Classifying sources of nitrate contamination in an alluvial deposit aquifer system using hydrogeochemical properties and multivariate statistical techniques

ABSTRACT

This study determined nitrate concentration and identify the classifying sources of nitrate pollution in the alluvial deposit aquifer system in Bachok, Kelantan.

Materials and Methods: A total of 300 groundwater samples were collected in two different areas; agricultural area (150 samples) and non-agricultural area (150 samples). The samples were analyzed for nitrate and other parameters such as pH, EC, NH4+, TDS, turbidity and salinity. The multivariate analyses were used to identify factors that govern the groundwater quality and potential nitrate sources in the study area.

Results: Samples in the agricultural area were slightly acidic (5.89 ± 0.67), contained high nitrate (15.10 ± 15.90 mg/L NO3-N), NH4+ (0.82 ± 1.24 mg/L) and turbidity (3.25 ± 2.78 NTU). The principal component analysis (PCA) have identified the groundwater quality in the study area was influenced by the natural processes and anthropogenic activities. Based on the hierarchal cluster analysis (HCA), Cluster II in the agricultural area was identified to be most heavily nitrate contamination, while Cluster III in the non-agricultural area was identified to be strongly affected by seawater intrusion.

Conclusion: The findings of this study are useful for developing protection alternatives of private well waters to prevent further deterioration of groundwater quality by nitrate such as control of nitrogen fertilizer use, manure applications and other agricultural practices in the agricultural area. In order to reduce the health risk of nitrate, private well water users in this area should be advised to treat their water or find alternative sources for drinking.

Keyword: Groundwater; Nitrate; Principal component analysis; Hierarchical cluster analysis