote Sensing and Space Sciences **18**, 35-52.

Demers MN. 2005. Fundamentals of Geographic Information Systems, John Wiley and Sons, Inc., Newyork, USA.455 p.

Dutra LV, Huber RI. 1999. Feature Extraction and Selection for ERS-1/2 in SAR Classification. International Journal of Remote Sensing **20(5),** 993-1016.

Egorova AV, Hansenb MC, Roya DP, Kommareddy A, Potapov PV. 2015. Image interpretation-guided supervised classification using nested segmentation. Remote Sensing of Environment **165**,135-147.

Fisher RA. 1936. The use of multiple measurements in taxonomic problems. Annals of Eugenics **7(2),** 179–188.

Gambarova YM, Gambarov AY, Rustamov RB, Zeynalova MH. 2010. Remote Sensing and GIS as an Advance Space Technologies for Rare Vegetation Monitoring in Gobustan State National Park, Azerbaijan. Journal of Geographic Information System **2,** 93-99.

Gao BC. 1996. NDWI – A normalized difference water index for remote sensing of vegetation liquid water water from space. Remote Sensing of Environment **58,** 257-266.

Jebali A, Jafari R, Khajedin SJ. 2013. Monitoring Sand Dunes Change of Gavkhouni International Wetland Using Sattelite Imagery. Iranian Remote Sensing and GIS **5(3),** 34-48.

Janssen LLF, vander Wel FJM. 1994. Accuracy Assessment of Satellite Derived Land-Cover Data: A Review. Photogrammetric Engineering and Remote Sensin **60(4),** 419-426.

Jensen JR. 1983. Urban/suburban land use analysis. Manual Remote Sensing **2,** 1571-1666.

Jensen JR. 1996. Introductory Digital Image Processing: A Remote Sensing Perspective Journal of Remote Sensing **10,** 989-1003.

Jensen JR. 2007. Introductory Digital Image Processing: A Remote Sensing Perspective. Prentice Hall.

Liao CH, Chang CL, Su CY, Chiueh PT. 2013. Correlation between land-use change and greenhouse gas emissions in urban areas. International Journal of Environmental Science and Technology **10,** 1275-1286.

Lillesand TM , Kiefer RW. 1994. Remote sensing and interpretation. Jhon Wiley and sons Inc., New York, 750 p.

Liu CH , Xiao-xiao MA. 2011. Analysis to driving forces of land use change in Lu,an mining area. Transactions of Nonferrous Metals Society of China **21,** 727-732

Maleky M , Saeedi Razavi B. 2013. Evaluation of Development and Changes in Land Use using Different Satellite Image Processing and Remote Sensing Techniques (Case Study: Kermanshah, Iran). Research Journal of Environmental and Earth Sciences **5(10),** 567-576.

Mas JFO, Velazquez A, Az-Gallegos D, Mayorga-Saucedo JR, Alcantara R, Boccob C, Castro R, Fernandez T, Perez-Vega A. 2004. Assessing land use/cover changes: a nationwide multidate spatial database for Mexico, International Journal of Applied Earth Observation and Geoinformation **5**, 249-261.

Meyer WB, Turner BL. 1994. Changes in Land Use and Land Cover: A Global Perspective. Cambridge,Cambridge University Press, 537 p.

Mohd HI, Kamaruzaman J. 2008. Satellite Data Classi-fication Accuracy Assessment Based from Reference Dataset. International Journal of Computer and Infor-mation Science and Engineering **2(2),** 96-102.

Mousavi SA, Shahriari AR, Fakhire A, Ranjbar F, Abolfazl Rahdari V. 2014. Assessment of changes trend of land cover with use of remote sensing data in Hamoon wetland. Journal of Biodiversity and Environmental Sciences (JBES) **4(5),** 146-156.

Na XD, Zang SY, Zhang NN, Cui J. 2015. Impact of land use and land cover dynamics on Zhalong wetlandreserve ecosystem, Heilongjiang Province, China. International journal environmental science technology **12,** 445–454.

Owojori A, Xie H. 2005. Landsat image-based LULC changes of San Antonio, Texas using advanced atmospheric correction andobject-oriented image analysis approaches. Paper Presented at the 5th International Symposium on Remote Sensing of Urban Areas, Tempe, AZ.

