Change Detection of of Bakhtegan and Tashk Basin during 2001-2013

Hadi Esandari1, Moslem Borji 2, Hassan Khosravi 3, Sara Nakhaee Nejadfar 4, Hamed Eskandari 5

1. M.Sc. Expert in Combating Desertification, Department of range and watershed, Faculty of Natural Resources, Esfahan University of technology, Iran
2. M.Sc. Expert in Watershed Management, Department of Arid and Mountainous Regions Reclamation, Faculty of Natural Resources, University of Tehran, Iran
3. Assistance Professor, Department of Arid and Mountainous Regions Reclamation, Faculty of Natural Resources, University of Tehran, Iran
4. Ph.D. Student, Faculty of Natural Resources , University of Hormozgan, Iran
5. M.Sc. Expert in Combating Desertification, Department of Arid and Mountainous Regions Reclamation, Faculty of Natural Resources, University of Tehran, Iran

Abstract: Monitoring and evaluation of aquatic ecosystems is crucial as one of the most beautiful creations provides goods and many services for human welfare. Using remote sensing is one of the new and efficient technologies in the area of monitoring and evaluation land use changes of lakes and wetlands, which can help administrators to provide a better solution to prevent destruction of these valuable ecosystems. The aim of this research is monitoring and evaluation of land use changes of Bakhtegan and Tashk Lakes during the period of 2001-2013. The results showed that the water level of Lake during the period of study has decreased significantly (from224.5 km^2 in 2001 to 9.32 km^2 in 2013). On the other hand, at the beginning of the period study (2001), the area of agricultural lands and riparian area of the lake were 1449.6 and 602.7 km^2 but at the end of it (2013) they were 1217.5 and 6.98 km^2, respectively. So the area of agricultural lands and riparian area of the lake have also declined in this period. By reducing the water level of the lakes and Agricultural lands, the area of urban and salt marsh lands has been added. Urban and salt marsh lands were 7.9 and 610.5 km^2 in 2001 but they were 8.46 and 1574.38 km^2 in 2013, respectively. Thus the significant increase in the salt marsh lands occurred in the study area.

Keywords: Bakhtegan and Tashk lakes, Land use changes, Remote Sensing.

Introduction

Assessment of land use changes is a process that leads to correct understanding of the interaction between humans and the environment. This is more important in environmental sensitive areas of aquatic ecosystems, especially wetlands and lakes (Jahani shakib et al., 2014 and Lambin and Geist, 2006). Planning for the conservation and development of wetlands and lakes need to monitor their changes during the time. Using remote sensing is one of the new and efficient technologies in the area of monitoring and evaluation land use changes of lakes and wetlands, which can help administrators to provide a better solution to prevent destruction of these valuable ecosystems (Mozafary et al., 2014, Zebardast and Jafary, 2011, Reed et al., 2009, Wang et al., 2009, Jones et al., 2009, Dennison et al., 2009, Rassl et al., 2009, Crabtree et al., 2009 and Ozesmi And Baur, 2002). Therefore, monitor and assess the fluctuations of the wetland area and these changes impact on their environment according to the high threshold of environmental sensitivity in these habitats is very important.

There are several studies in global and national levels about land use changes monitoring of aquatic ecosystems using satellite images. Zhao et al., 2010, in their research Based on landscape data produced from integrated Landsat MSS.TM.ETM+ images and spatial metrics presented a synthesis of wetland landscape changes in the Pearl River estuary from 1979 to 2009, and explored the spatio-temporal characteristics of wetland change. Their Results indicated that the total area of wetlands in the study region decreased and most of natural wetlands changed to artificial wetland, and artificial wetland changed to urban land and other land. Urban development, as a main reason, caused the reverse succession of wetland landscape in their study area. Schmid et al., 2005, determine changes of wetland characteristics in semiarid environments in Spain. Their results showed that the selected wetland components have undergone important changes in both their total area as well as their spatial distribution. These changes are mainly associated with the anthropogenic impact. Pastor et al., 2010, examined the effects of drought in the Mediterranean wetland in south-eastern Spain and determined by using satellite images which cover the ground, vegetation, soil and water in this area is severely damaged compared to previous years. Wang et al., 2011, studied the destruction and erosion of wetlands in the Yellow River, Shandong Province, China. They concluded that drought and human activities, such as population growth and urbanization are the main causes of degradation in their study area over the past century, especially in 50 recent years. Ghorbany et al., 2012, studied land use changes in international wetlands of Ala-Gol, Alma- Gol & Ajay-Gol in Turkaman Sahra, using multi-temporal satellite images. Results showed that during their research period (1987-2010) many changes in land use area has occurred which these changes include reduction in wetlands area, reduction of salt lands, reduction in vegetation with high density, increase in vegetation with low. Average density, and finally stability of the arid land area. The main causes of these changes should be explored in issues such as droughts, dam construction, extra wetlands water consumption in agriculture, fish farming and construction of canals and roads. Rafeei et al., 2011, examined changes in Neyriz wetland ecological using TM landsat temporal images. Their results indicated that the main changes in studied period were increasing area of salt in studied wetland about 129% and amount of water was reduced by 30%. Zebardast and Jafary, 2011, studied changes of Anzali wetland. The results of their study showed that eutrophication has increased in this wetland and its area has decreased during the period of study. Hashemi Tangestani et al., 2013, in the study of changes in Bakhtegan lake, Fars province, concluded that changes of land use and land cover around the lake zone are connected with changes of lake water level and whenever water zone area decreases, an area of wasteland and Salt marsh increases, which indicates lake is drying. Rahimy Bluchi and malek Mohammadi, 2013, evaluated environmental risks of Shadegan international wetlands. They concluded that physical changes such as change of natural habitats, changes in water flow like dam construction, water pollution caused by the discharge of

