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Network Centrality Assessment (NCA): Assessing the Transport Networks' Resilience for Urban Flooding

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Transport systems are vital to the functioning of urban areas. Minimizing disruptions to transport networks due to natural hazards is a key goal in disaster-resilient urban planning. This study presents a framework to assess transport networks' resilience to urban flooding. The proposed framework is developed based on network centrality and graph theory. The study utilizes betweenness and closeness centrality to capture transport network resilience under two movement thresholds: pedestrian movements (r=1km) and vehicular movements (r=10km). The study utilizes Open Source GIS tools to compute centrality values. The case study is carried out in Greater Colombo, Sri Lanka and selects three significant urban flooding events, i.e. 2010 May 17, 2016 May 15 and 2017 May 25. It assesses the transportation network resilience in two respects. First, the topological impacts from each flood event to the transportation network. Second, the accessibility changes in the transportation system. The results reveal three key findings. First, compared with direct impacts on the transportation network (≤7%), the relative impact is significantly higher (>60%). This is particularly pronounced in vehicular movements relative to pedestrian movements, because pedestrian movement is hindered by floods where there is a loss of several road segments in a given neighbourhood. For vehicle movement, floods significantly impact the entire transportation system and their pass-by trips. Second, the study revealed redundant depreciation of the transportation accessibility as it shifts the accessibility from downtown (CBD) to suburban areas and creates temporary accessibility hotpots in certain local areas. Third, considering the statistical distribution of network centrality, the study identifies significant declines of transportation accessibility in each flooding event, significantly impacting trips of longer length (>10km) as the loss of shortest path roads segments significantly impact the pass-by movements of the transportation system. The proposed framework can be utilized as a planning tool to assess transport network resilience and devise precautionary measures to mitigate disaster risk.

Keywords: *Urban Flood, Transport Planning, Network Centrality Assessment, Open Source GIS, Transport Network.*