Ozesmi SL, Bauer M. 2002. Satellite remote sensing of wetlands. Wetlands Ecology and Management **10,** 381–402.

Raul Romo-Leon J, Willem JD, Alejandro CV. 2014. Using remote sensing tools to assess land use transition in unsustainable arid agro-ecosystems. Journal of Arid Environments **106,** 27-35.

Rawat JS, Kumar M. 2015. Monitoring land use/cover change using remote sensing and GIS techniques: A case study of Hawalbagh block, district Almora, Uttarakhand, India. The Egyptian Journal of Remote Sensing and Space Sciences **18,** 77–84.

Roostayee SH, Ahadnezhad Rooshti M , Farrokhe M. 2015. Spatial Evaluation on land use changes using satellite imagery (Case Study : Urmia). Journal of Geography and Planning, **18(50),** 189-206.

Rouse JW, Haas RH, Schell JA, Deering DW.1973. Monitoring vegetation systems in the Great Plains with ERTS. Third ERTS Symposium, NASA , 309–317 p.

Saadat H, Adamowski J, Bonnel R, Sharifi F, Namdar M, Ale-Ebrahim S. 2011. Land use and land cover classification over a large area in Iran based on single date analysis of satellite imagery. ISPRS Journal of Photogrammetry and Remote Sensing **66(5)**, 608-619.

Sabet S, Ibrahim M, Latif AB , Pavlos K. 2011. Three decades of urban growth in the city of Shiraz, Iran: A remote sensing and geographic information systems application. Cities **28(4),** 320-329.

Sader SA, Hayes DJ,Hepinstall JA, Coan M, Soza C. 2001. Forest change monitoring of a remote biosphere reserve. International Journal of Remote Sensing **22(10),** 1937–1950.

Seif A, Mokarram M. 2012. Change detection of Gil Playa in the Northeast of Fars Province. Iran American Journal of Scientific Research **73,** 122–130

Senseman GM, Bagley CF, Tweddale Scotee A. 1995. Accuracy assessment of the discrete classification of remotely-sensed digital data for landcover mapping. USACERL Technical Report. EN-95/04.31P.

Serra P, Pons X, Sauri D. 2003. Post – Classification change detection with data from different sensors: some accuracy considerations. International Journal of Remote Sensing **24(16),** 3311-3340.

Singh A. 1989. Digital change detection techniques using remotely sensed data. InternationalJournal of Remote Sensing, **10(6),** 989-1003.

Solaimani K, Modallaldoust S, Lotfi S. 2009. Investigation of land use changes on soil erosion process using geographical information system. International journal environmental science technology **6(3),** 415-424.

Suffianian A, Madanian M. 2015. Monitoring land cover changes in Isfahan Province, Iran using Landsat satellite data. Environmental Monitoring and Assessment **187(8)**, 543-560.

Tripathi NK, Rai BK, Dwivedi P. 1997. Spatial Modeling of Soil Alkalinity in GISEnvironment Using IRS data. 18th Asian conference on remote sensing, Kualalampur, A.8.1-A.8.6 p.

Tso BM, Mather PM. 1999. Crop Discrimination Using Multi-Temporal SAR Imagery .International Journal of Remote Sensing **20(12),** 2443-2460.

Turner MG, Ruscher CL. 2004. Change in landscape patterns in Georgia. USA Landscape Ecology **1(4),** 251–421.

Wasige JE, Goren TA, Eric S, Victor J. 2013. Monitoring basin- scale land cover changes in Kagera Basin of Lake Victoria using ancillary data and remote sensing. International Journal of Applied Earth Observation and Geoinformation **21,** 32-42.

Zoran ME. 2006. The use of multi-temporal and multispectral satellite data for change detection analysis of Romanian Black Sea Coastal zone. Journal of Optoelectronics and Advanced Materials **8,** 252–256.

Zsuzsanna D, Bartholy J, Pongracz R, Barcza Z. 2005. Analysis of land-use/land-cover change in the Carpathian region based on remote sensing techniques. Physics and Chemistry of Earth **30,** 109-115.