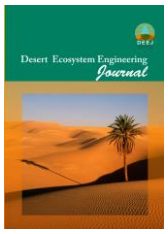
DEEJ (2018) 6 (17) 15-26

University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: http://deej.kashanu.ac.ir



Land use Changes Modelling using Satellite Data and Markov Chain (case study: Samal Watershed in Bushehr province)

Gholamreza Rahi[1], Ataollah Kavian*[2], Karim Soleimani[3], Ali Akbar Nazari Samani[4], Hamid Reza Pourghasemi[5]

Received: 5/07/2017 Accepted: 21/12/2017

Introduction

Assessment of land use spatiotemporal changes provide valuable data for managers to elaborate plans. Land use change modeling is one of the methods used by planers to manage land use changes. Detection of such changes may help decision makers and planners to understand the factors in land use and land cover changes in order to take effective and useful measures. Remote sensing (RS) and geographic information system (GIS) techniques are among the effective tools to detect and assess land use changes. Land cover mapping and change detection have increasingly been recognized as one of the most effective tools for environmental resource management. The latter is recently one of the most widely used techniques to predict land use through the variation of this model. The Markov prediction methods can serve to analyze the dynamic behavior of land use in a time-space pattern to provide forecasts of future changes that can help in making decisions. The present study aims to predict land use changes using Markov chain model in Samal watershed in Bushehr province.

Methods

The study area is located in the southwestern of Iran, in the Bushehr Province, with a surface area of 29,750 ha. Geographically, it is located between longitudes 51°7′ to 51 25′E and latitudes 28°59′ and 29°10.5′ N. Land use maps of the study area were prepared from Landsat images (L5-TM-1992, L7-ETM+-2002 and -L8-OLI-2013). Firstly, the pre-processing and the necessary processing such as geometric and atmospheric correction, as well as the vegetation index were made. NDVI and principal component analysis were used to separate the green cover and barren land, respectively. The classification accuracy can be assessed by an error matrix. Many measurements such as Kappa coefficient have been proposed to improve the interpretation of the error matrix. In the region, three major uses including grassland, bare land, and agriculture lands were identified. In this study, to classify the supervised classification, maximum likelihood method and to determine the comparative method of classification changes used. Each of the land use and land cover map was compared to the reference data to assess the accuracy of the classification. The reference data were prepared by

1. PhD student of Watershed Management, Sari Agricultural Sciences & Natural Resources University
2. Associate Professor, College of Natural Resources, Sari Agricultural Sciences & Natural Resources University ataollah.kavian@gmail.com
3. Professor, College of Natural Resources, Sari Agricultural Sciences & Natural Resources University
4. Associate Professor, College of Natural Resources, University of Tehran
5. Assistant Professor, College of Natural Resources, Shiraz University

considering random sample points, the field knowledge, and Google earth data. The ground truth dataset was obtained and used to verify the classification accuracy. In order to predict land use for 2023, a Markov Chains and Cellular Automata (CA), which are based on probabilistic modeling techniques, were employed. The combination of Markov and Cellular Automata (CA_Markov) allows simulating the evolution of the geographical area represented by pixels. Each pixel can take a value from a finite set of states. In this research, we use the 1992 and 2002 land cover maps to predict the 2013 land cover map and then use the 2002 and 2013 land cover maps to predict the 2001 land cover map.

Results

The results showed that TM, ETM+, and OLI images were classified respectively with 84.45, 99, and 98% accuracy and 0.82, 0.98, 0.97 kappa coefficients. The analysis of the change dynamics was assessed based on the results of calibration periods using kappa coefficients showed that the period 2002-2013 has the highest accuracy to predict 2023 land use map. The results of the land use changes showed that over the period 2002-2013, the decrease rate in grassland and agriculture land was 2.19 and 4.18%, respectively. Also during this period, bare land increased 56.13%. Overall, the results showed that rangeland has the most stability and non-vegetated lands have the least stability. Changes in the extent of bare land of the study area were further projected until 2028, indicating that the area of bare land could be continuously reduced.

Discussion and Conclusion

This study employs three time-period changes to better account for the trend and the modeling exercise. The Markov chain analysis describes the change of one land cover to another and predicts its trend. Modeling of land cover change plays a major role to understand the impacts of the changes. The results show that the RS and GIS technology is an effective approach in the analysis of land use change modeling with Markov. Finally, using Markov chain analysis land cover area statistics were predicted for the year 2020. This analysis would help to have an aggregate view of the future setting of Samal Watershed use to guide the policymakers.

Keywords: Markov chain, Accuracy assessment, Landsat satellite, Land use modeling.