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## Spatio-Temporal Changes and Fragmentation Patterns of Sinharaja Forest Peripheral Area Using Morphological Spatial Pattern Analysis

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### Abstract

Forest fragmentation is a landscape process that significantly impacts the spatial structure and ecological dynamics of natural ecosystems. As human populations continue to grow, this phenomenon has emerged as a pressing challenge. Consequently, high rates of forest degradation and fragmentation, especially in tropical regions, have become more prevalent. In recent decades, human activities have intensified in the peripheral areas surrounding the Sinharaja forest reserve, leading to forest fragmentation. The advancement of remote sensing-based approaches has provided valuable insights into forest cover change analysis. The objective of this research was to analyze the fragmentation patterns in the peripheral areas of the Sinharaja forest using Morphological Spatial Pattern Analysis (MSPA). MSPA is a method used for landscape pattern analysis related to forest fragmentation and other natural land cover classes. The study spans 24 years, from 1995 to 2019, using Landsat imagery. A forest cover map was created using Normalized Difference Vegetation Index (NDVI) analysis. Its accuracy was checked done by the accuracy assessment and assessing with the Google Earth images. The accuracy was 85.4% and 89.5% in 1995 and 2019 respectively. The study aimed to quantify the spatial and temporal changes, the fragmentation pattern of forest cover, and its associated ecological impacts. Various landscape indices such as Largest Patch Index (LPI), Number of Patches (NP), Patch Density (PD), and Shannon's Diversity Index (SDI) were applied to characterize the spatial pattern and assess the connectivity of forested and non- forested areas. SDI was analyzed using Leco's plugin after confirming accuracy for forest and non-forest patches through the validation procedure. The results revealed that forested areas decreased from 186 km² in 1995 to 180 km² in 2019, with the northern and northwestern parts of the peripheral zone being more susceptible to fragmentation. The core forest patches in the area increased over the 24-year period, while non-forest areas expanded by 3.23%. LPI for forest patches decreased from 1.88% to 2.06%, and SDI increased from 0.31 to 0.37 during this time frame. These findings indicated that the forest patches in 2019 became smaller and exhibited higher diversity compared to 1995. Overall, the results suggested that the peripheral areas of the Sinharaja forest reserve are vulnerable to forest fragmentation. MSPA contributes to our understanding of the landscape and fragmentation patterns in the area, which are essential for conservation and sustainable forest management. Additionally, this study demonstrated the effectiveness of using geospatial tools to quantify forest fragmentation even with limited data availability.

*Keywords:* Ecological impacts, Forest fragmentation, Landscape metrics, Morphological Spatial Pattern Analysis.

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