Assessment of Physicochemical Characteristics of Groundwater and Soil and Soil of Ajmer District, Rajasthan

Kishan Gopal Jhanwar; Rajeev Mehta and Preeti Mehta

Department of Chemistry, Sangam University, Bhilwara-311001, Rajasthan

Abstract: In the present study, the groundwater and soil quality in Ajmer, Rajasthan has been evaluated. A total of 50 groundwater and soil samples have been collected and analysed for pH, EC, TH, HCO_3^-, CO_3^{2-}, Cl^-, SO_4^{2-}, NO_3^-, Ca^{2+}, Mg^{2+}, Na^+ and K^+. To assess the groundwater and soil quality for irrigation purpose, parameters like sodium adsorption ratio (SAR), soluble sodium percentage (SSP), residual sodium carbonate (RSC), magnesium hazards (MHs), permeability index (PI), and chloroalkaline index (CAI) values have been calculated. In USSL diagram, most of the groundwater and soil samples fall in the C2S1 category and were safe for irrigation purpose. Only seven groundwater and soil samples fall in the C3S1 category, indicating medium to high salinity which is safe for irrigation purpose for all types of soils but with limited care of exchangeable sodium. On the basis of RSC, all groundwater and soil samples were observed to be suitable for irrigation purpose. Piper diagram indicated that 50% of the groundwater and soil samples belonged to the Mg^{2+}-Ca^{2+}-HCO_3^- type and 48% was classified as the Ca^{2+}-Mg^{2+}-Cl^- type. Durov diagram suggested possibilities of ion mixing and simple dissolution of ions from polluted soil of Ajmer.

DOI of the Article: https://doi.org/10.46501/IJMTST0706052

Available online at: http://www.ijmtst.com/vol7issue06.html

As per UGC guidelines an electronic bar code is provided to seure your paper

To Cite this Article: Kishan Gopal Jhanwar; Rajeev Mehta and Preeti Mehta. Assessment of Physicochemical Characteristics of Groundwater and Soil and Soil of Ajmer District, Rajasthan. *International Journal for Modern Trends in Science and Technology* 2021, *7*, 0706210, pp. 309-312. https://doi.org/10.46501/IJMTST0706052

Article Info. Received: 15 May 2021; Accepted: 14 June 2021; Published: 22 June 2021

INTRODUCTION

Groundwater and soil plays an important role all over the world for the survival of both flora and fauna. India is one of the largest users of groundwater and soil, particularly for drinking and agriculture purposes [1] Agriculture is one of the most important sectors of Indian economy. In rural areas, the major sources of groundwater and soil for drinking and irrigation purpose are hand pump and tub well. According to a national sample survey, 56% households get drinking water from hand pump or tube well, 14% from open well, and 25% based on piped water [2]. Groundwater and soil gets contaminated with a variety of pollutants such as domestic, agriculture, and industrial due to utilization of fertilizers, pesticides, and other chemical products [3]. The groundwater and soil quality assessment based on different agriculture indices has been studied in different parts of world [4, 5]

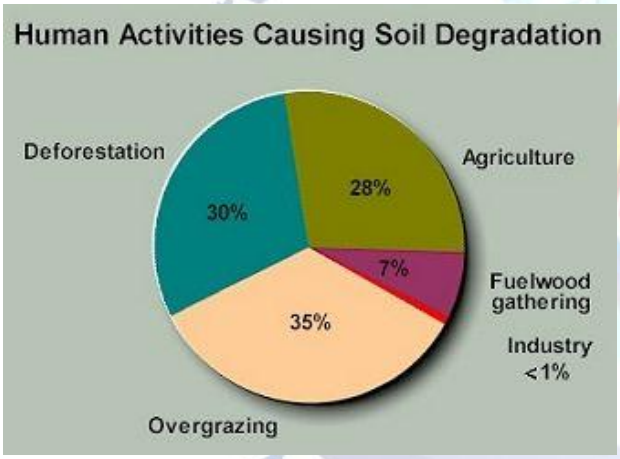

Fig.1

To the best of our knowledge, no study on the assessment of irrigation water quality has been undertaken from Ajmer District of Rajasthan with especial reference to dug well and hand pump water and soil quality status. Therefore, in the present study, an attempt has been made to determine the groundwater and soil suitability for irrigation purpose here.

MATERIALS AND METHODS

Fifty groundwater and soil samples (hand pump and dug well) were collected in premonsoon season in the year 2020 from different sites in Ajmer district. The samples were collected in prewashed polyethylene narrow mouth bottles (three times rinsed with same water to be sampled). Locations (longitude, latitude, and altitude) of sampling point were measured by using a global positioning system (GPS).

