

Abstract No: BO-16

Modeling the urban growth and land use changes in Vavuniya, Sri Lanka, using GIS

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The process of urban growth and its associated land use changes have significant implications for sustainable development and resource management. This research aims to model the urban growth patterns in seven *Grama Niladhari (GN)* divisions (i.e., *Koolankulam, Puthukulam, Paranaddakal, Nachimodai, Omanthai, Maruthanamadu, and Echankulam*) in *Vavuniya* between 2001 to 2021 using Geographical Information Systems (GIS). After obtaining Landsat images covering the study area for the years 2001 and 2021, supervised classification based on a maximum likelihood classifier was applied to the imagery to prepare Land use/Land cover (LULC) maps with four land cover classes: forests, water bodies, croplands, and built-up areas. High-resolution Google Earth images were used as ground truth. Land extents for each LULC type were calculated, and the changes in the area between 2021 and 2001 were compared using ArcGIS 10.8. The change of vegetation indices and water indices were analyzed to find the impact of human activities in the study area. The Normalized Difference Water Index (NDWI) and Normalized Difference Vegetation Index (NDVI) were used for water body analysis and to quantify vegetation, respectively. By using ground truth data, the accuracy assessment was done. The supervised classification indicates that forest cover and the cropland areas decreased (6820.92 ha to 5952.01 ha and 4769.1 ha to 2585.34 ha, respectively) while water bodies and built-up areas increased (633.15 ha to 983.97 ha and 2630.83 ha to 5332.68 ha, respectively). So, the vegetation cover and the water bodies have decreased in 2021. The overall accuracy for the 2021 (land use/land cover change map) is 0.64 (64%). We envision that the findings of this research will contribute to urban planning and policy-making processes by offering a comprehensive understanding of the past and potential future urban growth dynamics in the studied GN divisions. The results can assist local authorities and stakeholders in making informed decisions regarding land management, infrastructure development, and environmental conservation to ensure sustainable urban growth and resource allocation.

Keywords: Change Detection, Land Use Classification, Maximum Likelihood Supervised Classification, Remote Sensing, Sri Lanka

Acknowledgment

This work was supported by University of Kelaniya.