Monitoring the Process of Land Use/cover Changes Using Markov CA Model: a Case Study of Kermanshah City

Ali Akbar Shamsipour[1*], Sosan Heydari[2], Keyvan Bagheri[3]

1. Associate Professor of Climatology, University of Tehran, Iran
2. MA in Satellite Climatology, University of Tehran, Iran
3. PhD Candidate in GIS, University of Tehran, Iran

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Extended abstract

Introduction

Land is one of the primary natural resources required for many activities in cities. A city is expanded not only by population, but also by changing in the spatial dimensions. Changes of land are a natural process and can't be stopped, but it can be organized. Supervising land zoning in the rules of city zoning to residential, commercial, industrial, and administrative areas is one of the important issues of urban life. Land use is one of the basic concepts in urban and regional planning. Thus, in optimized urban and environmental management, it is necessary to know about the proportion of land use changes / land cover and their causes. Remote sensing is considered for monitoring and supporting decision making for effective tools related to urban planning. The modeling for prediction of land use changes by remote sensing data is also a helpful tool that can manifest a good recognition of land use changes and present good solutions for management. The goal of the current article is to survey changes of Kermanshah city's zones through Landsat satellite images in the past three decades (1985-2013) and to predict changes until 2026 by using a combination of regression logistic, Markov chain and Markov CA models.

Methodology

1. In order to produce the land use maps, satellite images of TM Landsat 5 and OLI Landsat 8 with the resolution of 30m, for 1985, 2000, and 2013, all in July, have been used. General stages of the investigation can be categorized in four sections, which are as follow:
2. Providing land use maps of three periods and manifesting changes.
3. Checking the factors influencing the urban growth, land use change, and providing the potential map of town expanding in the future periods. This has been done by the regression logistic model.
4. Estimating land use changes and spatial distribution of them by analytical methods of Markov chain.
5. Running the Markov CA model and predicting land use changes over the study area.

For the classification, the number of classes was determined by the available images and maps, conditions of the studied region, and the classes needed for vegetation maps. Finally, the classification has been done through maximum likelihood algorithm. To determine the changes, we used post-classification comparison method. Following the procedure, the potential change map was produced through regression logistic, as one of the extended linear models. Markov

* Corresponding Author, Email: shamsipr@ut.ac.ir, Tel: +989126024199

model was used for calibration to extract changed area matrix and change potential of each class. Finally, the change prediction map of 2026 was provided through Markov CA model.

Results and discussion

The results showed that in the first period (1985-2000) the pure changes of reduction in areas of vegetation and water surfaces is 4153 and 14 hectares, respectively. The pure changes of area increase in urban areas and mountains are 3947 and 221 hectares. In the second period (2000-2013), the area reduction in the mountains and the areas with water surfaces is 3261 and 22 hectares, respectively. The area increasing in towns and the areas with vegetation is 2594 and 689 hectares. In the last three decades, the most area reduction is for the vegetation and water areas, for example Ghare-sou River, and it's up to 3465 and 35 hectares, respectively.

The change prediction results with Markov CA model shows that, according to the past event, the most changes will occur in the built urban areas. This is in a way that these changes that are 9565 hectares in 2013 will increase to 2790 hectares in 2026. After the above-mentioned use, the vegetation area will increase to 1053 hectares in comparison with that of 2013. This is probably resulted from the afforestation plan of Kermanshah which has been started since 2015 by Kermanshah's municipality, Assistance of Parks and Green Spaces. Again, some parts of mountain areas will be placed in the vegetation class which is because of increase in the green spaces and tree planting establishment, causing a decrease in the level of the above-mentioned areas. However, the water bodies in 2026 will increase by 52 hectares. This is due to evacuating a very large amount of the waste water entering into the Ghare-Sou River, according to the present recognition of the region. This can make an increase in this class.

Conclusion

One of the principal properties of the developing cities is the fast and unplanned urban residency. This is one of the main factors of land use changes on the earth. The purpose of the current study is to predict the process of Kermanshah city expansion in order to provide a comprehensive plan for developing the city in the future through the prediction models. The results of monitoring and evaluating the changes of land use/vegetation of Kermanshah during the studied years showed that 6540.48 hectares were added to Kermanshah area from 1985 to 2013. Moreover, the results of Markov CA, urban growth, and land use changes of Kermanshah for 2026 show that 1426 hectares of vegetation cover, 2462.3 hectares of mountain areas, and 63 hectares of water areas will change to urban use until that year. Using these results in Kermanshah city plans and decision makings helps us prevent the urban growth to inappropriate areas in the future and avoid undesirable problems. Besides, it is important to state that the physical development of Kermanshah can be effective if it is in a controlled and monitored way and before any growth the appropriate options for this purpose should be evaluated.

Keywords: land use change/vegetation, Markov CA model, Kermanshah city.

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