Sustainable Urban & Regional Development Studies Quarterly

Volume 7, Issue 1 - Serial Number 23, Spring 2025 **Online ISSN: 2783-0764**
Journal Hompage https://www.srds.ir/
https://www.srds.ir/article_229441.html?lang=en

Detection and Monitoring of Urban Constructions in Central District of Noor Township Using Satellite Imagery and Based on Spatial Planning Approach

Azra Moshtagheh Mehr [1], Asadullah Hejazi[2*]
[1.] MA,Land Use Planning, Faculty of Planning and Environmental Sciences, University of Tabriz, Tabriz, Iran.
[2.] Associate Professor of Geomorphology, Department of Geomorphology, Faculty of Planning and Environmental Sciences, University of Tabriz, Tabriz, Iran

Received Date: 08 June 2025 **Accepted Date:** 14 September 2025

Abstract

Background and Objective: Given the increasing trend of global urbanization, studying and monitoring the expansion of urban constructions is of great importance, as the growth of such structures often leads to significant changes in land surface cover. Accordingly, the objective of this study is to analyze and investigate the trend of expansion of urban constructions in a part of Noor County, Mazandaran Province.

Methodology: In this study, land use maps of the study area for the period 2005–2025 were extracted using Landsat 5 and 8 satellite imagery and the Support Vector Machine (SVM) model. Additionally, the Land Change Modeler (LCM) tool was employed to assess the temporal-spatial patterns of change during this period.

Results and Findings: The The findings of this study indicate that the area of urban constructions in the region increased from 33.07 km^2 in 2005 to 92.7 km^2 in 2015, and further to 97.15 km^2 in 2025. Accordingly, the extent of constructions in proximity to the cities of the region has shown greater growth due to increased construction activities. Assessments reveal the inevitable impact of the expansion of constructions on the reduction of other land use types in the region. By 2025, approximately 99.8 km^2 of the region have been directly affected by the expansion of constructions, with pastures and agricultural lands experiencing the most significant impacts in this regard. The results of this study highlight the increasing trend of expansion of human constructions in parallel with the region's population growth and underscore the importance of adopting land use planning and programs to optimally manage land use in line with sustainable territorial development.

Keywords: "Change Detection", "Urban Constructions", "Remote Sensing", "Spatial Planning", "Noor".

Extended Abstract

* **Correspong Author Email**: a_hejazi@tabrizu.ac.ir
Cite this article: Moshtagheh Mehr, A. and Hejazi, S. A. (2026). Detection and Monitoring of Urban Constructions in Central District of Noor Township Using Satellite Imagery and Based on Spatial Planning Approach. *Journal of Sustainable Urban & Regional Development Studies (JSURDS)*, *7*(1), 340-354.

Introduction

Urban constructions are a combination of complex materials and surfaces, such as vegetation, impervious surfaces without vegetation, and partially or completely impervious surfaces, including asphalt, concrete, and various roof structures. These materials and surfaces are subjected to both natural and human-induced processes, continuously increasing the heterogeneity within the regional structure. Furthermore, tall and multi-story buildings are increasingly being constructed in urban areas worldwide, and this trend is expected to continue in the future as a solution to horizontal land scarcity by utilizing three-dimensional space. Accordingly, urban developments constitute one of the most important categories in the fabric and structure of any region. Therefore, identifying and monitoring urban developments plays a fundamental role in urban planning and management, crisis management, tourism, and other areas. Without access to up-to-date information on the trends of urban developments, effective spatial planning is hardly achievable. Additionally, the issue of unauthorized construction within city limits and their surrounding boundaries has become increasingly prominent. To understand this trend and take appropriate measures, there is a need to obtain immediate information from various urban areas and monitor unusual changes. Thus, the detection and monitoring of urban developments are of significant importance in various geographical applications, such as urban planning, natural disaster simulation, prediction, management, as well as land use change assessment in any region. Accordingly, the present study focuses on detecting and evaluating the increasing trend of urban developments within the central district of Noor County in Mazandaran Province. The ultimate objective of this research is to identify the existing challenges in the field of land use in the region and provide appropriate strategies for spatial planning in the area.