sewage into the wetlands, excessive utilization of biologically productive wetlands and phenomenon of drought are the most important wetland-threatening risks in Shadegan pond. Mozafari et al., 2014, in assessment of precipitation on Maharloo lake water level changes using remote sensing data, concluded that many changes in land use area has occurred which these changes include reduction in wetlands area (107 km^2) in 10 years period study (1999-2009) that mainly due to lower 200 mm of rainfall in this time.

According to studies about this issue and the importance of Bakhtegan and Tashk lakes in the province of Fars in southern Iran, in this study, assessment of the land use changes in these lakes and its related phenomena will be discussed by using satellite images.

Martial mad Methods

The study area

Bakhtegan Lake is a salt lake in Fars Province, southern Iran. It is Iran's second-largest lake and has the watershed with the area of 2.721.656 hectare. Tis basin is situated between 51 degrees and 44 minutes and 54 degrees 30 minutes east longitude and 29 degrees 7 minutes and 31 degrees 15 minutes north latitude. Fig 1 showed the geographical location of the two lakes in Iran and in Fars Province.

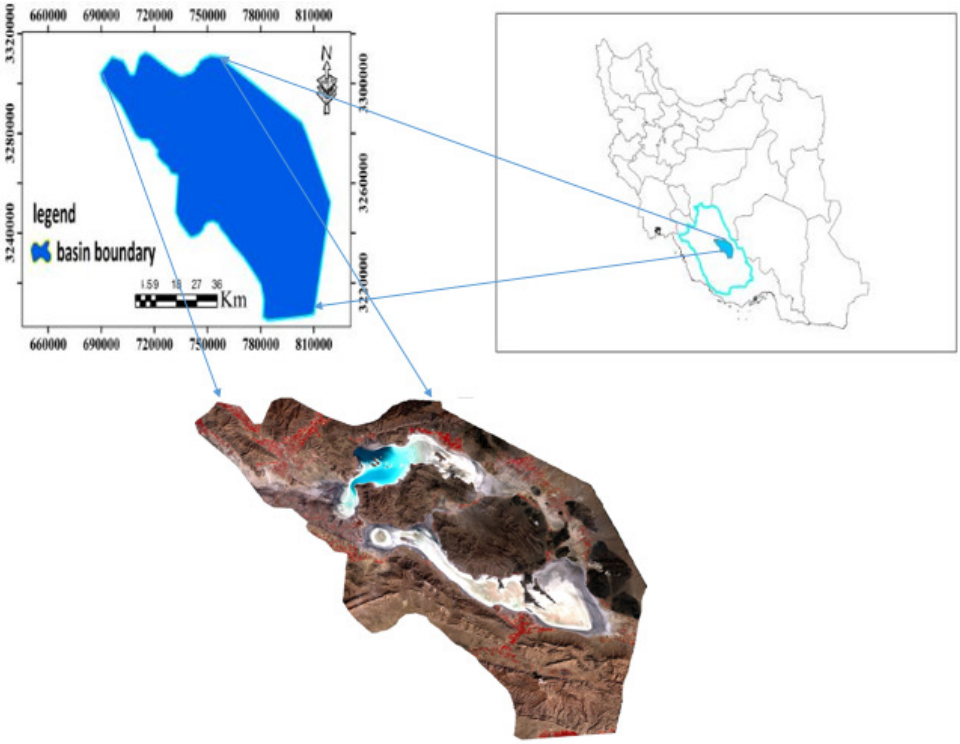

Fig1: location of the study area

They are fed by the Kor River. Several dams on the Kor River have significantly reduced water flow into the lake, increasing its salinity. Lake height from sea level is 1525. The lake water near river estuary is sweet so sometimes the lake's water is used for agriculture there (Teimury et al., 2011).

