Monitoring, assessment and prediction of spatial changes of Land Use /Cover using Markov Chain Model (Case study: Shushtar- Khuzestan)

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Extended Abstract

Introduction

In recent years, the growth of urbanization in Iran and the increase of migration to the major cities have led to the sudden and abnormal expansion of these cities, degradation of fertile lands and natural resources, and irreparable damages to the nature. As the population of the city of Shushtar has increased, there has been a lot of growth in the built lands in the region, causing a large change in the use of the lands around the city and the degradation of the fertile lands in the suburbs; so that, the continuation of this process could cause irreparable damages to the environmental resources of the region. Land-use prediction models are essential in planning for sustainable use of the lands (Kamusoko et al., 2009: 435, Mas et al., 2004: 94, Sohl and Claggett, 2013: 235). In addition, predicting land use changes and creating a relation between these changes and their socio-economic consequences is very important for sustainable land management (Whitford et al., 2008: 340). So far, the Markov-genetic model has been used in several studies. Wu et al. (2006) studied the monitoring and forecasting of the Beijing region of China over a 16-year period and used the Markov chain model and regression to predict the land use. Therefore, the purpose of this study was to investigate the trend of land use changes over the past years and predicting the land use and land use changes using the Markov chain model in the city of Shushtar in Khuzestan province. By predicting land use variations, the development and degradation of the resources can be identified and it can be led to managing the changes in the appropriate pathways (Brown et al. 2000: 247, Hathout, 2002: 229 and Jenerette et al., 2001).

Materials & Methods

The study area of this research is Shushtar city with an area of 340645.2 hectares located in the North of Khuzestan province. The software packages used in this research include ArcGIS 10.2, ENVI 4.8 and IDRISI Selva 17.0. The images used to extract ground cover classes include Landsat series satellite images; these images were used in this research due to having a long time series, having an appropriate spatiotemporal resolution to study the land cover changes, and being free. Regarding the existing land uses in the region, the research objectives, and the capabilities of the images used to extract useful information, especially the land use mapping, four land uses including rangeland, irrigated agricultural lands, rainfed agricultural lands and residential lands were considered. In the analysis of the Markov chain, the cover classes are used as the states of the chain. To determine the possibility of a change, the chain

needs two land use maps (model inputs), which are usually obtained by processing the satellite images (Mitsova et al., 2011: 141). Markov chain analysis was performed using Markov chain order in the Idrisi Selva software. Markov chain analysis is provided for two purposes, the first matrix is used for calibration and the second one is used to simulate the possible changes occurring in the future. The output of the model also includes the possibility of transforming the state, transition area matrix for each class, and at the end of the conditional probability images for converting different uses (Gilks et al., 1996: 19 and Weng, 2002: 273).

Regarding the trend of changes during these three periods, the irrigated and residential lands classes had an increasing state, but on the contrary, rainfed lands and rangelands classes had been decreasing. The accuracy of classifications is generally more than 77%, and suitable for use in the Markov model. The results of the detection of changes in 2030 are such that if the current trend continues in the region, 20.33% will be added to the area of the irrigated agricultural land use, so that irrigated agricultural land use constitutes 60.95% of the area in 2030. This increase is due to the changes of the land uses of rangeland and rainfed to the irrigated agriculture. The decrease in the rangeland and rainfed classes will be 21.12% and 0/21% respectively which will be added to the area of the irrigated agricultural lands. These changes are more pronounced around the rural areas in the region.

Results & Discussion

During the research period, irrigated agriculture has been the most dynamic land use in the region. The area of these lands has increased from 1989 to 2015, so that, 1350131.69 ha has been added to the area of this land use during the three study periods. In the first period, the annual rate of increase was 3650 hectares and in the second period the annual rate increase was 3998 hectares. Considering the lack of change in regional governance and planning, the trend is such, that more than 60 percent of the plain area will be covered by this class in 2030 which can be led to changes in the ecosystem conditions. This result is consistent with the results of Gholamali Fard et al. (2014) in the middle coasts of Bushehr province and is not consistent with the results of Ali Mohammadi et al (2010), Dejkam et al. (2015), and Ramezani and Jafari (2014).

Conclusion

In general, the results of this study indicate an increase in the area of irrigated agriculture, as well as development of the Shushtar, which has occurred through the disappearance of rangelands and rainfed lands. As it is well known, if the current strategy of land use in this area continues to reduce natural lands and increase urban lands, regardless of sustainable development considerations until 2030, significant environmental problems, including degradation of rangeland, decline in production of the major agricultural products of the region, decrease in the fertility, and increase in the deserts, will be a serious threat to the future ecosystem of the region. Also, considering the current productivity status, the region's economy which is based on the agricultural and livestock production will face a serious threat in 2030. Therefore, this research recommends the use of resulting maps to identify the sensitive areas for better planning and management of the executive organizations.

Key words: Land use changes, Forecasting, Markov chain model, Shushtar, Landsat images, khuzestan, Monitoring