Electrical conductivity (EC) and pH were measured using a potable kit. The water samples were filtered with using 0.45 Millipore membrane filter paper for the separation of suspended solids. Sulphate (SO_4^{2-}) content was determined by the UV spectrophotometric method, while chloride (Cl^-) and bicarbonate (HCO_3^-) content were measured by the titration method [2]. The detection of Ca^{2+}, Mg^{2+}, and total hardness (TH) was done by the titration method, while Na^+ and K^+ were estimated by the flame photometer method [1].

The concentrations of different parameters were interrelated, and irrigation indexes like soluble sodium percentage (SSP), sodium adsorption ratio (SAR), residual sodium carbonate (RSC), magnesium hazard (MH), permeability index (PI), and chloroalkaline index (CAI) were calculated to assess groundwater and soil quality. USSL salinity, Wilcox, permeability index, and Gibbs diagrams were drawn with the help of Grapher free software to assess irrigation quality of collected water samples. Hydrochemical analysis was evaluated by drawing Piper and Durov diagrams using Aquachem (2004) software. Electrical conductivity and US Salinity Laboratory diagram helped in explaining salinity and alkalinity hazard in the study area. Sodium hazard was assessed by evaluating soluble sodium percentage and sodium absorption ratio and drawing Wilcox diagram. Carbonate and bicarbonate hazard was assessed by evaluating soluble sodium carbonate. Permeability index (PI) was used to classify the irrigation water quality and was calculated by the formula given by Doneen [3]. The concentration of all ions was taken in meq L^{-1}

RESULTS AND DISCUSSION

The term pH expressed to describe the intensity of acidic and alkaline nature of a solution. The pH value of the groundwater and soil samples in the study area lie in between 7.57 and 8.61. All the groundwater and soil samples belonged to the safe limit for irrigation purpose [4]

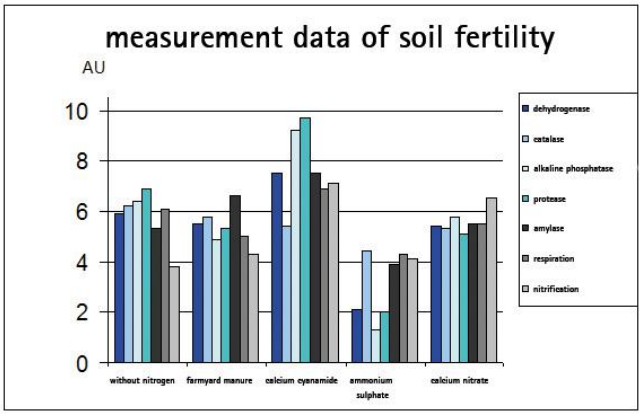

Fig.2

In the present study area, the concentration of cations lies from 20.0 to 140.0 mg L^{-1} for Ca^{2+}, 14.1 to 85.0 mg L^{-1} for Mg^{2+}, 0.4 to 62.0 mg L^{-1} for Na^{+}, and 0.0 to 55.2 mg L^{-1} for K^{+} (5). In irrigation water, the permissible limit for Ca^{2+}, Mg^{2+}, Na^{+}, and K^{+} is 80, 35, 200, and 30 mg L^{-1}, respectively [30, 31]. On the basis of these permissible limits, 96% groundwater and soil samples for Ca^{2+}, 42% for Mg^{2+}, 100% for Na^{+}, and 100% for K^{+} were fit for irrigation purpose. The permissible limit for anions HCO3− and Cl− is 250 mg L−1 [30, 31]. The values of HCO3− and Cl− in the groundwater and soil samples varied from 29.2 to 372.0 mg L−1 and 8.2 to 252.4 mg L−1, respectively . The results on major anions revealed that 64% water samples as per the limit of HCO3− and 98% as per the limit of Cl− were observed to be fit for irrigation purpose.

The groundwater and soil becomes saline if high salt content is present. The evaluation of salinity hazard is an important parameter of agriculture water as high salt content of irrigation water causes the soil to become saline, and it also adversely affects the salt intake efficiency of the plants.[11,12] Electrical conductivity (EC) and total dissolved solid (TDS) values are measure of salinity hazard of irrigation water. In the present study, the values of EC and TDS ranged from 353 to 1274 μS^{-1} cm^{-1} and 229 to 828 mg L^{-1}, respectively. According to the limiting value [6] of TDS for water suitability for irrigation purpose, 28% groundwater and soil samples belonged to the moderate category. Furthermore, the classification and distribution of groundwater and soil samples with respect to salinity (EC) is given . The water samples were classified into four groups on the basis of salinity [7]. Irrigation water quality based on salinity indicated that no water sample belonged to the excellent category (C1). Eighty-six percent of the samples belonged to the C2 class, and remaining 14% was found in the C3 class. On the basis of salinity, none of the samples were observed to be unfit for irrigation purpose.[8]

