



## Analyzing the effects of land use change on vegetation and surface temperature of the city and the response of urban managers to this trend (Case study: Mashhad city)

Rostam Saberifar \*<sup>1</sup>

1. Associate Professor, Department of Urban and Geography, Faculty of Social Science, University of Payam e Noor, Tehran, Iran

### Extended Abstract

#### Introduction

Urbanization has triggered massive development activities which led to significant changes in land use and land cover (LULC). Fundamentally, the changes in LULC have to be monitored to detect the presence of regional environmental changes and impacts. Reducing the suburban area of arable lands, destruction of vegetation, and increase of land surface temperature in urban areas, and the effects of rising temperatures are some negative consequences of urban development, building street and other malicious activities within cities. This research aims to use remote sensing to assess the consequences of destruction, and changes in land use in the city of Mashhad, was performed, and this project is trying to focus on determination and comparison of its negative effects on vegetation loss and increase of temperature and the response of city management to these changes.

#### Methodology

The methodological framework adopted in this study involved different analytical processes of Landsat imagery to examine the effects of the LULC changes on land surface temperature. Satellite images for 1979 from Landsat 5 Thematic Mapper (TM) and Landsat 8 Operational Land Imager and Thermal Infrared Sensor (OLI-TIRS) for 2009 and 2023 were obtained and were used to analyze the changes in LULC in Mashhad. All the images were selected based on the clarity of the images with less cloud coverage; moreover, the images were all captured in the month of May for the corresponding years. In this study, Orthorectification of images for 1987 and 2009 and 2023 in this study area, which has a geographic coordinate system, was carried out by the ILWIS software capabilities, and by using affine method. Then, using resampling on bands related to 1987, their sizes were equal to the bands of 2009. Vegetation map of the study area, using satellite data and remote sensing techniques were developed. For this purpose, a vegetation index called Normalized Difference Vegetation Index or NDVI was used.

#### Results and Discussion

The results showed that Based on the classified the uneven distribution of LULC in Mashhad varied by year. The built-up areas expanded tremendously in almost every part of city within 36 years. This pattern was also associated with the loss of vegetation cover as the built-up category took over the green space on a large scale. However, the land use pattern in 2009 displayed an exceptional fluctuate trend of vegetation and built-up areas dispersion. From the map roughly, there was a conversion of built-up area into vegetation land from 1979 to 2009. But in 2023, it appeared plausible that the previous barren lands which was categorized as built-up areas had turned into green space for urban

\* Corresponding Author Email: [r\\_saberifar@pnu.ac.ir](mailto:r_saberifar@pnu.ac.ir)

Cite this article: Saberifar, R. (2025). Analyzing the effects of land use change on vegetation and surface temperature of the city and the response of urban managers to this trend (Case study: Mashhad city). Journal of Sustainable Urban & Regional Development Studies (JSURDS), 6(1), 68-83.

agriculture or urban park. Referring to the map, it was apparent that the largest transition of vegetation covers into built-up areas occurred from the central towards the north of Mashhad. In general land-use patterns can directly impact the generation of heat in the urban climate. The identification of NDVI and LST parameters could provide useful information regarding the environmental changes for sustainable urban development and management. Hence, it can be concluded that a relative increase in urban ambient air temperature in Mashhad, therefore, vegetation is changed, which can be regarded as the negative effect of land use change in this city; but due to the development of green spaces, the process of destruction has decreased in recent years.

### **Conclusion**

Conjointly, rapid urbanization in Mashhad city led to the occurrence of regional heating based on the increase in LST value. Therefore, sufficient allocation of vegetation and water body in the city is recommended as a measure to reduce urban heat generation. Of course, because the development of green space has reduced the speed of changes, proper and timely intervention prevents the situation from escalating. Of course, such interventions should take into account all national and local conditions. So the study further recommends that additional factors like other LULC indices, socioeconomic variables, and other factors could be considered in future studies to produce more sturdy conclusions regarding the surface climate impact study.

