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Assessment of Low Impact Development Strategies with Multi-Scale, Multi-Criteria Decision Making Approaches for Urban Flood Resilience

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Urbanization exacerbates runoff, peak flow unpredictability, deterioration of water quality, and the Urban Heat Island Effect. Low-income, flood-prone areas are disproportionately impacted by weak governance and inadequate infrastructure. All of which influence water, energy, and equality balance. As preventing urban development is unfeasible, Low Impact Development (LID) provides a viable alternative. We offer a multi-scale framework that incorporates LID solutions for stormwater management in Ankara, Türkiye; therefore, filling the gap in holistic, multidisciplinary, and multiscale approaches via engineering and urban planner perspectives. Our framework contains: (i) Multi-Criteria Decision Making (MCDM)-Driven Pixel Scale Analysis of WorldView-4 images to create Land Use Land Cover (LULC) data using Random Forest (81.34% accuracy) on Google Earth Engine and SRTM-based slope and flow accumulation data. Using expert opinion and literature, we created and scored criteria matrices for LULC, slope, flow accumulation, and cost. This resulted in detailed LID suitability maps via the MCDM algorithm by the R programming language. (ii) Expert-Driven Neighborhood Scale Analysis for prioritization of LID based on urban parameters such as slope, surface morphology, population density, impervious surfaces, road networks, and runoff hotspots by the junction areas that emerge from the overlapping of the areas. Bioretention cells are suggested for 42.9% of the research area, rain barrels for 19.6%, and vegetative filter strips for 1.4%. Expert-Driven analysis facilitates prioritizing, whereas MCDM-Driven analysis gives pixel-level LID placement recommendations. This scalable, multidisciplinary framework provides a solid model for urban water management that may influence urban planners and policymakers in Ankara and other cities throughout the world.