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A remote-sensing-based assessment of a city's urban environmental quality

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Unprecedented and unplanned urban sprawl poses a substantial challenge for cities in developing nations, detrimentally impacting the environmental quality of the urban landscape. The key environmental factors affected by urbanization must be vigilantly monitored to ensure sustainable urban development. Consequently, it is imperative to have a sustainable framework for a comprehensive and critical assessment of the environmental parameters that are affected because of urbanization. The aim of this research is to assess the environmental quality of a developing city in India – Bhopal and to quantify the environmental damage. The environmental quality is compared at 5-year time steps from 2000 to 2020 keeping 2000 as the benchmark year. The study employs satellite-based remote sensing data to extract all the parameters that are considered. The biophysical indicators (BI), include Normalized Difference Vegetation Index (NDVI) and Land Surface Temperature (LST), Particulate Matter concentration (PM_{2.5}) and actual Evapotranspiration (ET_a), and the census-related parameters include the Population Density (PD) and Built-up Volume (BV). The research assesses the relation between these parameters, followed by the quantification of an Environmental Quality Index (EQI) for the years 2005, 2010, 2015 and 2020 to investigate the city's environmental quality. The city's environmental quality is then categorized based on the EQI values in each year. The results reveal that there is a poorer quality of environment where the BV and PD is high, and vegetation cover is low, which also results into higher LST. PM_{2.5} was higher in the traffic congestion zones, industrialisation areas and major roads. The comprehensive findings indicate pronounced environmental degradation in specific areas characterized by dense urbanization, heavy traffic, industrial zones, and major highways. This study sheds light on the adverse environmental impacts of unplanned urbanization, providing valuable insights for policymakers and urban designers to enhance the quality of urban development and promote sustainability. Additionally, the research proposes strategies and policy interventions for addressing industrial and vehicular pollutants, emphasizing the crucial role of urban greening in elevating the overall urban environment.