**Keywords:** Vegetation, Land Use Change, Remote Sensing, temperature rise, Mashhad.

### **References**

Abdulahi, J. & Rahimian, A.M. (2008). Comparison of the environmental effects of land use change on the change of vegetation cover and surface temperature in urban and non-urban areas by using remote sensing, *Mohitshenasi*, 45, 96-85. [Persian]

Ahmed, B., Kamruzzaman, Md., Zhu, X., & Rahman, K. (2013). Simulating Land Cover Changes and Their Impacts on Land Surface Temperature in Dhaka, Bangladesh, *Remote Sens.*, 5, 5969-5998.

Asghari Saraskanroud, S. & Faal Naziri, M. (2024). Analysis of land use and its effects on surface temperature changes, case study: Karaj city, *Urban Ecology Research*, 34, 99-80. [Persian]

Ashwini, K., & Sil, B. (2022). Impacts of Land Use and Land Cover Changes on Land Surface Temperature over Cachar Region, Northeast India-A Case Study, *Sustainability*, 14(21), 1-14.

Asnawi1, N.H., Choy, L., Rose, R., Widiawaty, M., Alavi-Panah, S.K. (2003). Application of remote sensing in earth sciences (soil sciences), Tehran: University of Tehran. [Persian]

Atwater M. A. (1974). Thermal changes induced by urbanization pollutants, *Appl. Meteor*, 14, 1061-1071.

Azad, K., Ghurbani, O., Asghari Saraskanroud, S., Qala, E. & Ghafari, S. (2019). Investigating the relationship between land use changes and vegetation cover with surface temperature in Nemin city, remote sensing and geographic information system in natural resources (application of remote sensing and GIS in natural resources sciences), 11(2), 27-48. [Persian]

Dede, M. & Muhammad, F. (2024). Impacts of urban land use and land cover changes on land surface temperature in Kuala Lumpur, Malaysia, *Geografia-Malaysian Journal of Society and Space*, 20 (1), (99-120). <https://doi.org/10.17576/geo-2024-2001-07>

Ebrahimi, H. (2005). Investigating the presence of temperature change in the Mashhad Plain as an index of climate change in the region, *Geographical Research*, 20(4), 5-18. [Persian]

Ghahreman, N. (2011). Investigating the change trend of minimum, maximum and daily average values in some climatic samples of Iran, *Physics of Earth and Space*, 37(1), 179-169. [Persian]

Ghaysari, M., Shafayoun, E., Majidi, M. M. & Abedikopaei, J. (2012). Investigating the effect of type of surface cover on average, maximum and minimum temperature in Isfahan city, *Water and Irrigation Management*, 3(1), 109-97. [Persian]

Golestani, Z., Mohammadi, H., Borna, R. & Assadian, F. (2022). Analysis of Earth's and Vegetable Coating Relationship in the formation of thermal island and its risks (Case Study: Isfahan Metropolitan), *Environmental Hazard Management*, 9 (4), 354-341. [Persian]

Goward, S. N., Cruickshanks, G. D. & Hope, A. S. (1985). Observed relation between thermal emission and reflected spectral radiance of a complex vegetated landscape, *Remote Sensing of Environment*, 18, 137-146.

Habibi, K. & Nazari Adli, S. (2007). Implementation of neighborhood matrices in the spatial information system in order to determine or change urban uses, *Geomatic Conference*, Tehran: Country Mapping Organization. [Persian]

Imran, H. M., Hossain, A., Islam, A. K. M. S., Rahman, A., Bhuiyan, M. A. E., Paul, S., & Alam, A. (2021). Impact of land cover changes on land surface temperature and human thermal comfort in Dhaka City of Bangladesh, *Earth Systems and Environment*, 5 (3), 667-693.

Jihad Daneshgahi of Mashhad. (2011) Mashhad Metropolis Project (Social and Cultural Studies), Mashhad, Mashhad Municipality. [Persian]

Maathuis, B. H. P. (1995). Remote sensing and image processing, ITC Lecture notes.

Mahmoudi, P., Alijani, B., Saligheh, M. & Rigichahi, A. (2011). Investigating the Minimum and Maximum Changes of Iran, *Geographical Research*, 26 (3), 122-101. [Persian]

Mansouri, M., Safarzadeh, Z. & Rodeh, H. (2024). The impact of urban expansion on the spatial changes of the heat island of Sari, *Structure and Function of Urban Function*, 38, 240-218. [Persian]

Marofnanjad, A. (2011). The Impact of Urban Users on Creating thermal islands (Case Study of Ahvaz City), *Environmental Preparation*, 4 (14), 65-90. [Persian]

Mashhad Municipality. (2023). Statistics of Mashhad city, Mashhad: Deputy of Planning and Development of Mashhad Municipality. [Persian]

Mousavi-Baygi M., & Miyanabady, A. (2010). The Investigation of Tehran's Heat Island by using the Surface Ozone and Temperature Data, *International Journal of Applied Environmental Sciences*, 5(2), 189–200.

