

Ecological Threshold and Assimilative Capacity of an Urban River Network: A Coupled Modeling Approach for the Manggahan Subbasin, Philippines

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Abstract

Rapid urbanization and industrialization have degraded water quality in the Manggahan Subbasin, a main tributary of Laguna de Bay. However, no comprehensive study of water quality has been conducted in this area, and government monitoring has only focused on the downstream reaches. Thus, this study will evaluate river water quality against DAO 2016-08/2021-19 standards, identify spatiotemporal pollution drivers using Principal Component Analysis (PCA), conduct hydrologic assessment of the Manggahan Subbasin, and determine the pollutant fate and transport by coupling the Soil and Water Assessment Tool (SWAT) and Water Quality Analysis Simulation Program (WASP) models across nine municipalities and cities. The Total Maximum Daily Loads (TMDLs) will be quantified with a 15% margin of safety, and watershed health will be classified using the Reliability-Resilience-Vulnerability (RRV) framework. Wastewater treatment scenarios, from current conditions to planned and recommended upgrades, will then be tested to see which best improve compliance with water quality standards. This combined framework of SWAT-WASP modeling, pollution load limits, watershed health assessment, and source apportionment is the first of its kind in the Philippines. The results are expected to pinpoint pollution hotspots and their sources, providing regulators and policymakers with an evidence basis for treatment upgrades and watershed management, not only for the Manggahan Subbasin but also for similar urbanizing watersheds across Laguna de Bay and nationwide.

Keywords: SWAT, WASP, Total Maximum Daily Load, Reliability-Resilience-Vulnerability (RRV), Principal Component Analysis (PCA), Laguna de Bay