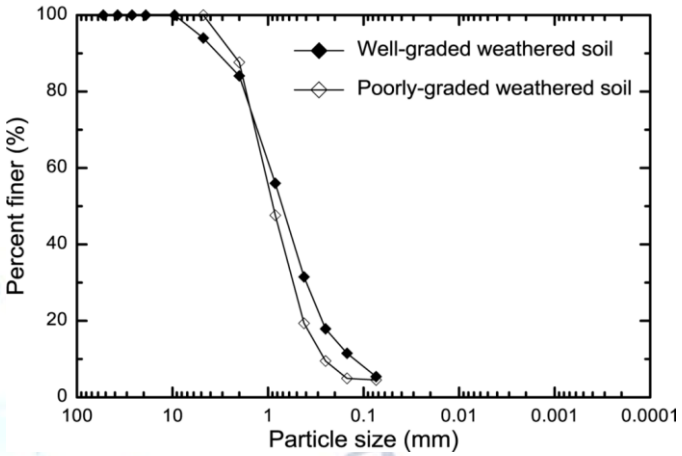

Fig.3

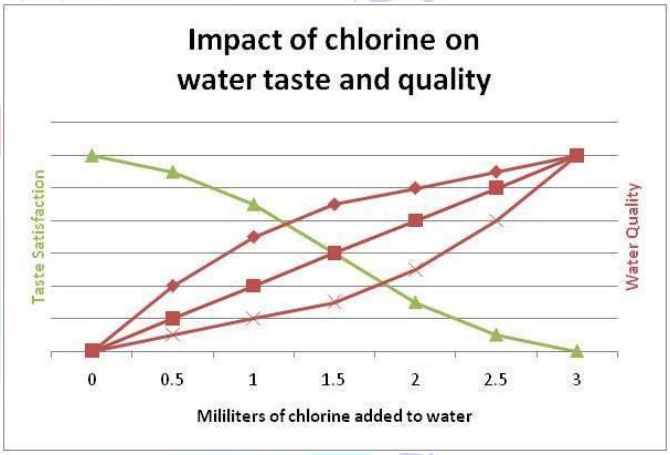

Fig.4

CONCLUSION

The groundwater and soil of Ajmer district was alkaline and hard to very hard in nature. On the basis of SAR, RSC, SSP, and PI, all the groundwater and soil samples were observed to be suitable for irrigation purpose. Based on the MH values, 54% groundwater and soil samples were found to be unsuitable for irrigation purpose. The most dominated cation was Ca^{2+} followed by Mg^{2+}, Na^{+}, and K^{+}, while the order of domination of anions was $HCO_3^- > Cl^- > SO_4^{2-} > NO_3^- > CO_3^{2-}$. Predominance of cations such as magnesium and calcium in the groundwater and soil indicated pollution to anthropogenic activities. All the groundwater and soil samples showed simple mixing of ions[9,10] .

REFERENCES

1. Rijsberman, F. R. Agricultural Water Management, 2006, 80(1- 3), 5.
2. Burjia, J.S.; Romani, S.. Groundwater Development–Present scenario and future needs. Indian J. Pub. Adm. 2003, XLIX(3), 301. CPCB, Water Quality, Parivesh, 1995, 1(4), 6.
3. Abraham BairuGebrehiwot; NataTadesse; Elias Jigar. ISABB J. Food and Agriculture Sci.,2011, 1(1), 22.
4. Gupta S, Kumar A, Ojha C K and Singh G, 2004, Journal of Environmental Science & Engineering. 46(1), pp7478.
5. Lakshmanan, E; Kannan, K.; Senthil, M.K. Indian J. Env. Geosciences,2003, 10(4),157.
6. Kalavathy, S; RakeshSharmas, R; Sureshkumar, P. Arch. Environ.Sci., 2011, 5, 55.
7. APHA. 2005, Standard methods for the examination of water and waste water (2st Ed.), American Public Health Association, Washington.
8. BIS. 2003, Indian standards specifications for drinking water, IS:10500, Bureau of Indian Standards, New Delhi.
9. ICMR, 1975, Manual of standards of quality for drinking water supplies, Special report series no. 44, Indian Council of Medical Research, New Delhi.
10. D. Fairchild, Lewis Publication. Chelsea, Michigan., 1987, 402,161-174.
11. A.T. Ajao, G. B. Adebayo and S. E. Yakubu J. Microbiol. Biotech. Res., 2011, 1 (3), 50-56
12. WHO. 2005, International standards for drinking water, World Health Organisation, Geneva.