

AI-Driven Digital Twin Framework for Water-Sensitive and Climate-Resilient Urban Transformation

Prof. Dr. Sheetal Sharma

VIT Bhopal University, India

Abstract

Urban flooding, dwindling green cover, and the effects of urban heat islands (UHIs) have all increased due to the rapid urbanisation of cities in the Global South, especially in environmentally vulnerable catchment zones. In keeping with the ISDRS 2026 theme of transforming global issues into cooperative sustainability solutions, this study reframes these interrelated crises as possibilities for digitally enabled sustainable change. Using Bhopal, India (1974–2024) as a longitudinal case, the study suggests an integrated AI-driven Urban Digital Twin architecture to predict and optimise flood resilience and green infrastructure design. A multi-layered approach was used: (1) mapping UHI and AI-based green space optimisation scenarios for 2035 and 2050; (2) hydrological modelling using SWMM integrated with Artificial Neural Networks for improved flood prediction; (3) multi-temporal remote sensing and GIS-based Land Use Land Cover and NDVI analysis to quantify urban expansion and vegetation loss; and (4) creating an interactive Digital Twin using Unity and AR/VR for participatory planning and policy simulation. The results show that the built-up area has increased thrice over the past fifty years, and that the frequency of floods is strongly correlated with the substantial loss of open space in important watersheds. When compared to traditional simulations, AI-integrated flood models increased prediction accuracy by about 20%. In high-risk wards, scenario-based green reallocation solutions show the potential to reduce peak surface runoff by up to 22%. Through immersive visualisation, the Digital Twin platform improved stakeholders' comprehension of climate-risk mitigation techniques. The study offers a transdisciplinary, scalable framework that combines immersive technology, artificial intelligence, and water-sensitive urban planning to improve collaborative governance and further SDGs 11, 13, and 15 in the world's fastest-urbanizing regions.

Keywords: Digital Twin, AI, Climate Risk, Urban Floods, Water conservation