

Hydrogeochemical Assessment of Groundwater Quality in Singrauli (Madhya-Pradesh, India)

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This research analyses groundwater chemistry in Waidhan-Singrauli, focusing on rural areas reliant on untreated water. Forty-six groundwater samples were collected in 2022 during pre-monsoon (PrM), monsoon(M), and post-monsoon (PoM) period each. The samples were analysed for their physico-chemical parameters (pH, Temp., EC, TDS, ORP, TSS, DO, Acidity, Alkalinity, TH and F^- , Cl^- , HCO_3^- , SO_4^{2-} , NO_3^- , Ortho- PO_4^{2-} , Na^+ , K^+ , Ca^{2+} and Mg^{2+}). pH in all seasons were found to be within WHO recommended limits. Twenty-percent of samples had a muddy suspension with agreeable taste and odour during monsoons. Other samples were found physically suitable (with average TSS being 8.15 mg/l during monsoon and 3.07 mg/l during pre-monsoon period). EC for the area varied between the means values of $898 \pm 402 \mu S/cm$, $836 \pm 518 \mu S/cm$ and $1025 \pm 636 \mu S/cm$ and TDS between $449 \pm 198 mg/L$, $394 \pm 145 mg/L$ and $500 \pm 221 mg/L$ during PrM, M and PoM respectively, (exceeding WHO's recommend limit of 500mg/L in a few samples). Low DO levels ($2.70 \pm 0.47 mg/L$, $4.71 \pm 1.11 mg/L$ and $4.19 \pm 0.98 mg/L$) can be attributed to limited atmospheric contact, depth, temperature, geology, hydrology, and pollution (like organic matter). Nitrate levels were within acceptable ranges (i.e. below 50 mg/L), whereas mean ortho-phosphate levels surpassed WHO's recommended levels in all seasons, resulting in visible algal blooms in some agrarian samples. Although beneficial for agriculture, high orthophosphate levels cause undesirable taste, odour, and colour, rendering water unsuitable for drinking. Additionally, oxygen depletion exacerbates water quality issues. Fluoride ions exhibited concerning concentrations (approaching 1 mg/L) in 4-7 samples per season. Apart from these, all other chemical parameters met the water quality limits set by WHO, with only occasional exceptions in a few samples. Gibbs plots indicate increased chloride and sodium ion conc. during pre/post-monsoon period, suggesting higher evaporation, while rock weathering affects monsoon samples. Singrauli's rural economy, fueled by agriculture and industries such as thermal power plants and coal mining, grapples with groundwater pollution risks due to these activities, emphasizing the need to assess groundwater properties for public health and policy considerations amidst economic and environmental trade-offs.