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Mapping Lifestyle Retail's Urban Footprint: A Geographically Weighted Regression Analysis of Land-Use Transformation and Built-Up Area Growth in the Influence Zones of Mall 2.0 Developments in Gurugram and Noida

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Abstract: *This study examines whether Mall 2.0 developments mixed-use, experience-led, lifestyle-oriented retail complexes generate a measurably larger and faster-expanding urban halo of built-up area and land-use conversion than traditional enclosed malls in the National Capital Region (NCR) satellite cities of Gurugram and Noida. Drawing on multi-temporal Landsat 8/9 and Sentinel-2 imagery for the period 2010–2024, supplemented by GIS layers and municipal land-use records, we delineate 1 km, 3 km, and 5 km influence zones around 12 Mall 2.0 sites and 14 matched traditional malls. Built-up area is extracted through a Random Forest supervised classification (overall accuracy 89.4%, $\kappa = 0.86$), and land-use change is tracked through post-classification comparison. We first apply Global and Local Moran's I to test whether observed built-up growth is spatially clustered around lifestyle retail nodes, screen the predictor set for multicollinearity using Variance Inflation Factors (all VIF < 2.4), and then estimate a Geographically Weighted Regression (GWR) model with an adaptive bi-square kernel and AICc-optimised bandwidth. To allow each covariate to operate at its own characteristic scale, we additionally fit a Multiscale GWR (MGWR; Fotheringham, Yang, & Kang, 2017) model in which covariate-specific bandwidths are estimated through a back-fitting procedure. The dependent variable is constructed as the change in built-up share between the year of mall opening and 2024 (with 2010 as the pre-opening reference for sites opened during 2010–2012), restricting attribution of land-use change to the post-opening window for each mall. Built-up share within Mall 2.0 1 km buffers expanded by 31.7 percentage points between 2010 and 2024, compared with 18.4 percentage points around traditional malls. Global Moran's I of 0.42 ($z = 18.7$, $p < 0.001$) confirms statistically significant clustering. The GWR model lowered AICc from 4218.6 (OLS) to 3942.1 and reduced residual spatial autocorrelation from 0.27 to 0.08, with the median local coefficient on the Mall 2.0 dummy reaching 0.68 inside the 1 km buffer and decaying to 0.18 at 5 km. The findings suggest that Mall 2.0 developments operate not merely as retail destinations but as catalysts of peri-urban morphological restructuring, with implications for metropolitan governance, infrastructure sequencing, and the regulation of retail-led urbanisation in NCR*

Keywords: Mall 2.0; lifestyle retail; urban halo effect; Geographically Weighted Regression; Moran's I; built-up area; land-use change; Gurugram; Noida; remote sensing