Methodology

To achieve the main objectives of the study, available TM 2000 and ETM 2012 satellite sensor imagery Bakhtegan and tashk international wetlands were selected and also data from field visit was used as more information. The processing and analysis of satellite imagery was conducted in ENVI 5.1 software. In order to prepare a land use changes map, supervised classification method and maximum likelihood method was used. After classification, all the land uses of study area were divided into six classes (water, agricultural land, salt marsh lands, riparian area lands, mountains and residential land). Finally these layers were transferred to Arc GIS 10.1 software for calculating the area of land uses and creating appropriate output map.

Maximum likelihood classification (MLC)

MLC is the most common parametric classifier which assumes normal or near normal spectral distribution for each feature of interest and an equal prior probability among the classes. This classifier is based on the probability that a pixel belongs to a particular class. It takes the variability of classes into account by using the covariance matrix (Tso et al., 2001). Determining the type and number of classes is the first step in the supervised classification. This method based on the accurate recognition of intended classifications (Li & Yeh, 1998).

Results

In this study, in order to evaluate area changes of land uses in Bakhtegan and Tashk lakes, the land use map based on supervised classification method was used with applying the most similar. Figures 2 and 3 show the illustrations extraction of the land use map for the years of 2001 and 2013. Also the area of wetlands and its changes have shown in Table 1.

