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Urban Parks as Catalysts for Sustainable Land Use: Enhancing Climate Resilience in Colombo Urban Area

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Abstract

Rapid urbanization in Colombo has intensified environmental challenges, notably the Urban Heat Island (UHI) effect, which results in higher temperatures in urban areas compared to rural surroundings. Through their Park Cool Island (PCI) effect, urban parks serve as critical tools in mitigating UHI by creating cooler micro-climates within cities. This study investigates the role of park characteristics in mitigating the UHI effect across five major urban parks in Colombo: Viharamahadevi Park (VMDP), Diyasaru Park (DP), Diyatha Uyana Park (DUP), Nugegoda Urban Wetland Park (NUWP), and National Sandalwood Garden (NSG), which range in size from 3.66 ha to 29.31 ha. Data was collected between September 2023 and February 2024, incorporating field-based temperature measurements, satellite imagery analysis, and vegetation surveys. PCI intensity, defined as the temperature difference between park interiors and surrounding urban areas, ranged from 0.25°C to 1.46°C, with an average PCI intensity of 0.98±0.21 °C. Larger parks and those with higher canopy density provided greater cooling effects. For instance, Diyasaru Park, spanning 29.31 ha with a canopy density of 88.3%, exhibited the highest PCI intensity of 1.46°C. Conversely, the National Sandalwood Garden, covering 3.66 ha with minimal vegetation, recorded the lowest PCI intensity of 0.25°C. Canopy density exceeding 80% was particularly crucial, enhancing PCI by over 1.0 °C on average. Quantitative analysis revealed significant positive correlations between PCI intensity and other vegetation attributes such as tree basal area (R^2=0.868), tree height (R^2=0.784), diameter at breast height (R^2=0.757), and stem density (R^2=0.717). Key Park characteristics such as layout (area and perimeter) and vegetation structure (tree height, DBH, stem density, basal area, and canopy density) significantly influenced PCI intensity. These findings underscore the importance of incorporating robust green infrastructure into urban planning. Parks with larger areas and higher vegetation densities are critical assets for urban climate resilience, mitigating thermal stress and promoting sustainable land use. Policymakers and urban planners should prioritize enhancing vegetation attributes, particularly canopy density and tree characteristics to maximize cooling benefits. Additionally, strategic interventions such as increasing tree diversity and optimizing park layouts can further enhance cooling effects. This study provides actionable insights for developing climate adaptive urban landscapes, reinforcing the pivotal role of urban parks in achieving sustainable development goals and improving urban life quality.

Keywords: *Sustainable land use, Park cool island, Climate resilience, Urban planning, Sustainable development*