

EXPLORING THE POTENTIAL OF NATURE-BASED SOLUTIONS FOR WATER MANAGEMENT AND SANITATION IN URBAN AREAS

K.H.T. Vidusika, J.M.A. Manatunge *

Department of Civil Engineering, University of Moratuwa, Moratuwa

Rapid urbanisation, water pollution, and infrastructure development are increasingly facing challenges in water management and sanitation in urban areas. Conventional gray infrastructure such as centralised treatment plants and extensive drainage networks, while effective in certain contexts, often remains costly, energy-intensive, and environmentally unsustainable. Traditional infrastructure can cause environmental degradation and public health risks when managing wastewater and stormwater. Therefore, Nature-based Solutions (NbS) emerge as a sustainable alternative to address these challenges. The main objective of the research was to assess the feasibility of implementing NbS to create more resilient, sustainable, and liveable urban water systems. Specific objectives included identifying the most suitable NbS for urban residential wastewater management, evaluating their performance in terms of pollutant removal, and designing context-appropriate systems for a selected study area. Parliament Lake sub-catchment 1 in Sri Lanka, one of the most urbanised and heavily polluted areas in the country, was selected as the study area for this research. A methodological framework was developed comprising terrain and hydrological analysis, land-use compatibility assessment, and ecological enhancement potential. After investigating the applicability of various types of NbS for this sub-catchment, constructed wetlands (CWs) were selected based on the existing needs and requirements of water management and sanitation.

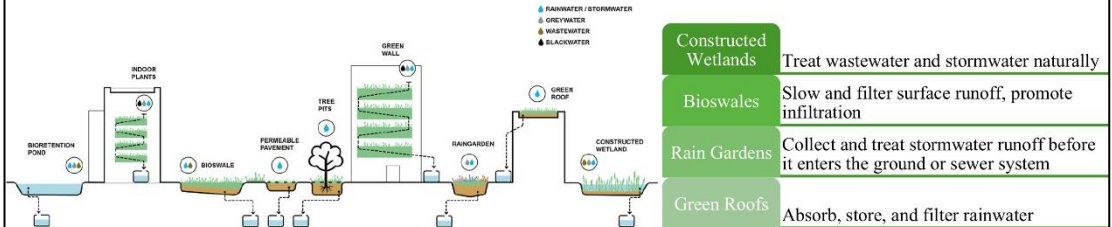
This study specifically targeted two sites within the Parliament Lake sub-catchment. Location 1 consisted of three houses, and Location 2 consisted of seven houses, both of which contribute domestic wastewater to the sub-catchment. Based on site suitability and functional requirements, hybrid constructed wetlands combining Horizontal Flow (HF) and Vertical Flow (VF) systems were selected for application. At Location 1, a HF wetland of 30.4 m² and a VF wetland of 22.8 m² were proposed, while at Location 2, larger units of 70.8 m² (HF) and 53.1 m² (VF) were designed. HF wetlands were selected to efficiently remove Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and suspended solids, while VF wetlands were designed to target ammonia removal. The hybrid system combining HF and VF wetlands provides a comprehensive approach to treating complex wastewater streams. It was found that scaling up CWs within the available land space of the selected sub-catchment was practical and feasible. Beyond wastewater treatment, CWs offer co-benefits including urban cooling, biodiversity conservation, flood control, and opportunities for safe water reuse in non-potable applications. However, successful implementation requires attention to long-term maintenance, institutional coordination, and community engagement to ensure sustained functionality.

Keywords: Constructed wetlands, Sustainable sanitation, Urban water management, Wastewater treatment

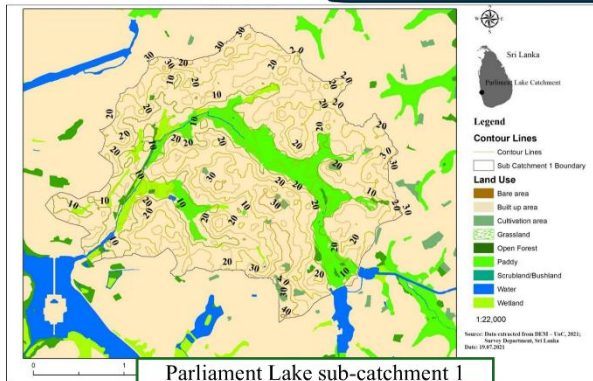
* Correspondence: manatunge@uom.lk

EXPLORING THE POTENTIAL OF NATURE-BASED SOLUTIONS FOR WATER MANAGEMENT AND SANITATION IN URBAN AREAS

Background



Methodology



Find the NbS for Water Management and Sanitation

Identify the Potential Solution

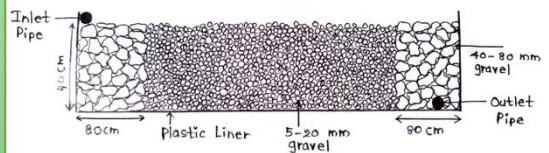
Refer the Case Studies

Apply the Potential NbS to Selected Locations of Catchment Area

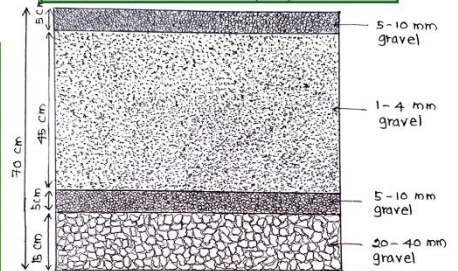
Results

Horizontal Flow (HF) Unit

- Area: Location 1: 30.4 m² / Location 2: 70.8 m²
- Depth: 0.4 m
- Gravel in the treatment zone - 5 – 20 mm
- Gravel in the inlet/outlet zones - 40 – 80 mm
- Function: Removes organic matter and suspended solids; enables denitrification
- Vegetation: *Phragmites karka*



Horizontal Flow (HF) Unit



Vertical Flow (VF) Unit

Vertical Flow (VF) Unit

- Area: Location 1: 22.8 m² / Location 2: 53.1 m²
- Depth: 0.7 m
- The recommended substrate profile for VF unit is shown in figure
- Function: Further organic removal and nitrification of ammonia to nitrate
- Vegetation: *Phragmites karka*

