Desalination and Water Treatment
www.deswater.com

doi: 10.5004/dwt.2021.27913

244 (2021) 41–54
December

Hydrogeological studies and evaluation of surface and groundwater quality of Khyber Pakhtunkhwa, Pakistan

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Received 26 January 2021; 25 October 2021

ABSTRACT

The hydrochemistry and suitability of the groundwater for drinking and irrigation purposes in Haripur District, Pakistan, were investigated. The hydrogeological system, land use, and drainage areas have all been linked to identifying chemical compounds' sources in groundwater. Thirty-four (34) groundwater samples and eight (08) surface water samples were collected in the research area to determine the physico-chemical parameters of the groundwater and surface water. The results were compared with Pakistan Standard Quality Control Authority (PSQCA) and World Health Organization (WHO) standards for suitability. The spatial distribution map of the major ions (cations and anions) has been prepared, including calcium (Ca^{2+}), sodium (Na^{+}), magnesium (Mg^{2+}), potassium (K^{+}), chloride (Cl^{-}), bicarbonate (HCO_3^{-}) and sulphate (SO_4^{2-}). The irrigation water quality has been assessed using the sodium adsorption ratio, residual sodium carbonate, magnesium hazard, electrical conductivity, and Kelly's ratio. Most of the samples fall within the permissible range of drinking water quality. However, in some samples, Cl^{-} and Na^{+} concentrations exceed the permissible limits. By using the Piper Trilinear Diagram (1944), major hydrogeochemical facies were identified. All the field data showed that there existed three different groups of water. Ca-HCO_3 (52.38%), Na-Cl-SO_4 (21.42%), mixed type Ca-Mg-HCO_3 and Ca-Na-HCO_3 (26.19%) are dominant groups. Ca-HCO_3 type water is freshwater. Based on sodium adsorption ratio, four (4) samples were considered unsuitable for irrigation. Wilcox's classification shows that 90% of samples fall in the C_2S_1 category, which is permissible for irrigation purposes. There are two important parameters that suggest improvement of water prior to its use, that is, the sodium hazard and the magnesium hazard. The study furnished the fact that the hydrogeochemical facies and the constituents are mainly controlled by hydrogeology, water depth, land use and drainage.

Keywords: Groundwater; Hydrogeology; Physicochemical analysis; Hydrogeochemistry

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