**Geospatial and AI-Based Modelling to Assess Temporal and Spatial Dynamics of Forest Fragmentation**

Herath H.M.B.S.1, Nayanajith J.2\*, Jayasinghe K.D.P.P.3

1Senior Lecturer, Department of Geography, Faculty of Humanities and Social Sciences, University of Sri Jayewardenepura, Sri Lanka

2Undergraduate, Department of Geography, Faculty of Humanities and Social Sciences, University of Sri Jayewardenepura, Sri Lanka

3Senior Lecturer, Department of Geography, Faculty of Humanities and Social Sciences, University of Sri Jayewardenepura, Sri Lanka

\* nayanajithku20@gmail.com

***ABSTRACT***

Traditional geospatial techniques for assessing forest fragmentation often lack the precision needed for accurate forest cover extraction. This study introduces a geospatial and AI-based model designed to enhance the accuracy of land use and land cover (LULC) classification. The objective was to utilize this model to accurately extract forest cover data and apply it to forest fragmentation analysis, which necessitates precise data for comparing temporal changes. The study focused on the Anuradhapura District of Sri Lanka, using medium-resolution optical satellite imagery, aerial photographs, and non-spatial data. The model leverages advanced machine learning algorithms, including convolutional neural networks (CNNs) and random forest methods, to classify LULC in the district. The forest cover was extracted with an overall accuracy of 95%, and the fragmentation analysis was conducted using the Landscape Fragmentation Tool, analyzing temporal changes in forest fragmentation over the period from 2004 to 2024. By tracking these spatial and temporal changes, the model identifies LULC transformations that may contribute to forest fragmentation. This approach enhances explanatory power and provides valuable information for targeted conservation efforts and policy-making. The findings reveal significant trends in forest fragmentation and the primary drivers behind them, offering a detailed understanding of the spatial and temporal dynamics involved. The study demonstrates the utility of integrating geospatial and AI techniques to address complex environmental issues and suggests a framework for multidisciplinary research efforts aimed at understanding and mitigating forest fragmentation.

**Keywords:** *Geospatial techniques, AI-based modeling, forest fragmentation, spatial and temporal dynamics*