**Assessing the Future Vulnerability of Coastal Salinity Intrusion Using the GALDIT Model and R: A Case Study from Negombo to Galle, Sri Lanka**

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***ABSTRACT***

Coastal groundwater systems are increasingly threatened by salinity intrusion, where saline water encroaches into freshwater aquifers. This study investigates the critical issue of coastal salinity intrusion along the Negombo to Galle coastal line in Sri Lanka. The primary objective is to assess the future vulnerability of this area to salinity intrusion. The research employs a combination of empirical data analysis and predictive modeling using the GALDIT model and advanced statistical techniques in R. Salinity variations are analyzed using historical data (2016-2020) from multiple sample stations along the coast, with a focus on seasonal patterns and the influence of monsoon cycles. Subsequent regression analysis identifies key factors contributing to salinity changes, including GALDIT parameters (Groundwater occurrence, Aquifer hydraulic conductivity, depth of groundwater Level above the sea, Distance from the shore, Impact of existing seawater intrusion, and aquifer Thickness), geological formations, groundwater extraction rates, and climate variability. Salinity intrusion of future years was predicted by using salinity data from 2016 to 2019. The findings reveal significant seasonal variations in salinity levels, with reduced contamination during monsoon periods compared to off-monsoon periods. Regression analysis indicates that the impact of existing seawater intrusion is a primary factor influencing salinity levels. A predictive analysis conducted using R to forecast salinity intrusion revealed no significant trends in salinity variation over the years, with the model demonstrating moderate accuracy at 52.93%. The implications of these findings are substantial for coastal water resource and coastal ecosystems management. The study highlights the necessity for long-term monitoring and the development of sustainable management strategies to mitigate the adverse effects of salinity intrusion.

Keywords: coastal salinity intrusion, GALDIT model, regression analysis, predictive modeling.