Methodology

In the present research, using Landsat satellite imagery and employing a supervised classification algorithm (SVM), land use maps for the study area were extracted for the period from 2005 to 2025. Furthermore, the LCM (Land Change Modeler) was used to assess land use changes and the existing patterns in this context. This study utilized Landsat satellite data as the primary source of spatial information. Accordingly, images from three time periods—2005, 2015, and 2025—were selected from the Landsat image collection to analyze the historical land changes in the region. It is worth noting that these images were obtained and used free of charge in the form of Level 1 (L1) data from Collection 2 (C2) through the United States Geological Survey (USGS) database. Additionally, ancillary data such as existing maps and high-resolution Google Earth imagery of the area were used to define land use classes, select training samples for the classification, and assess the accuracy of the resulting maps. In this research, various platforms, including ENVI 5.3, ArcGIS 10.4.1, IDRISI TerrSet, and Google Earth Pro, were utilized to perform the necessary processing on the available images.

Results and Findings

According to the findings, the trends of change for water, forests, orchards, and barren lands have been fluctuating. In this regard, the water, forest, and barren land classes experienced a decrease in area from 2005 to 2015, but then showed an increasing trend again from 2015 to 2025. Conversely, the opposite trend was observed for agricultural land changes, whereby their area increased until 2015 but then followed a decreasing trend from 2015 to 2025. The investigations also showed that the area of rangelands consistently experienced a decreasing trend throughout these twenty years. On the other hand, examining the trend of changes for built-up areas in the study region indicates that the extent of this land class has consistently followed an upward trajectory. Accordingly, the extent of built-up areas increased from 33.07

km² in 2005 to 92.7 km² in 2015, and further to 97.15 km² in 2025. Its share of the total area increased from 7% at the beginning of the period to 20.58% at the end of the period. Therefore, urban developments currently occupy approximately one-fifth of the land area in the central district of Noor County. Regarding the spatial trend of land use changes in the region, a vast area from the far south of the region had undergone severe changes by 2015. Given the topography of this area, it can be said that these changes were primarily related to natural and climatic factors, which led to a relatively significant increase in the area of forest and jungle, followed by the expansion of road construction (built-up areas) there. This trend continued until 2025, with other parts of the southern region undergoing relatively severe land use changes. According to the conducted investigations, the intensity of land use changes in the northern areas, especially those adjacent to the coastline, was relatively high between 2015 and 2025. Therefore, the evaluations indicate a significant impact of the expansion of built-up areas on the reduction of other land cover classes across the region. According to the research findings, from 2005 to 2025, approximately 99.8 km^2 of the central district of Noor County were directly affected by the expansion of built-up areas. Among these, forest, with 44.04 km², and orchards, with 29.66 km², were the most impacted. Furthermore, approximately 0.12 km^2 of jungles, 9.11 percent of barren land, and 2.22 percent of water bodies have been overshadowed by the expansion of urban developments and constructed areas.

Conclusion

The results of this study reveal the increasing trend of built-up area expansion alongside regional population growth and highlight the importance of adopting land-use planning measures and approaches for the optimal management of land use in line with sustainable regional development. Accordingly, the formulation and implementation of comprehensive land-use plans at the district level—plans that designate suitable land uses and construction restrictions in sensitive areas—can prevent the suboptimal expansion of urban developments.

Declarations

Funding

There is no funding support for this study.

Authors' Contribution

Authors contributed equally to the conceptualization and writing of the article. All of the authors approved the content of the manuscript and agreed on all aspects of the work declaration of competing interest none.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgments

We are grateful to all the scientific consultants of this paper.

References

Abbas, Z., and Jaber, H. S. (2020). Accuracy assessment of supervised classification methods for extraction land use maps using remote sensing and GIS techniques. In IOP Conference Series: Materials Science and Engineering (Vol. 745, No. 1, p. 012166). IOP publishing. https://doi.org/10.1088/1757-899X/745/1/012166

Abdollahi, A. A., khabazi, M., & dorani, Z (2020). Modeling and Predicting Land Use Changes in Lahijan City with a sustainable development approach. *Sustainable city*, *2*(4), 17-30. doi: 10.22034/jsc.2020.205453.1148 **[In Persian]**.

