Explainable GeoAI Cartography for Delineating Urban Flood Priority Corridors in a Deltaic Environment

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Abstract

AI-driven geospatial models can rapidly generate high-resolution hazard and exposure surfaces, but their value for flood-risk communication depends on whether model outputs are interpretable, spatially coherent, and cartographically defensible. This study presents a human-in-the-loop GeoAI framework for translating automated flood susceptibility outputs into decision-relevant urban flood priority corridors across Bangladesh. The central premise is that cartographic expertise remains essential after model prediction: analysts must interrogate model behavior, evaluate spatial clustering, distinguish hazard from exposure, and design maps that communicate planning relevance without overstating model certainty. The workflow integrates multisource geospatial data within a harmonized 30 m national grid. A machine-learning-derived flood hazard surface is interpreted using explainable AI to relate predictions to physically meaningful controls, including terrain, hydroclimatic forcing, coastal proximity, and land-surface conditions. The hazard layer is then combined with gridded building and population indicators to identify locations where flood-prone conditions intersect with concentrated urban exposure. Spatial autocorrelation, local clustering, and hotspot analysis are used to move beyond pixel-level classification toward regional interpretation of contiguous priority zones. The analysis reveals a critical cartographic insight: the geography of modeled flood hazard does not fully coincide with the geography of urban flood priority. Highly susceptible floodplain districts are not necessarily the highest-priority urban districts when building concentration and population exposure are considered. Conversely, dense urban corridors may emerge as priority zones even when their hazard signal is less extreme than that of major floodplain basins. This distinction demonstrates why susceptibility maps should not be treated as final risk maps without expert-guided exposure interpretation. A dominant central-eastern priority corridor emerges around the Dhaka-Meghna urban system, where modeled flood hazard, dense built form, and population concentration converge. Spatial clustering further indicates that this corridor is not an isolated administrative artifact, but a coherent regional pattern requiring cross-district planning attention. The results show how human-in-the-loop cartographic reasoning can improve transparency, trustworthiness, and policy relevance of GeoAI outputs by converting automated predictions into interpretable spatial narratives. This study contributes to GIScience and cartography by demonstrating a transferable workflow for explainable GeoAI mapping in data-constrained flood-prone regions. Rather than replacing expert judgment, the framework positions AI as an analytical engine and the cartographer as the interpreter, evaluator, and communicator of spatial evidence.