Studies on Estimation of Major Ions Constituents of Ground Water of Khetri Nagar (rajasthan)

Surendra Kumar Sharma*
Jaswant Sharma**
Ritu Pathak***
Usha Sharma****

Abstract :-

Ground water qualities of KHETRI Nagar (Jhunjhunu) in Rajasthan were studied Pre Monsoon, Monsoon and post Monsoon (2015 to 2017) to assess its suitability for drinking and Irrigation purpose. Water samples from different sites were collected and seventeen physico-chemical parameters were analysed and values obtain were compared with standard values recommended by BIS, ICMR, WHO and USPH Standards. Groundwater of the study area was found "poor" for drinking purposes with reference to WQI, NO3 , TH and TDS. From the Piper trilinear diagram, it is observed that the majority of ground water from sampling stations are mixed type water. The values of sodium absorption ratio and electrical conductivity of the ground water were plotted in the US salinity laboratory diagram10 for irrigation water. Most of the samples quality with high salinity hazard and low sodium hazard.

Key Words :- Water Quality index, Ground Water Physico-chemical, water quality, sodium, potassium.

Introduction

Water on Earth moves continually through the hydrological cycle1 of evaporation and transpiration, condensation, precipitation, and runoff, usually reaching the sea. Approximately 70% of the fresh water used by humans goes to agriculture. Water appears in nature in all three common states of matter (solid, liquid, and gas) and may take many different forms on Earth: water vapor and clouds in the sky; seawater in the oceans; icebergs in the polar oceans; glaciers and rivers in the mountains; and the liquid in aquifers in the ground3. Water plays an important role in the world economy, as it functions as a solvent for a wide variety of chemical substances and facilitates industrial cooling and transportation. Water is one of the most vital components on the earth not only essential for life but also for total well balanced of environmental system. Water is essential for life on Earth12. Water is essential natural resources for sustaining life and environment that we have always thought to be available in abundance and free gift of nature14.

Material and Methods :-

Samples were collected in good quality polyethylene bottles6 as per the standard procedure. Sampling has been carried out without adding any preservatives in rinsed bottles directly for avoiding any contamination and brought to the laboratory.. Reagents use for the present investigation were of AR Grade and double distilled water was used for preparing various solutions. The samples were analyzed as per the standard methods (APHA131992, Trivedi and Goel 1984). Various physical parameters like pH, EC, DO and TDS were determined on the site with the help of digital portable water analyzer kit (CENTURY-CK-710) The chemical analysis was carried out for calcium (Ca2+), Magnesium (Mg2+), Chloride (Cl-), Sulfate (SO42-) Carbonate (CO32) and Bicarbonate (HCO3-1) by volumetric tritration methods. While fluoride

(F-) by Spectro-photometric (AIMIL-C160-80314) method. The nitrate was estimated at wavelength 220 nm by Ultra violet Spectrophotometer (ELICO-CL-54D) method. Sodium (Na+) and Potassium (K+) by flame photometry (ELICO-CL-220) methods. The respective values for all these parameters are reported in Table No.2 and all results are compared with their standards limits recommended by ISI15, ICMR 16and WHO17.

Result and Discussion

Water samples of KHETRI Nagar (Jhunjhunu) were collected and analyzed as per standard methods and the water quality index (WQI)8 was determined. With the help of WQI, we assessed the seasonal results of KHETRI Nagar area. Sampling was done during three seasons (pre–monsoon, during monsoon and post–monsoon) throughout the two–years from various areas during (April, 2015 to February, 2017) Results of three seasons physico-chemical analysis are shown in Table A and Table B. Suitability of ground water for domestic and irrigation purposes are classified on the basis of Piper diagram (Figure 1) and USSL diagram (Figure 2).

a. Electrical Conductivity (EC): The physico–chemical data reveals that the EC values of both years varied from 1446 to 3160 seimens/cm and these values were much higher than the prescribed standard limit recommended by WHO for all the samples. The minimum and maximum values of EC were observed in sample GA5 and GA1 respectively.

b. pH: pH values ranged between 7.22 to 8.25 during two years samplings. The pH values showed that water samples were slightly alkaline in nature and these values were within the limit as prescribed by WHO for all samples. The average value of pH was 7.57. The minimum value of pH was monitored in sample GB5 and the maximum value of pH was viewed in sample GB3.

c. Calcium (Ca2+): Calcium values were varied from 24.05 to 162.32 mg/L and these values were within permissible limit prescribed by ICMR & BIS. The average value of calcium was 91.52 mg/L. In sample GB2 minimum value of calcium was observed and in sample GA3, maximum value was surveyed.