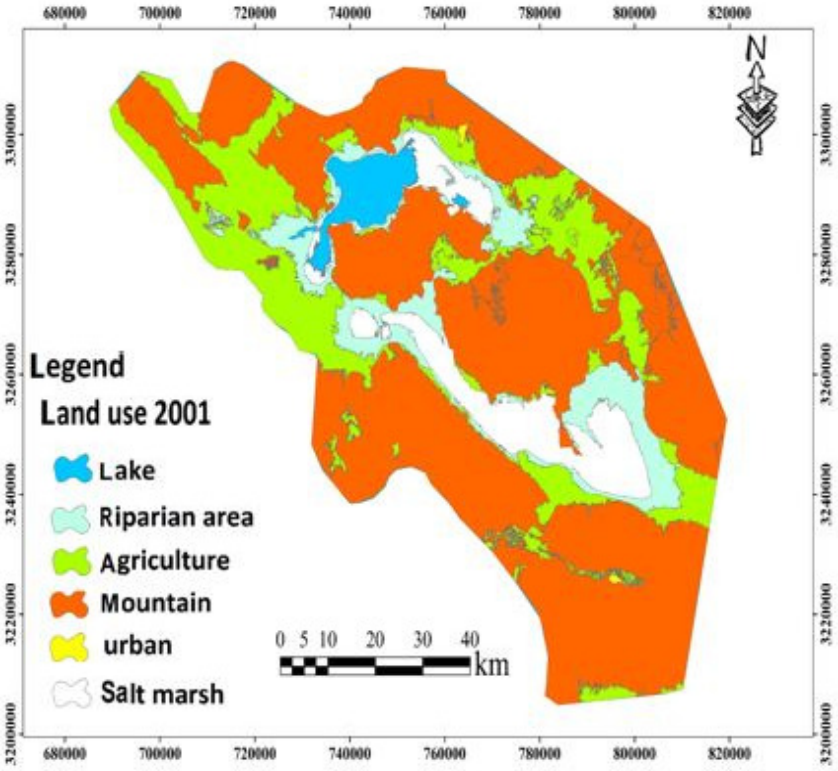

Fig 2. The map of land use changes in 2000

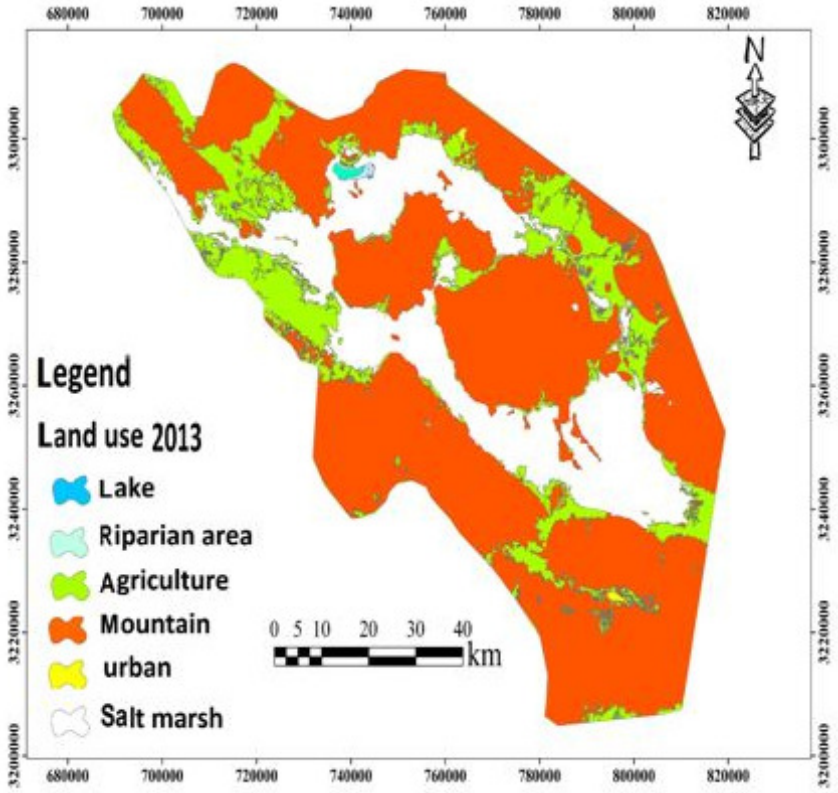

Fig 3. The map of land use changes in 2013

Table 1: the area of land use changes in 2000 and 2013

Land use	2013		2000	
	Percent	Area (km^2)	Percent	Area (km^2)
lake	0.1	9.32	3.12	224.5
Agriculture	16.91	1217.5	20.14	1449.6
Salt marsh	21.87	1574.38	8.47	610.5
Riparian area	0.09	6.98	8.07	602.7
Mountain	60.1	4301.8	60.1	4301.8
Urban	0.93	8.46	0.1	7.9

Conclusion and Discussion

Trend assessment of changes in an ecosystem is one of the important applications of remote sensing data which has a relatively high accuracy in determining land use. On the other hand, investigation of changes in aquatic ecosystems, direction determination of them and development of appropriate management about them is very important during the time. Therefore in this study was discussed trend assessment of land use changes of Bakhtegan and Tashk lakes in the period of 2001-2013. The results of using Landsat data in this study represent the efficiency images in land use mapping due to available and updated this date. As many researchers have attempted to use these images to obtain this valuable target. Based on Figure 2 and Table 1, the water level of Lake during the period of study has decreased significantly (from224.5 km^2 in 2001 to 9.32 km^2 in 2013) so the lake is exposed destruction. On the other hand, at the beginning of the period study, the area of agricultural lands and riparian area of the lake were 1449.6 and 602.7 km^2 but at the end of it, they were 1217.5 and 6.98 km^2, respectively. So the area of agricultural lands and riparian area of the lake have also declined in this period. However, by reducing the water level of the lakes and Agricultural lands, the area of urban and salt marsh lands has been added. Urban and salt marsh lands were 7.9 and 610.5 km^2 in 2001 but they were 8.46 and 1574.38 km^2 in 2013, respectively.

Reference

Crabtree, R., Potter, C., Mullen, R., Sheldon, J., Huang, S., Harmsen, J., & Jean, C. (2009). A modeling and spatio-temporal analysis framework for monitoring environmental change using NPP as an ecosystem indicator. Remote Sensing of Environment, 113(7), 1486-1496.

Dennison, P. E., Nagler, P. L., Hultine, K. R., Glenn, E. P., & Ehleringer, J. R. (2009). Remote monitoring of tamarisk defoliation and evapotranspiration following saltcedar leaf beetle attack. Remote Sensing of Environment, 113(7), 1462-1472.

Ghorbani, R., Taghipour, A. A., Mahmoudzadeh, H., 2013. Analysis and Evaluation of Land Use Changes in International Wetlands of Ala-Gol, Alma- Gol & Ajay-Gol In Turkaman Sahra, Using Multi-temporal Satellite Images, Geography and Environmental Planning Journal, 48(4): 167-186.

