Spatiotemporal Analysis of Land Use, Land Cover and Flood Extents in Colombo District (2017–2023) Using Remote Sensing and GIS

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Key words: Cartography; Geoinformation/GI; Land management; Remote sensing; Risk management; Spatial planning; Change Detection; Flood Risk Assessment; Land Use Land Cover (LULC)

SUMMARY

Flood disasters are among the most frequent and damaging natural hazards worldwide and are being intensified by rapid urbanisation, land-cover change, and climate variability. Across Asia, growing exposure in dense cities is creating acute challenges for sustainable urban management. Colombo District, Sri Lanka's economic hub, exemplifies these pressures, yet spatiotemporal assessments that explicitly link land-use/land-cover (LULC) transitions with flood exposure remain scarce, knowledge that is essential for urban planning, wetland conservation, and risk reduction. This study quantifies LULC dynamics and associated flood extents across thirteen Divisional Secretariat Divisions (DSDs) for 2017, 2020, and 2023, years chosen to capture pre- and post-pandemic urban expansion and to leverage the latest high-resolution land-cover products for consistent comparison. Multi-sensor data fusion is essential to overcome the spatial–temporal trade-offs of individual Earth Observation(EO) products: MODIS supplies long-term continuity (2017, 2020) but at coarse resolution, whereas ESA WorldCover and Dynamic World provide fine-scale, recent LULC detail; integrating these with all-weather Sentinel-1 SAR produces temporally consistent, high-resolution surfaces and reliable flood detection despite persistent cloud cover. Flood inundation was mapped using a four-detector majority-vote algorithm, and all outputs were integrated within a GIS framework. Results show marked land-cover transformation: agricultural area declined by >12% between 2017 and 2023 while urban area nearly doubled, with the most rapid growth in Colombo, Dehiwala, and Kolonnawa. Inundated area increased from 0.012 km² (2017) to 0.031 km² (2020) and 0.043 km² (2023), a rise from ~0.01 km² to >0.04 km² over the period. Urban and low-lying DSDs (e.g., Kolonnawa, Kaduwela) consistently recorded the largest flooded extents, whereas wetlands, though reduced—remained disproportionately exposed. By coupling LULC change with flood mapping, the analysis demonstrates how urban expansion directly amplifies flood vulnerability across Colombo. The resulting workflow is transferable to data-scarce urban regions and underscores the urgency of enforcing sustainable land-use controls, safeguarding wetland

buffers, and advancing resilience strategies to mitigate escalating flood hazards in Sri Lanka's most urbanised district.

Keywords: Change Detection, Colombo District, Flood Risk Assessment, Land Use Land Cover (LULC), Remote Sensing.