

Evaluating and Optimizing Nature-Based Solutions for Urban Flood Mitigation in a Semi-Arid Watershed: Case of Oued Merzeg (Casablanca, Morocco)

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Abstract

Urban flooding has become a major challenge in semi-arid cities facing accelerated urban growth, where drainage systems often fail to handle extreme rainfall events.

Our study focuses on the Oued Merzeg watershed, in Casablanca, Morocco, a context that is both highly relevant and still underexplored in the scientific literature. It evaluates the effectiveness of Nature-Based Solutions in flood mitigation.

We began by establishing a reference scenario without NbS in place, subsequently evaluating individual NbS implementations

The methodology adopted is based on 2D hydraulic modelling using Iber model to derive spatially distributed indicators, including water depth, flow velocity, inundation extent, and peak discharge. Under various NbS configurations, such as retention basins, reforestation, and riparian corridor restoration.

The results highlighted that NbS significantly reduce flood hazard intensity. Natural retention basins primarily attenuate peak discharge through short-term storage of excess runoff, while riparian corridors improve flow regulation through the fluvial network.

Reforestation contributes to reducing runoff at the watershed scale. Collectively, reductions in peak flow exceeding 25% were observed, along with a noticeable decrease in flooded areas in vulnerable urban zones. The findings highlight that the effectiveness of NbS is not only dependent on their type but also on their spatial distribution within the watershed. Strategic placement, particularly in upstream areas and along flow paths, enhances their efficiency. This study provides a practical framework for integrating NbS into urban flood management strategies and supports their role as sustainable alternatives to conventional grey infrastructure in semi-arid environments.

Keywords: Nature-Based Solutions (NbS), Flooding, Iber model, Morocco.