HashemiTangestani, M., Beyranvand, S., Tayyebi, M. H., 2013. Change Detection of Bakhtegan Lake, Fars Province, During 1956-2007, Journal of environmental studies, 39(3): 189-199.

Jahani Shakib, F., Malek Mohammadi, B., Yavari,A.,Sharifi,Y And Adeli. (2014). Assessment Of Wetland Landscape Changes In Land Use And Climate Change, With A Focus On Environmental Impacts. Ecology, 40 (3), 631-643.

Jones, D.A., Hansen, A.J., Bly, K., Doherty, K., Verschuyl, J.P., Paugh, J.I., Carle, R., Story, S.J (2009) "Monitoring land use and cover around parks: A conceptual approach," Remote Sensing of Environment, 113: 1346-1356.

Lake ice, and NDVI in southwest Alaska. Remote Sensing of Environment, 113, 1443–1452.

Lambin, E. F., Geist, H., & Rindfuss, R. R. (2006). Introduction: local processes with global impacts. In Land-use and land-cover change (pp. 1-8). Springer Berlin Heidelberg.

Leila Rahimi Baluchi., L and Malek Mohammadi., B. Shadegan international wetland environmental risk assessment based on ecological performance indices. Journal of Ecology, spring 1393, Volume 39, Number 65 :101-112

Li, X.,Yeh, A. G. O., 1998.Principal component analysis of stacked multitemporal images for the monitoring of rapid urban expansion in the Pearl River Delta. International Journal of Remote Sensing 19, 1501–1518.

Melendez-Pastor, I; Navarro-Pedreno J; Gomez, I; Koch, M (2010); Detecting drought induced environmental changes in a Mediterranean wetland by remote sensing; Applied Geography; 30, 254-262

Mozaffari, GA., & narangi fard,m,. Evaluation of precipitation on lake water level changes using sensing data Dvr.nshryh Akvbyvlvzhy wetlands, Spring 1393, Volume 6, Issue 19: 73-82

Ozesmi, S. L., & Bauer, M. E. (2002). Satellite remote sensing of wetlands. Wetlands ecology and management, 10(5), 381-402.

Reed, B., et al. 2009. Integration of MODIS-derived metrics to assess interannual variability in snowpack,

Ressl,R., et al. 2009. Operational active fire mapping and burnt area identification applicable to Mexican nature protection areas using MODIS-DB data. Remote Sensing of Environment, 113, 1113–1126.

Schmid, T; Koch, M; Gumuzzio, J) 2005)Multisensory Approach to Determine Changes of Wetland Characteristics in Semiarid Environments) Central Spain) Geoscience and Remote sensing; Vol. 43 No. 11, November; 2516-2525.

Stewart, S., & Rassl, D. (2009). Advances in the understanding and classification of pulmonary hypertension. Histopathology, 54(1), 104-116.

Teymoorey, I., Pour Ahmad, A., Habibi, L., Salarvandian, F., 2012. Using the Fuzzy C-means Classification Method for the Need Water Determination of Lakes Bakhteghan & TashkGreen, Physical Geography Research Quarterly, 43(77): 21-37.

Tso, B., Mather P. M., 2001. Classification methods for remotely sensed data. Taylor and Francis. New York.

Wang M, Qi S, Zhang X (2011) Wetland loss and degradation in the Yellow River Delta, Shandong Province of China. Environ Earth Sci 67(1):185–188

Wang, Y., Mitchell, B. R., Nugranad-Marzilli, J., Bonynge, G., Zhou, Y., Shriver, G (2009) "Remote sensing of land-cover change and landscape context of the National Parks: A case study of the Northeast Temperate Network," Remote Sensing of Environment, 113: 1453-1461

yusef Rafii ; bahram Malekmohammadi ; aliakbar Abkar ; ahmadreza Yavari ; majid Ramezani Mehrian ; hamid Zohrabi, 2011, Environmental Change Detection of Wetlands and Protected Areas Using Multi Temporal Images of TM Sensor (Case Study: Neyriz Wetland, Iran), Journal of environmental studies, 37(57): 65-76.

Zebardast, L., Jafari, H., Use of Remote Sensing in Monitoring the Trend of Changes of Anzali Wetland in Iran and Proposing Environmental Management Solution, Journal of environmental studies, 37(57): 1-8.

Zhao, H; Cui, B; Zhang, H; Fan, X; Zhang, Z Lei, X (2010); A landscape approach for wetland change detection (1979-2009) in the Pearl River Estuary; Procedia Environmental Sciences; 2, 1265-1278