

Evaluation of groundwater quality using hydrogeochemical characteristics and its suitability for drinking and irrigation around oil and natural gas drilling sites

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This study investigates the hydrochemical characteristics of groundwater quality for human and agricultural use in the East and West Godavari districts of Andhra Pradesh. Forty groundwater samples were collected from around oil and natural gas drilling sites in the study area, and were analysed for their physico-chemical parameters (pH, EC, TDS, TH and F⁻, Cl⁻, HCO₃⁻, SO₄²⁻, NO₃⁻, Na⁺, K⁺, Ca²⁺, Mg²⁺). The mean values obtained indicated 5177 (µS /cm) for EC, 2588 mg/L for TDS and 1244 mg/L for TH. Further, the results confirmed that the majority of the parameter mean values exceeded the acceptable range, whereas Mg²⁺, NO₃⁻, and F⁻ were within the desirable limit of drinking quality standards prescribed by WHO (2011). Water quality data and dissolved component sources were evaluated using the Piper trilinear diagram, Gibbs plot, water quality index, and principal component analysis (PCA). Based on piper tri-linear diagram classification, sodium and magnesium were observed to be the dominant cations, whereas sulphate and chloride as dominant anion. Gibbs's figure indicates that all samples fall into the rock-water interaction and evaporation dominance fields, showing that rock weathering influences groundwater chemistry. PCA revealed four data structure factors that explained 80.4% of groundwater variation and permitted parameter grouping by similar characteristics. The results of the water quality index (WQI) showed that 50% of the groundwater samples were unsafe for people to drink. Sewage influence and industrial waste also increase the amount of chloride, sodium, sulphate, and bicarbonate in groundwater. The mean concentrations of the major ions followed the order Cl⁻ > Na⁺ > SO₄²⁻ > HCO₃⁻ > Ca²⁺ > K⁺ > Mg²⁺ > NO₃⁻ > F⁻. The majority of groundwater tests showed salinity, total hardness, chlorine, and sodium concentrations that considered it unsuitable for irrigation or domestic purposes.