Abdollahi, S., & Nasiri., V (2020). Detection and prediction of forest level changes in Guilan province using satellite images and geomod model. *Journal of Environmental Research and Technology*, 7(5), 141-151. **[In Persian]**.

Abiyat, M., Attar Roshan, S., & Abiyat, M (2020). Evaluating and Predicting Vegetation Changes Pertaining to Land Use Changes using LCM Model and CA-Markov Chain (Case Study: Ahvaz City). *Journal of Geography and Environmental Hazards*, *9*(3), 183-204. doi: 10.22067/geoeh.2020.67236.0 **[In Persian]**.

Alsharif, M., Alzandi, A. A., Shrahily, R., & Mobarak, B (2022). Land Use Land Cover Change Analysis for Urban Growth Prediction Using Landsat Satellite Data and Markov Chain Model for Al Baha Region Saudi Arabia. Forests, 13(10), 1530. https://doi.org/10.3390/f13101530

Asghari Saraskanroud, S., Pasandeh, A. & Khavarian, H (2025). Detection of Land Use Changes in the 2013-2024 Period Using Landsat 8 Image Processing and Analyzing its Effects (Case Study: Miandoab City). *Journal of Sustainable Urban & Regional Development Studies (JSURDS)*, *5*(4), 329-346. **[In Persian]**. https://www.srds.ir/article_222189_en.html

Chaturvedi, S., Shukla, K., Rajasekar, E., & Bhatt, N (2022). A spatio-temporal assessment and prediction of Ahmedabad's urban growth between 1990–2030. *Journal of Geographical Sciences*, *32*(9), 1791-1812. https://doi.org/10.1007/s11442-022-2023-4

Chen, B., Song, Y., Huang, B., & Xu, B (2020). A novel method to extract urban human settlements by integrating remote sensing and mobile phone locations. *Science of Remote Sensing*, *1*, 100003. https://doi.org/10.1016/j.srs.2020.100003

Feng, X., Li, P., & Cheng, T (2021). Detection of urban built-up area change from Sentinel-2 images using multiband temporal texture and one-class random forest. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, *14*, 6974-6986. https://doi.org/10.1109/JSTARS.2021.3092064

Ghodousi, V., Nazmfar, H., & Rahmati, M (2025). Land use changes and simulation of urban growth and development (Case study: Ardabil city). *Journal of Sustainable Urban & Regional Development Studies (JSURDS)*, *6*(3), 168-185. **[In Persian]**. https://www.srds.ir/article_215756.html?lang=en

He, T., Wang, K., Xiao, W., Xu, S., Li, M., Yang, R., & Yue, W (2023). Global 30 meters' spatiotemporal 3D urban expansion dataset from 1990 to 2010. *Scientific data*, *10*(1), 321. https://doi.org/10.1038/s41597-023-02240-w

Holobâcă, I. H., Ivan, K., & Alexe, M (2019). Extracting built-up areas from Sentinel-1 imagery using land-cover classification and texture analysis. International Journal of Remote Sensing, 40(20), 8054-8069. https://doi.org/10.1080/01431161.2019.1608391

Huang, X., Ren, L., Liu, C., Wang, Y., Yu, H., Schmitt, M., ... & Mayer, H (2022). Urban building classification (ubc)-a dataset for individual building detection and classification from satellite imagery. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition* (pp. 1413-1421). https://doi.org/10.1109/CVPRW56347.2022.00147

Kabisch, N., Selsam, P., Kirsten, T., Lausch, A., & Bumberger, J (2019). A multi-sensor and multi-temporal remote sensing approach to detect land cover change dynamics in heterogeneous urban landscapes. *Ecological indicators*, *99*, 273-282. https://doi.org/10.1016/j.ecolind.2018.12.033

