# VULNERABILITY OF COLOMBO SUBURBS FOR KELANI RIVER FLOODS

P.G.T.N. Geeshan [1], T.M.N. Wijayaratne [1, *]

[1] Department of Civil Engineering, University of Moratuwa, Moratuwa

Floods are globally recognised as a foremost and expensive hazard, cause extensive damage worldwide, affecting lives, property, and crops. Low lying terrain in most of the river basins of Sri Lanka and heavy rainfall in central highlands magnify the susceptibility to these catastrophic events. The study area is lower Kelani basin which is the second largest river in Sri Lanka. It originates from the Central Highlands and flows westwards to the country's western coast. The lower basin of the Kelani River, including the Colombo metropolitan, the business capital of Sri Lanka with a high population, frequently experiences severe inundation due to high discharges of the Kelani River and localised heavy rainfall events.

HEC-RAS 2D model was used in this study to analyse water levels in the Kelani River and assess flood extents with depths and velocities, enabling reliable future predictions despite limited data availability. The model was calibrated and validated by comparing observed and simulated water levels during the May 2008 and June 2016 flood events, demonstrating satisfactory performance with a Root Mean Square Error of 0.134 m, coefficient of correlation of 0.951, Nash-Sutcliffe efficiency of 0.914, and a goodness-of-fit index of 70.1% for inundation extents. Additionally, an ArcGIS model was employed to generate a flood susceptibility map for the lower basin of the Kelani River.

This study involves several steps, including collecting data, setting up the HEC-RAS 2D model, analysing model parameter sensitivity, selecting parameters, calibrating and validating model simulations, generating flood inundation maps, and exploring the effectiveness of the flood bunds during extreme flood events. The study included identifying flood-prone areas in Colombo suburbs, assessing the flood risk through simulation of hypothetical flood bund breaches, estimating the flood extent and related maximum flood depths and maximum velocities. Evaluating the efficiency of existing flood bunds for floods with different return periods and assessing the vulnerability of areas protected by flood bunds on the left bank of Kelani River during 50 and 100-year Kelani floods and a 50-year rainfall in Colombo metropolitan area were the main tasks of the study.

The bund breaching simulation reveals that the total inundated area covers 108 km2, with 35% of that area experiencing an inundation depth exceeding 2 m. During a 50-year flood, the total overtopping length at the right bank is 300m, while it increases to 650m during a 100-year flood. This analysis provides valuable insights into the potential advantages of investing in infrastructure improvements to mitigate flood risk in the Colombo Suburbs. The generated flood inundation maps due to the Kelani River flood and the localised rain and flood susceptibility map will serve as a valuable tool for future flood risk planning, formulating implementation strategies aimed at minimising flood damage in Colombo suburbs.

**Keywords: HEC-RAS, Kelani River, Flood inundation mapping, 2D model**

[*] Correspondence: nimalw@uom.lk

# Vulnerability of Colombo Suburbs for Kelani River Floods

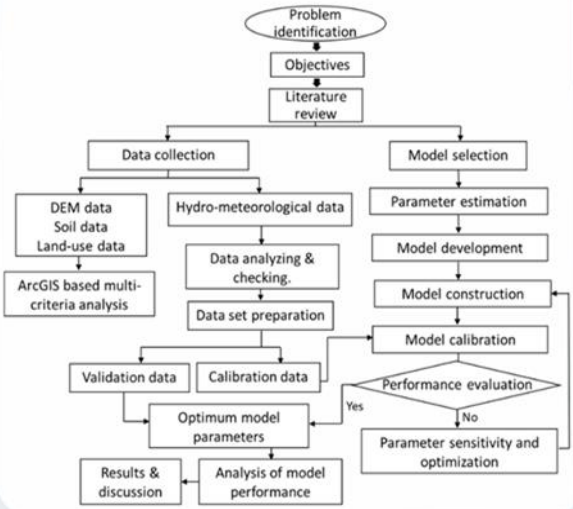
## AIM

DISCUSS COLOMBO AT RISK OF FLOODING WITH THE VARIATION OF FLOOD LEVELS, DISCHARGE, DURATION, AND RAINFALL IN COLOMBO SUBURBS.

## OBJECTIVES

1. TO CHECK THE ADEQUACY OF THE EXISTING FLOOD BUND AND DESIGNING NEW FLOOD BUND HEIGHTS FOR THE PRESENT CONDITIONS
2. TO IDENTIFY THE CRITICAL LOCATIONS, SIMULATING POSSIBLE HYPOTHETICAL BUND BREACH/GATE FAILURE SCENARIOS, AND ESTIMATING THE FLOOD EXTENT
3. TO DEVELOP A SUITABLE MODEL FOR THE COLOMBO CATCHMENT AREA USING HEC-RAS
4. TO FIND OUT HOW EXTREME RAINFALL AFFECTS THE VULNERABILITY OF COLOMBO AND ITS SUBURBS DURING THE KELANI FLOODS

## METHODOLOGY



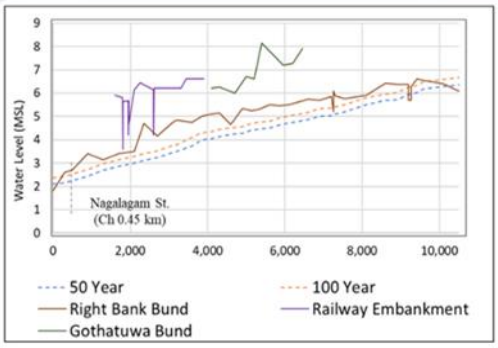




FIGURE 1. EXISTING FLOOD BUNS LEVELS AND DESIGN FLOOD LEVELS

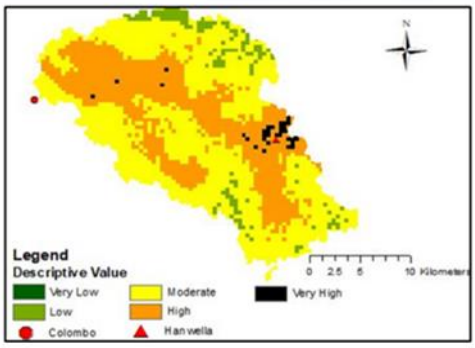



FIGURE 2. FLOOD SUSCEPTIBILITY MAP

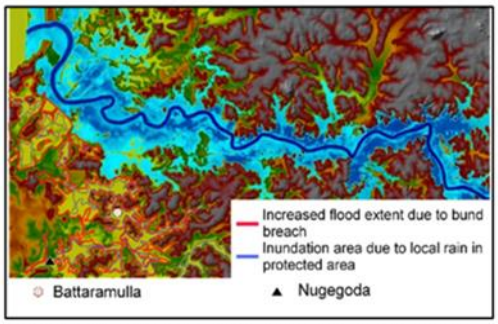



FIGURE 3. INCREMENT OF FLOOD EXTENT DUE TO BUND BREACH AND LOCAL RAINFALL


FIGURE 4. EXISTING FLOOD BUNDS AND IDENTIFIED VULNERABLE LOCATIONS