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Assessment of Pilot Wetland Buffer Strips for Attenuation of Organic Matter and Nutrient Fluxes from Municipal Wastewater Effluents in Urban Environments of East Africa

PhD thesis

Abstract

Developing countries, including East Africa are still grappling with public health and eutrophication challenges due to persistence of pathogens, organic matter, nutrients and other emerging pollutants in municipal wastewater effluents. The overall objective of this study therefore was to assess and elucidate the performance of horizontal (HF) and vertical (VF) subsurface flow (SSF) constructed wetlands (CWs) as buffer systems for enhancing organic matter (OM) and nutrient removal processes between deficient wastewater treatment plants (WWTPs) and receiving urban environments of East Africa. An initial 5 year baseline performance assessment of a typical centralised WWTP in Masaka Uganda indicated 100% non-compliance to the national effluent discharge standards. However, a

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high pollution attenuation potential by a natural wetland was demonstrated. In addition, an experimental setting using HF and VF CWs planted with *Cyperus papyrus* and operating under batch hydraulic loading conditions exhibited higher efficiency for remediation of OM, N and P effluent pollution loads, with the highest mean reduction efficiencies observed in planted VF CWs due to optimal oxygen supply. The CO_2 fluxes were highest in planted VF and HF CWs. Moreover these systems demonstrated low CH_4 and N_2O emissions hence suitable technological options for low carbon development targets regarding sanitation and wastewater management in East Africa. It was therefore concluded that SSF CWs could be adopted as technologically less intensive interventions at a local scale, to increase the resilience of receiving environments by buffering intermittent and pulse pollution loads from WWTPs.

Key Words: Municipal Wastewater; Pollution Load; Wetland Buffer; Constructed Wetlands; East Africa