

ASSESSMENT OF FLOATING DEBRIS TRANSPORT IN PUTTALAM LAGOON

M.A.T.I. Mapa, T.M.N. Wijayaratna *

Department of Civil Engineering, University of Moratuwa, Moratuwa

The research tested the hydrodynamic behaviour and pollutant movement within the Puttalam Lagoon in Sri Lanka by applying numerical models that underwent calibration processes. The Puttalam Lagoon acts as an essential coastal ecosystem that preserves ecological services while sustaining local economies. Environmental decline occurs in the lagoon because of rising levels of urbanisation and industrial procedures, and insufficient waste management systems in the surrounding areas. The semi-enclosed character of the lagoon has received insufficient systematic examination to determine how pollutants are processed through its water system.

The main purpose of this research was to create a detailed hydrodynamic model through Delft3D-FLOW modelling software with drogue tracking implemented to replicate pollutant movement patterns. The six principal sources of pollutants that underwent assessment in this study included Kala Oya, Mee Oya, Dutch Canal, Puttalam town, and Kalpitiya town. The simulations examined pollutant transport through six extended scenario tests, which ran for twelve months, as well as shorter scenario tests that lasted one month. Pollutant transport was assessed by altering river discharge rates and wind velocity values.

The model results show strong reliability in its predictions of tidal dynamics and circulation patterns in the lagoon area through calibration and validation processes with historical data. The research study found that substantial differences existed between how pollutants were transported depending on the pollution source location and water flow characteristics. Pollutants from Kala Oya showed extensive transport capability, which caused extensive damage to the Dutch Bay shoreline and moved towards the offshore area, passing the lagoon mouth. The pollutants released from Mee Oya moved throughout the Etalai Basin before they spread into wider areas during conditions of increased wind speed. Pollutants originating from the Dutch Canal and Puttalam town, along with Kalpitiya town, accumulated locally, which resulted in high shoreline risks because they settled persistently at nearby locations.

The research study showed that wind speed and discharge intensity mostly affected non-decayable pollutants' movement. Delft3D drogue tracers delivered efficient visual results for tracing pollutant transport routes while detecting areas where pollutants would accumulate, such as floating plastics and microplastics. The study makes essential findings that demonstrate that hydrodynamic elements powerfully shape the distributions and retention patterns of pollutants. The study establishes the requirement for purpose-driven environmental management through periodic monitoring, together with persistent accumulation zone cleaning and buffer area development at exposed shorelines and waste management practice promotion.

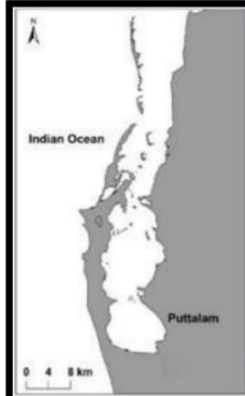
This research adds critical understanding about pollutant behaviour in Puttalam Lagoon, thus creating scientific groundwork for authorities to develop effective management policies. The findings provide the essential basis for both protecting the lagoon's natural structure and maintaining sustainable resource-based livelihoods, so proactive, evidence-driven actions need to be developed for lagoon pollution control.

Keywords: Delft3D-FLOW, Drogue tracers, Hydrodynamic modelling, Pollutant dispersion, Tidal dynamics

* Correspondence: nimalw@uom.lk

ASSESSMENT OF POLLUTANT TRANSPORT IN PUTTALAM LAGOON

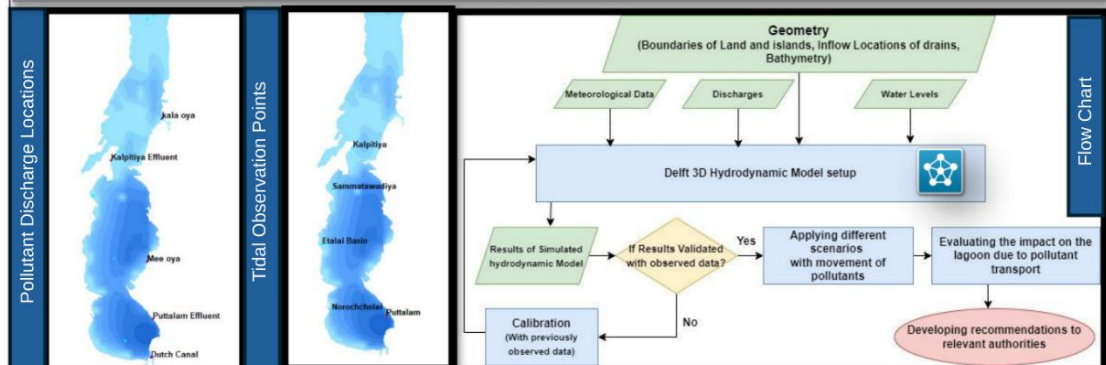
BACKGROUND



Study Area

- ❖ Vital coastal ecosystem supporting biodiversity and livelihoods
- ❖ Threatened by urbanization, industry, and poor waste management
- ❖ **Limited studies** on pollutant dispersion and accumulation
- ❖ **Need for hydrodynamic modeling** to assess pollutant pathways
- ❖ Focus on Kala Oya, Mee Oya, Dutch Canal, Puttalam City, and Kalpitiya City
- ❖ **Importance of understanding pollutant movement** for sustainable lagoon management

METHODOLOGY



RESULTS

