A Multi-Indicator Approach to Assessing the Impact of Treated Wastewater Discharged into Flowing Surface Waters

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Abstract:
The aim of this study was to comprehensively assess the impact of treated municipal wastewater from WWTP located in southeastern Poland, on the water quality of the Wisłok. River using a pollutant load balance, a mixing model, and indices describing sewage pressure and the receiving water's assimilation capacity. The analysis was based on 33 monthly observations of treated wastewater quality, including BOD_5, COD, total suspended solids, total nitrogen, and total phosphorus, as well as six water quality measurement sessions upstream and downstream of the discharge point. Variability of wastewater flow and river flow was also taken into account. Daily pollutant loads and the eutrophication potential (EP) were determined for the entire dataset. In the six measurement sessions, a full mixing model was used, along with the Wastewater Impact Ratio (WIR), the receiving water's assimilation capacity (RWAC), its utilization rate (ACU), and the critical flow Qcritical. The average sewage flow was 21,427 m^3/d. The average concentrations of BOD_5, COD, total suspended solids, total nitrogen, and total phosphorus were 4.23; 53.29; and 7.40; 9.60; and 0.384 mg/dm^3 respectively. The average eutrophication potential was 134.29 kg $P\text{-}PO_4/d$, corresponding to 49.02 Mg $P\text{-}PO_4$/year. The model results showed that the impact of discharge on the receiving water body is strongly dependent on the relationship between sewage flow and river flow. High WIR values for selected parameters indicated that the observed changes in water quality cannot always be explained solely by mixing. The proposed set of indicators allows for a more comprehensive assessment of point source pollution pressure and the identification of the hydrological conditions potentially most unfavorable for the receiving water of treated wastewater.