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Application of Multilayer Perceptron and Markov Chain Analysis Based Hybrid-Approach for Predicting and Monitoring the Pattern of LULC Using Random Forest Classification in Jhelum District, Punjab, Pakistan

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Abstract : Land Use and Land Cover Change (LULCC) is a critical environmental issue that has significant effects on biodiversity, ecosystem services, and climate change. This study examines the spatiotemporal dynamics of land use and land cover (LULC) across a three-decade period (1992–2022) in a district area. The goal is to support sustainable land management and urban planning by utilizing the combination of remote sensing, GIS data, and observations from Landsat satellites 5 and 8 to provide precise predictions of the trajectory of urban sprawl. In order to forecast the LULCC patterns, this study suggests a hybrid strategy that combines the Random Forest method with Multilayer Perceptron (MLP) and Markov Chain analysis. To predict the dynamics of LULC change for the year 2035, a hybrid technique based on multilayer Perceptron and Markov Chain Model Analysis (MLP-MCA) was employed. The area of developed land has increased significantly, while the amount of bare land, vegetation, and forest cover have all decreased. This is because the principal land types have changed due to population growth and economic expansion. The study also discovered that between 1998 and 2023, the built-up area increased by 468 km² as a result of the replacement of natural resources. It is estimated that 25.04% of the study area's urbanization will be increased by 2035. The performance of the model was confirmed with an overall accuracy of 90% and a kappa coefficient of around 0.89. It is important to use advanced predictive models to guide sustainable urban development strategies. It provides valuable insights for policymakers, land managers, and researchers to support sustainable land use planning, conservation efforts, and climate change mitigation strategies.

Keywords : land use land cover, Markov chain model, multi-layer perceptron, random forest, sustainable land, remote sensing.
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