

Geology and suitability assessment of groundwater of Kafin-Koro and its environs, North Central Nigeria for drinking and irrigation use

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Abstract

Groundwater samples from Kafin-Koro and its environs, North-central Nigeria were measured for Physico-chemical parameters to evaluate the groundwater suitability for drinking and irrigation purposes. The area was mapped on a scale of 1:25,000. Basement Complex rocks mapped consist of three (3) lithological units namely banded gneiss, granite gneiss and granite. The result of petrographic analysis shows the rocks found in Kafin-Koro and its microcline, quartz, biotite, hornblende, plagioclase and opaque minerals. Fifteen groundwater samples were collected and Standard methods for physicochemical determinations were employed. Results of physical parameters showed the pH range of 6.5-8.5, electrical conductivity 112 to 270 $\mu\text{S}/\text{cm}$ and Total dissolved solids 76-182 mg/L. Chemical parameters are calcium 12-23 mg/L, magnesium 0.54-9.13 mg/L, sodium 6-27 mg/L, potassium 3-7 mg/L, chloride 6.58-34.3 mg/L, sulphate 5- 21 mg/L, bicarbonate 38-111 mg/L, nitrate 0.89-13.4 mg/L, nitrite 0-0.13 mg/L, phosphate 0.2-1.83 mg/L, fluoride 0.1-0.76, iron 0.01-0.5, chromium 0-0.1 mg/L, copper 0-0.35 mg/L, manganese 0-0.34 mg/L, zinc 0-1.03mg/L, silica 0.26-15.5 mg/L while arsenic and nickel are negligible. The ionic dominance for the major cations and the anions respectively were in these order: $\text{Ca} > \text{Na} > \text{Mg} > \text{K}$ and $\text{HCO}_3^- > \text{Cl}^- > \text{SO}_4^{2-} > \text{NO}_3^-$. The concentrations of major ions in groundwater are within the permissible limits for drinking. However iron concentration at Kafin-Koro (FBC), Tanda and Angwuwanidi have values higher than 0.3mg/L permissible limits for drinking water stipulated by WHO (2011) and NSDWQ (2007). The dominant water type is Ca-HCO₃ (86.67%) as well as mixed Ca-Na-HCO₃ water type (13.33%). Various determinations such as Electrical Conductivity, Sodium Adsorption Ratio, Percent Sodium Percentage, Residual Sodium Carbonate, Magnesium Adsorption Ratio, Kelly's Ratio and Permeability Index were within safe limits, thus largely suitable for irrigation purposes.