Participatory–Hydrodynamic Modelling of Localised Flood and Sanitation Exposure in Kibera During the 2024 El Niño(Oral)

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ABSTRACT

Rapid urbanisation across Sub-Saharan Africa is reshaping river catchments and intensifying flood risk, particularly in vulnerable informal settlements located along riparian corridors. In Nairobi, Kenya, an estimated 60-75% of residents live on just 5% of the city's land area, much of it adjacent to the city's main rivers and their tributaries. Climate projections indicate increasing rainfall variability and more intense precipitation extremes, amplifying existing hydrological pressures. The 2024 El Niño event provided a critical moment to examine how river flooding interacts with dense informal development and essential service infrastructure.

This study investigates flood hazard dynamics and sanitation infrastructure exposure in Kibera, Nairobi's largest informal settlement, during the 2024 floods. Hydrodynamic modelling in such environments is particularly challenging: dense construction, limited drainage records, waste accumulation, and incremental household-level modifications to surface flow create highly localised hydraulic behaviour that is rarely represented in conventional digital elevation models (DEMs) or formal drainage datasets.

A two-dimensional HEC-RAS model was developed to simulate flood depth and velocity using rainfall data, satellite imagery, terrain data, and field-verified infrastructure mapping. However, preliminary model outputs highlighted a critical limitation: the DEM did not capture fine-scale hydraulic restrictions such as blocked drains, informal embankments, narrow flow paths between structures, or solid-waste-induced diversions. These features significantly influence flood propagation but remain invisible in standard datasets.

To address this, six participatory mapping focus groups were conducted with residents affected by the 2024 floods. Participants generated spatial data on observed flood extents, depth variations, drainage failures, latrine inundation, and informal flow modifications. Rather than serving as post-hoc validation,

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