

# ***Spatial and temporal analysis of land use changes using remote sensing in Sari city***

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## **Abstract**

The increasing population growth and subsequent horizontal expansion of cities has led to land use changes, especially in Mazandaran province, which has led to an increase in land prices and the destruction of urban ecosystems. The conversion of horticultural and paddy lands into residential areas, which have shown increasing growth in Mazandaran over the past few decades, can be an important factor in exacerbating urban flooding. As a result of the destruction of vegetation, we see consequences such as urban floods. In addition, land use change is one of the major challenges in the future and seems to affect many vital chains and regional security. The study used data from a 30-year period of Landsat satellites from 1978, 2001 and 2013 in and around Sari. Using the GIS environment from the LCM model, land change forecasts were made until 2018. In this regard, out of three scenarios of A-B-C and for each of the six variables and 10 maps, the potential for transfer prediction of changes was performed. The kappa coefficient and the overall accuracy of the maps for 1987 have been calculated as 88%, 86.87%, for 2001, 89% and 87.22%, respectively, and for 2011, this coefficient has been calculated as 90% and 88.89%. The results show that the level of agricultural lands is declining sharply and the occupation of residential lands is increasing.

## **Introduction**

Due to the nature of the data used in this study and the objectives in the analysis of land use change and urban development, therefore, LCM model is considered as one of the common models in land use studies. Chen et al. (2013), using the NDVI index obtained from the images, showed that the trend of vegetation type changes is different in two different time periods. Therefore, the physical development of cities is inevitable, so the use of remote sensing technologies and land use change survey models can help planners to have the growth rate of cities along with ecosystems.

## **Materials and Method**

Sari city with the coordinates of 52° and 56' to 53° and 59' E and 35° and 58' to 36° and 50' N as the center of Mazandaran province is the study area. TM sensor images from Landsat 5 satellite related to 1987, TM sensor image from

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Landsat 7 satellite related to 2001 and TM sensor image from Landsat 8 satellite related to 2013 were used. In this study, Maximum Likelihood algorithm was used (Solaimani, 2019).

Since the Kapa index takes into account incorrectly classified pixels, the following relationship was calculated (Bradley, 1997).

$$K = \frac{N \sum_k X_{KK} - \sum_k X_{K\Sigma} X_{\Sigma K}}{N^2 - \sum_k X_{K\Sigma} X_{\Sigma K}}$$

Where;  $K$  is the same as the kappa coefficient,  $N$  is the total number of pixels in all truth classes,

$\sum_k X_{KK}$  is total error matrix diagonals and  $\sum_k X_{K\Sigma} X_{\Sigma K}$  = total truth pixels in a class multiplied by the total class pixels close to that class with all classes.

## Results and Discussion

In order to provide information layers for residential land uses, agricultural lands and forest lands in the central area of Sari city in 1987, 2001 and 2011, the classification method was monitored and the maximum probability algorithm was used. In order to evaluate the accuracy of the produced maps, the criteria of Kappa coefficient and general accuracy coefficient were used. In order to evaluate and validate the LCM model, the land use map predicted by the model for 2011 and the 2011 ground truth map were used.

## Conclusion

Land use changes were anticipated over the years using the LCM model. According to the findings of this study, the physical development of the city of Sari has grown the most from agricultural lands. In the present study, analysis and modeling of land use changes in the central area of Sari city was performed using logistic regression and Markov chain, the results of which show compliance with the ground truth. The results of the present study showed that the area of agricultural lands has significantly decreased, which has led to an increase in the level of residential use with an increasing growth rate. The findings of this study were consistent with the results of many researchers, including; Zanoun et al. (2013), Tafari et al. (2013) and Nowruz et al. (2012).

**Keywords:** Temporal analysis, land use, Landsat and Sari city

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