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Monitoring Vegetation and Land Cover Changes in Galle District, Sri Lanka Using NDVI-Based Time Series Analysis (2008-2024)

Thathsarani, W.Y.T.*, Dasuni, V.N., Thikra, M.N.F., Tennakoon, T.M.P.D.U.B., Manage, L.P.M.

Department of Zoology and Environmental Conservation, Faculty of Science, University of Kelaniya, Kelaniya, Sri Lanka

**28tharushiyapa@gmail.com*

Abstract

Vegetation cover plays a crucial role in maintaining ecological balance and supporting biodiversity. In Sri Lanka, rapid urbanization and land-use pressures have altered vegetation patterns, particularly in the Galle District, where both ecologically and economically significant. This study analyzed vegetation changes using the Normalized Difference Vegetation Index (NDVI) derived from Landsat imagery for 2008, 2016, and, 2024. This study aims to assess changes in forest cover in Galle district over time and to identify spatial and temporal patterns of deforestation within that region. Because these data driven insights support sustainable forest management and policy development. The years 2008,2016 and,2024 were selected because they represent regular 8-year intervals that allow for consistent long-term comparison of land surface changes. Using high quality satellite images spaced across such intervals helps capture meaningful environmental trends, comparability in spatial resolution and sensor characteristics. The images were selected due to their availability, seasonal comparability, and consistent acquisition during the dry period. Landsat data, with a 30 m spatial resolution, visible-NIR spectral bands essential for NDVI computation (TM Band 3/4; OLI Band 4/5), and 12-bit radiometric resolution (Landsat 8), ensured sufficient detail for long-term vegetation monitoring. NDVI values were reclassified into six land-cover categories: water bodies, built-up areas, barren land, sparse vegetation, moderate vegetation, and dense vegetation. Results indicated that in 2008, dense vegetation expanded significantly from about 658.3 km^2 to over 1,000 km^2 in 2016, representing a 55% increase likely caused by natural regeneration and targeted reforestation programs. By 2024, dense vegetation declined by nearly 15% to under 900 km, implying with a near doubling of built-up areas from 14km^2 to 30 km^2 and a significant reduction in water bodies by approximately 43%. To validate the classification 99 random points were generated across NDVI classified layers using ArcGIS. These points were verified against high resolution satellite images from Google Earth Pro. Vegetation changes detected through the study reflect rapid urban expansion and land conversion pressure mainly in low-lying and peri urban areas. Continuous monitoring through remote sensing and GIS is essential to support sustainable development and ensure ecological resilience in the district.

Keywords: *NDVI, Vegetation dynamics, Remote sensing, Land-use change, Urbanization*