d. Magnesium (Mg2+): The data table reveals that the magnesium values in both years varied from 79.04 to 152 mg/L. For all 42 % groundwater samples values were within the standard limit recommended by BIS. The minimum value of magnesium was observed in sample GA5 and the maximum value of magnesium was found in sample GB4.

e. Sodium (Na+): Sodium values ranged from 82 to 335 mg/L and the average value of sodium was 160.69 mg/L all of the studied samples of both years. Except GA1, all samples were lesser values than the prescribed US standards. The minimum and maximum values of sodium were examined in sample GB1 and GA1 respectively.

f. Potassium (K+): Potassium values ranged from 1.27 to 5.30 mg/L and the average values of potassium was 3.26 mg/L all of the studied samples of both years. All samples were lesser values than the prescribed US standards. The minimum value of potassium was examined in sample GB5 and the maximum value of potassium was scrutinized in sample GA1.

g. Carbonate (CO32–): Carbonate concentration in KHETRI Nagar was only detected in GB1 as 36 mg/L.

h. Bicarbonate (HCO3–): Bicarbonate values were varied from 135.40 to 610 mg/L and 75% bicarbonate values were within permissible limit prescribed by USPH. The average value of bicarbonate was 388.98 mg/L. In sample GB1 minimum value of bicarbonate was observed and in

sample GA4 maximum value was surveyed2.

i. Chloride (Cl–): Chloride values ranged from 224.93 to 484.35 mg/L and the average value of chloride was 306.95 mg/L all of the studied samples of both years. 25% samples were lesser values than the prescribed WHO standards. The minimum value of chloride was examined in sample GB5 and the maximum value of chloride was scrutinized in GA1.

j. Sulphate (SO42–): Sulphate values ranged between 78.92 to 263.10 mg/L during two years samplings. All these values were within the limit as prescribed by WHO for all studied samples except GA1. The average value of sulphate was 145.32 mg/L. Sulphate was monitored in sample GB1 as minimum value and sulphate was monitored in sample GA1 as maximum value.

k. Nitrate (NO3–): Nitrate7 values ranged from 65 to 130 mg/L and the average value of nitrate was 91.22 mg/L for all of the studied samples of both years. Values of nitrate were above in all samples as prescribed by WHO. The minimum value of nitrate was examined in sample GA2 and the maximum value of nitrate was scrutinized in GB4.

l. Fluoride (F–): The data table reveals that the fluoride values in both years varied from 0.54 to 1.60 mg/L. 33 % of the groundwater samples of KHETRI Nagar were not within the standard limit recommended by ICMR. The minimum value of fluoride was observed in samples GA2, GB5 and GB6. The maximum value of fluoride was found in sample GA4 and 0.89 mg/L was the average value of fluoride.

m. Total Hardness (TH): All values of TH were above the value recommended by BIS, WHO & ICMR standards in both years. TH values varied from 550.44 to 850.66 mg/L. The minimum value of TH was found in sample GB2 and the maximum value of TH was detected in sample GA1. The average value of TH was 695.54 mg/L.

n. Total Dissolved Solids (TDS): TDS values were varied from 760 to 1666 mg/L and these all values were above the permissible limit prescribed by ICMR & WHO. The average value of TDS was 1109 mg/L. In sample GB1 minimum value of TDS was observed and in sample GA1 maximum value was surveyed.

o. Dissolved Oxygen (DO): The data table reveals that the DO values in both years varied from 6.6 to 7.7 mg/L for all groundwater samples and there were not any large variations of DO values found and all the values were within the limit (4 to 6 Mg/L) permissible limit recommended by USPH standards. The minimum value of DO was observed in sample GB5 and the maximum value of DO was found in sample GA5 and 7.1 mg/L was the average value of DO.

p. Biochemical Oxygen Demand (BOD): BOD values ranged between 2.62 to 3.3 mg/Lduring two years samplings. All these values were within the limit as prescribed by USPH for all studied samples. The average value of BOD was 2.96 mg/L. BOD was monitored in sample GB5 as minimum value and BOD was monitored in sample GB1 as maximum value.

q. Chemical Oxygen Demand (COD): COD values were varied from 4.44 to 12 mg/L and all these values were not within permissible limit prescribed by USPH standards except few ones. The average value of COD was 9.08 mg/L. In sample GA6 minimum value of COD was observed and in sample GB2 maximum value was surveyed.

r. Percent Sodium (%Na): All values of %Na were under recommended CPCB standards in both years. %Na values varied from 23.45 and 46.38. The minimum value of %Na was found in sample GB1 and

the maximum value of %Na was detected in sample GA1.

