RS & GIS for Natural Resources
(Vol. 11/ Issue 2) Summer 2020
Indexed by ISC, SID, Magiran, Noormags, Civilica, Google Scholar
journal homepage : www.girs.iaubushehr.ac.ir

Compilation of a model for hazardous waste disposal site selection using GIS-based multi-purpose decision-making models

Mahboobeh Hajibigloo, Vahed berdi Sheikh, Hadi Memarian, Chooghi Bairam komaki

Received: 9 March 2020 / Accepted: 12 May 2020
Available online 5 July 2020

Abstract

Background and Objective Land use/cover changes (LU/LC) are considered as one of the most important issues in natural resource management, sustainable development and the environmental changes on a local, national, regional and global scale. Changing uses into each other and changing permissible uses into impermissible uses such as changing agricultural lands into residential regions or changing rangelands into eroded and low-yielding dry farming lands are always considered as importand issues in natural resources. Detection of the patterns of the land use changes and prediction of the changes in the future to carry out suitable planning for optimal utilization of uses in natural resource management reveal the need for modeling spatial and temporal changes of LU/LC.
This study aims to assess the efficiency of the integrated model of Markov chain automatic cell (CA-Markov model) in simulation and prediction of spatial and temporal changes of Land use/Land cover (LU/LC) in Gorgan-rud river basin by applying three-dimensional Pentius-Melinus analysis in calibration of land use changes by using three assessment indices of Quantity Disagreement, Allocation Disagreement and Figure of Merit as new indices in the assessment of the accuracy of CA-Markov model.

Materials and Methods In this research, the Earth observing sensor images of Landsat-5 Thematic Mapper (TM) and Landsat-8 Operational Land Imager (OLI) acquired from the U.S. geographical site dependent on the U.S. Geographical Survey (USGS) were used to predict land use changes by using the integrated model of Markov chain automatic cell in Gorgan-rud river basin. Seven land use classes were separated for Gorgan-rud river basin including forest land class with the use code 1, agricultural land class with the use code 2, rangeland class (a mixture of shrubbery,langeland,agriculture) with the use code 3, water bodies class with the use code 4, barren land class (barren, rangeland, agriculture) with the use code 5, residential and industrial region class with the use code 6, streambed class with the use code 7.
In this study, object-oriented classification method and Support Vector Machine (SVM) algorithm were used to classify Landsat 5 and 8 satellite images and extract the land use classes of Gorgan-rud river basin. Segmentation scale in this algorithm on a 50 unit scale (SL 50) was selected to classify the satellite images of 1987, 2000, 2009 and 2017. The assessment of the accuracy of Support Vector Machine algorithm in the object-based classification of satellite images was done by representing overall accuracy, Kappa cefficient, user accuracy, producer accuracy, commission error and omission error for four study periods. To understand how the changes in the region were created during the period of the study three decades and which classes had the area expansion and which classes had the area decrease, changes in the limits of the classes were revealed and percent of the changes in each class were obtained by using the classification maps and IDRISI software.

M. Hajibigloo(✉)[1], V. berdi Sheikh [2], H. Memarian [3], Ch. Bairam komaki [4]

1. PhD. Student of Watershed Management, Faculty of Range and Watershed Management, Gorgan University, Gorgan, Iran
2. Associate Professor, Department of Watershed Management, Faculty of Range and Watershed Management, Gorgan University, Gorgan, Iran
3. Associate Professor, Department of Natural Resources, Faculty of Natural Resources, University of Birjand, Birjand, Iran
4. Assistant Professor, Department of Arid Zone Management, Faculty of Range and Watershed Management, Gorgan University, Gorgan, Iran
e-mail: hajibigloo@gmail.com

CA-Markov model predicts the changes of different groups of LU/LC units based on spatial neighbourhood concept, transition probability matrix. Preparing land suitability maps is necessary to predict land use changes so that spatial changes can be controlled for each use by probability rules via filtering suitability maps. Validation of Markov model was performed by using three-dimensional Pentius-Melinus analysis with three assessment indices of Figure of Merit, Quantity Disagreement and Allocation Disagreement.

Results and Discussion Support Vector Machine algorithm in the classification of the land use based on object-oriented showed that the highest rate of commission error and omission error were observed in rangelands and agricultural lands with 19.12 and 18.55 percent respectively in the land use map of the year 2009. The lowest accuracy of the producer with 71.49 percent belongs to the rangeland use class in the land use map of the year 2009 and the lowest use accuracy with 71.45 percent belongs to agricultural land use class in the land use map of the year 2017. In keeping with the obtained results, the highest positive change belongs to the agricultural land use increase and the highest negative changes belong to rangeland and forest land use decrease during the period of three decades from 1987 to 2017. The highest forest land decrease with 4.8 percent, the highest agricultural land increase with 5.3 percent, the highest rangeland decrease with 9 percent, the highest barren land increase with 4.6 percent and the highest residential and industrial land increase with 0.8 happened during the periods of 2000-2017, 1987-2017, 2009-2017, 2009-2017, and 1987-2017 respectively.
After validating the predicted land use chnges in CA-Markov model, based on the analysis of the 5 existing states in three-dimensional Pentius-Melinus analysis, the CA-Markov model with the accurate prediction of simulation of 89.92 percent showed the high efficiency of CA-Markov model in simulation process. After the implementation of the CA-Markov model analysis on the obtained land use map from the classification of the satellite images, one transition probability matrix and one transitioned area matrix were created. In predictions made by using CA-Markov model in 2017 to 2033, the most changes relate to barren and forest land expansion decrease to 16966 and 6961 hectare respectively and in contrast to the use decrease, rangeland, residential and agricultural land expansion increase will be observed to 20397, 3913 and 3825 hectare respectively.

Conclusion Detecting land use changes by using LCM tool for the period of three decades 1987-2017 in Gorgan-rud river basin showed that the forest, agricultural and residential use has had significant changes in this region. The obtained results of the prediction of the land use changes during the coming eighteen years by using the integrated model of Markov chain automatic cell following the detected changes by LCM tool show that we will face extreme deforestation phenomenon in this area. Investigation of the obtained results from the implementation of the future use network model by using Markov transition estimator showed that the future use changes can be predicted based on the existing environmental conditions showing that the agriculture will extremely increase in Gorgan-rud river basin during the coming eighteen years. Thus we can protect water and soil resources with comprehensive and long-term management and prevent the degradation of these valuable resources. Three indices of Quantity Disagreement, Allocation Disagreement and Figure of Merit in three-dimensional Pentius-Melinus analysis had an important role in representation of the accuracy rate and calibration of the land use classification and the land use prediction corresponding with the obtained results from the carried out studies concerning the accuracy assessment with indices of Quantity Disagreement, Allocation Disagreement and Figure of Merit. The results of the studied land use changes by using LCM tool and the integrated model of Markov chain automatic cell during the period of 1987 to 2035 show the degradation of more than 24309 hectare of the forest lands and agriculture increase in an area about 62421 hectare indicating human interfernces and deforestation we face in this area.

Keywords: Support vector machine algorithm, LCM tool, CA-Markov model, Pentius-Melinos 3D analysis