Kranjčić, N., Medak, D., Župan, R., & Rezo, M (2019). Support vector machine accuracy assessment for extracting green urban areas in towns. Remote Sensing, 11(6), 655. https://doi.org/10.3390/rs11060655

Kuras, A., Brell, M., Liland, K. H., & Burud, I (2023). Multitemporal feature-level fusion on hyperspectral and LiDAR data in the urban environment. *Remote Sensing*, *15*(3), 632. https://doi.org/10.3390/rs15030632

Li, B. S., & Tan, Z. C (2020). Dynamic monitoring method of illegal buildings using spatiotemporal big data based on urban high lying zones. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *42*, 17-23. https://doi.org/10.5194/isprs-archives-XLII-3-W10-17-2020, 2020.

Liu, X., Hu, G., Chen, Y., Li, X., Xu, X., Li, S., ... & Wang, S (2018). High-resolution multi-temporal mapping of global urban land using Landsat images based on the Google Earth Engine Platform. *Remote sensing of environment*, *209*, 227-239. https://doi.org/10.1016/j.rse.2018.02.055

Luo, H., He, B., Guo, R., Wang, W., Kuai, X., Xia, B., ... & Xie, L (2021). Urban Building Extraction and Modeling Using GF-7 DLC and MUX Images. *Remote Sensing*, *13*(17), 3414. https://doi.org/10.3390/rs13173414

Ouma, Y. O., Keitsile, A., Nkwae, B., Odirile, P., Moalafhi, D., & Qi, J (2023). Urban land-use classification using machine learning classifiers: comparative evaluation and post-classification multi-feature fusion approach. European Journal of Remote Sensing, 56(1), 2173659. https://doi.org/10.1080/22797254.2023.2173659

Puttinaovarat, S., & Horkaew, P (2017). Urban areas extraction from multi sensor data based on machine learning and data fusion. *Pattern Recognition and Image Analysis*, *27*(2), 326-337. https://doi.org/10.1134/S1054661816040131

Radvash, F & Ghazanfari, E (2024). Analyzing land use changes in Noor County using remote sensing technologies. 8th International Congress of Developing Agriculture, Natural Resources, Environment and Tourism of Iran. **[In Persian]**.

Ramlal, B., Archibald, D., Al-Tahir, R., Sutherland, M., & Davis, D (2023). Assessment of Multi-Perspective and Multi-Sensor Data for Urban Strata Mapping. https://doi.org/10.21203/rs.3.rs-2599958/v1

Sedighi, S., Darban Astane, A. & Rezvani, M. R (2018). An Investigation of the physical and political Factors Affecting Land Use Changing of Mahmoudabad Town. *Spatial Planning*, *7*(2), 39-58. **[In Persian]**.

van der Linden, S (2015). Urban Mapping & Change Detection.

Yousefi, S., Mirzaee, S., Tazeh, M., Pourghasemi, H., & Karimi, H (2015). Comparison of different algorithms for land use mapping in dry climate using satellite images: a case study of the Central regions of Iran. Desert, 20(1), 1-10. https://doi.org/10.22059/jdesert.2015.54077

Yousefi, S., Tazeh, M., Mirzaee, S., Moradi, H. R., & Tavangar, SH (2014). Comparison of Different Classification Algorithms in Satellite Imagery to Produce Land Use Maps (Case Study: Noor City). *Journal of Rs and Gis for Natural Resources (Journal of Applied Rs and Gis Techniques in Natural Resource Science)*, 5(3), 67-76. SID. https://sid.ir/paper/189580/en **[In Persian]**.

Zhai, W., Shen, H., Huang, C., & Pei, W (2016). Fusion of polarimetric and texture information for urban building extraction from fully polarimetric SAR

imagery. *Remote Sensing Letters*, *7*(1), 31-40. https://doi.org/10.1080/2150704X.2015.1101179

Zhang, Y (2001). Detection of urban housing development by fusing multisensor satellite data and performing spatial feature post-classification. *International Journal of Remote Sensing*, *22*(17), 3339-3355. https://doi.org/10.1080/01431160010031289