Nitrate and Other Nutrients Levels in Groundwater for Sustainable Management in Rayong Province, Thailand

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Rayong is situated along the eastern seaboard of the Gulf of Thailand and has been facing various anthropogenic pressures such as agriculture, industry, and urbanization. Moreover, the rapid development of the Eastern Economic Corridor (EEC) in Rayong Province lead to an increasing demand for groundwater resources. One particular concern about the use of groundwater for drinking water supply is the raised nitrate levels in groundwater in the Rayong province. Groundwater nitrate in Rayong ranged from <0.9 to 400 mg/L between 2013 and 2022. The highest reported concentrations exceed acceptable values, which can affect human health and lead to various environmental problems, especially eutrophication and subsequent deoxygenation.

This research aimed to evaluate and compare the concentrations of groundwater nitrate and other essential nutrients in different groundwater basins in Rayong Province. The study areas were divided into two groundwater basins: the Rayong basin and the Prasae sub-basin, which is part of the Chanthaburi-Trat groundwater basin. Groundwater samples were collected from 24 wells in the Rayong basin and 17 wells in the Prasae sub-basin during the wet season (July 2023) and the dry season (January 2024). These groundwater samples included those from unconsolidated sedimentary aquifers and rock aquifers. Essential Nutrients, including nitrate, nitrite, ammonium, phosphate, and silicate, were measured by colorimetry using a UV/VIS spectrophotometer.

The nitrate and other nutrient concentrations for both seasons in the Rayong and Prasae basins differed. In the wet season, the average groundwater nitrate concentration in the Rayong basin and Prasae sub-basin was 1.76 mg/L and 0.56 mg/L, respectively. Meanwhile, the average groundwater nitrate concentration in the dry season was 2.25 mg/L in the Rayong basin and 0.95 mg/L in the Prasae sub-basin. The results indicated that groundwater nitrate levels in the Rayong basin exceeded those in the Prasae sub-basin in both seasons, likely due to differences in hydrogeological conditions and agricultural activities. These activities may involve land use practices that favor more fertilizer input and enhanced biological activity related to nitrification. Moreover, concentrations of other nutrients in the Rayong basin were generally higher than in the Prasae sub-basin, except for silicate during the dry season. The differences in nutrient levels between the two basins are likely attributable to several factors, such as land use, aquifer regimes, and environmental conditions.

However, the water quality in Rayong Province, as observed in this study, remained within the water quality standards of Thailand. Notably, the groundwater nitrate levels in this study were lower than the WHO threshold for drinking water, unlike previous reports. Thus, it is imperative to conduct additional studies to identify potential nitrate sources, assess the impact of land use changes, and evaluate the effects of climate change on groundwater nitrate. This effort intends to provide critical information for sustainably managing groundwater resources, ensuring safe drinking water, and protecting the environment in Rayong Province.

Keywords: Water quality; Rayong groundwater basin; Prasae groundwater sub-basin