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Compound Vulnerabilities in an Urban Setting: Impact of Floods on the Transportation Network in Istanbul

Irem Daloglu Cetinkaya and Özge Naz Pala
Institute of Environmental Sciences, Boğaziçi University, Istanbul, Turkey

Urban areas, the core of socio-economic activity with high population density, are considered highly vulnerable to flood hazards. Istanbul, Turkey's most populated city with around 16 million inhabitants, and at the same time commercial, cultural, and social capital, was chosen as the study area. Istanbul is a metropolis that has grown under unplanned growth, particularly with rural to urban migration in the 1950s. A significant portion of the city's natural areas, stream basins and valleys have been replaced by concrete surfaces. This transformation not only brought societal challenges, but increased urban vulnerability to extreme events and hazards. As a coastal city that consists of two peninsulas, Istanbul is highly prone to flash floods from heavy rainfalls. Flood events intensely impair the municipal services (e.g., public transportation, water and sanitation, electricity distribution), consequently affect the operation of businesses and public services, and cause high economic losses as well as even deaths and casualties. Many of the highly vulnerable zones for floods already endure inadequate housing and transport access. This study aims to build a flood vulnerability index to identify the districts vulnerable to floods in the metropolitan area and assess the impacts of floods on households and transportation infrastructure. The developed vulnerability index incorporates socioeconomic and physical vulnerability components, while also closely examining key transportation infrastructure in highly vulnerable locations. Using the multi-criteria decision making approach, 9 different indicators of flood vulnerability were evaluated, then weighted by stakeholders and experts using the Analytical Hierarchy Process (AHP) method. This methodology is implemented to 100 year flood zones and 500 year flood zones to represent the potential impact of future climate change. The proposed assessment disclosed that 22% of the basin has low urban flood vulnerability while the extremely vulnerable and vulnerable zones together constituted approximately 40% of the total area. Approximately 75% of the road length (i.e., highways, main arteries, boulevards) and 20% of the public transportation lines (i.e., stations, railways, bus lines) across the basin are located in the vulnerable areas. The findings of the study have the potential to provide policymakers with up-to-date and detailed flood vulnerability assessments to serve as the foundation for their decision-making processes under flooding hazards.