

Assessment of groundwater quality for irrigation and its effects on crop yield and soil salinity by using Geographic Information System (GIS) in Tehsil Kohat, Pakistan

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Abstract

Groundwater is extensively used for irrigation in southern districts of Khyber Pakhtunkhwa, Pakistan. Sustainability of agriculture production is under threat due to irrigation with groundwater of poor quality in some of the areas such as District Kohat. A study was conducted to assess the suitability of groundwater for irrigation and its effect on crop yield and soil salinity. A total of ten villages were selected in Tehsil Kohat and there were seventy groundwater samples randomly collected from the study area and were analyzed in laboratory and divided into water quality classes using different criteria. These samples were analyzed for Electrical Conductivity (EC), Sodium, Calcium and Magnesium ions for determination of Sodium adsorption ratio (SAR). Carbonate, bicarbonate and the residual sodium carbonate (RSC) were also determined. A total of 70 soil samples in each corresponding water sample location command area were taken at different depths for salinity and sodicity assessment. The data of all the parameters were analyzed through GIS. Based on GIS analysis, the study area was classified into three water quality zones – usable, marginal and hazardous. On the basis of EC_w it can be concluded that one-third of the study area's groundwater was saline and not fit for irrigation. Similarly on the basis of SAR, half of the study area has marginal water quality and one-sixth was hazardous (not fit for irrigation). The RSC values showed that overall the concentrations of carbonate and bicarbonate were higher. One-fourth of the study area has RSC concentration greater than permissible limit 5 meqL⁻¹. EC_w greater than 5 dSm⁻¹ has resulted 75% yield reduction in Cucumber, Turnip, Tomato and Radish and 100% yield reduction in Onion and Carrot. Taking together the effects of EC_w and SAR_w on soil infiltration, one-sixth of the study area is severely affected. Irrigation water quality with greater EC_w resulted relatively higher soil salinity (EC_e) in the root zone. It can be concluded that the use of groundwater for irrigation with EC_w > 5 dSm⁻¹ should be restricted for the sensitive crop.