Oke T. R. (1982). The energetic basis of urban heat island, *Journal of the Royal Meteorological Society*, 108, 1-24, 1982.

Ramezani, S. & Nagibi, F. (2019). Analyzing changes in vegetation index in the formation of urban thermal islands (case study: Urmia city), *Urban Research and Planning*, 11(42), 206-195. [Persian]

Roth, M., Oke, T. R. & Emery, W. J. (1989). Saterllite derived urban heat islands from three coastal cities and the utilization of such data in urban climatology, *International Journal of Remote Sensing*, 19(3), 12-24.

Ruki, Z., Mohammadi, H. & Zandi, R. (2023). The role of land use changes on the formation of ground surface temperature in cities, a case study: Isfahan city, *Natural Geography Research*, 55(3), 1-17. [Persian]

Saberifar, R. (2022). Climate Change and Water Crisis (Case Study, Mashhad in Northeastern Iran), *Polish Journal of Environmental Studies*, 32 (1):705-716.

Saberifar, R., Shokri, H. & Mohammadnejad, M. (2013). Sustainable urban development, planning, management and policymaking, Mashhad, Omid Mehr. [Persian]

Sabrifar, R. & Mazraavi, E. (2011). An introduction to sustainable urban development, Ahvaz, Katiba Sabz. [Persian]

Sajjadzadeh H. & Ghorbani, F. (2023). The effect of vegetation changes on the intensity of urban surface heat island (case example: Karaj metropolis), *Urban Studies Quarterly*, under publication. [Persian]

Shahsund, M., Soleimani, K. & Rashidpour, Mustafa. (2016). Investigation of land use changes on surface temperature of the urban environment of Isfahan, 5th National Conference of Geographical Sciences, Shahin Shahr: Payam Noor University. [Persian]

Shirgholami, H. & Gharaman, B. (2005). Investigating the trend of annual average temperature changes in Iran, *Agricultural Science and Technology and Natural Resources*, 9(1), 179-169. [Persian]

Shrestha, D. P. (1994). Remote sensing techniques and digital image processing, ITC lecture notes.

Small, R. & Balstad, M. (1999). *Monitoring the Urban Environment from Space*, Lamont Doherty Earth Observatory, USA: Columbia University, and Palisades.

Sobhani; B. & Mansouri, M. (2023). Analyzing the role of temperature changes in urban land uses using Landsat satellite images (Amel city case study), *Environmental Sciences Studies*, 8(4), 7448-7437. [Persian]

Tumanov S., Stan-Sion, A., lupu, A., Soci, C. & Oprea, C. (1999). Influences of the city of Bucharest on weather and climate parameters, *Atmospheric Environment*, 33, 4173-4183.

Uchida, S. (1997). *Temporal Analysis of Agricultural Land Use in the Semi-Arid Tropics of India Using IRS Data*, Environmental Resources Division, Japan International Research Center for agricultural Sciences (JIRCAS).

UN (United Nations, Department of Economic and Social Affairs, Population Division). (2019). *World Urbanization Prospects: The 2018 Revision*. United Nations.

Wagrowski, D. M. & Hites, R. A. (1997). Polycyclic aromatic hydrocarbon accumulation in urban, suburban and rural vegetation, *Environmental Science & Technology*, 31(1), 279-282.

Zandi, R., Zahiri Abdo, Z. & Emami, S. (2024). Earth surface temperature measurement and its relationship with spectral indices of a case study: Khuzestan province, *Geography and Development*, 76, 64-39. [Persian]

Zhao, Q., Haseeb, M., Wang, X. & Zheng, X. (2024). Evaluation of Land Use Land Cover Changes in Response to Land Surface Temperature With Satellite Indices and Remote Sensing Data, *Rangeland Ecology & Management*, 19(10), 1-18. <https://doi.org/10.1016/j.rama.2024.07.003>