s. Sodium Absorption Ratio (SAR): SAR values ranged from 1.46 to 5.00 mg/L and the average value of SAR was 2.64 mg/L all of the studied samples of two years analysis. All samples were lesser values than the prescribed CPCB standards and the minimum and maximum values of SAR were scrutinized in samples GB1 & GA1 respectively. Data is plotted on the US salinity diagram (Figure 2), in which EC is taken as salinity hazard and SAR is taken as alkalinity hazard. Most of the ground water samples fall in the C3S1 quality with high salinity hazard and low sodium hazard, which can be used for irrigation11 on almost all type of soil with little danger of exchangeable sodium

t. Residual Sodium Carbonate (RSC): All RSC values were found below the zero, which means waters containing a carbonate plus bicarbonate concentration greater than the calcium plus magnesium concentration and these values fall in under "good" category with respect to RSC .

u. Water Quality Index (WQI): The critical study from the Table 3B reveals that WQI values of two years were varied from 66.7879 to 111.8089 with an average value 86.6106, which means that all water of samples were of poor quality and is not recommended for domestic purposes. It may be concluded with the help of WQI that the water of the various samples were unfit for drinking purpose without further treatment (mainly disinfection).

v. Heavy Metals: Heavy metals like Co, Cd, Pb and Mn values in all studied two-year samples were non-detectable (ND). Concentration of copper and iron ranged from 0.01 to 0.03 during 2015 to 2017 and all these values are under the permissible limit prescribed by BIS. Zinc concentration varied from 0.02 to 0.06 mg/L that is under the standard value prescribed by BIS.

Piper Trilinear Diagram: Major cations and anions such as Ca2+, Mg2+, Na+, K+, CO32 , HCO3 , SO42¬ and Cl in meq/L were plotted in Piper's trilinear diagram to evaluate the hydrochemistry of groundwater of KHETRI Nagar with the help of GWW- software (Figure 2). On the basis of Walton's classification , all the water samples showed an excess of alkaline earth (Ca2+ + Mg2+) over alkalies (Na++ K+) and all the groundwater samples showed an excess of strong acids (SO42¬ + Cl) over weak acids (CO32 , HCO3).The plot shows that all the groundwater samples fall in the field of mixed type water (No cation – anion exceed 50%).

Conclusion: Groundwater of the study area was found "poor" for drinking purposes with reference to WQI, NO3 , TH and TDS. From the Piper trilinear diagram, it is observed that the majority of ground water from sampling stations are mixed type water. The values of sodium absorption ratio and electrical conductivity of the ground water were plotted in the US salinity laboratory diagram for irrigation water. Most of the samples fall in C3S1 quality with high salinity hazard and low sodium hazard. Chemical analysis of groundwater shows that mean concentration of cation (in meq/L) is in order magnesium > sodium > calcium > potassium while for the anion (in meq/L) it is chloride > bicarbonate > sulphate > nitrate > fluoride > carbonate.

Table (A): Physico- Chemical Parameters of Groundwater of KHETRI Nagar Area during 2015 to 2017

Code	Season	EC	pH	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	CO_3^{2-}	HCO_3^{-}	Cl^{-}	SO_4^{2-}	NO_3^{-}	F^{-}
GA1	Pre 2006-07	3160	7.39	100.20	145.92	335.00	5.30	0.00	500.25	484.35	263.10	80.58	0.72
GA2	Mon 2006-07	1738	7.80	126.26	80.26	101.00	4.00	0.00	329.40	317.40	196.00	65.00	0.54

GA3	Post 2006-07	1872	7.80	162.32	96.06	116.87	3.05	0.00	384.30	379.88	216.00	75.64	0.81
GA4	Pre 2007-08	1980	7.40	156.31	102.14	166.00	5.00	0.00	610.00	319.90	150.00	95.00	1.60
GA5	Mon2007-08	1446	7.27	98.20	79.04	153.37	3.17	0.00	475.80	224.93	130.65	79.17	1.23
GA6	Post2007-08	1635	7.32	124.25	91.20	156.98	4.06	0.00	585.60	257.42	154.84	84.04	1.23
GB1	Pre 2006-07	1848	7.76	76.15	99.71	82.00	4.30	36.00	135.40	237.43	78.92	77.96	0.64
GB2	Mon 2006-07	1738	7.98	24.05	119.17	146.00	3.00	0.00	366.00	299.91	98.00	85.00	0.83
GB3	Post 2006-07	1872	8.25	30.06	143.49	168.94	2.29	0.00	427.00	359.89	108.00	98.91	1.25
GB4	Pre 2007-08	2090	7.35	82.16	152.00	175.00	2.00	0.00	311.10	319.90	120.00	130.00	0.70
GB5	Mon2007-08	1526	7.22	52.10	117.95	161.68	1.27	0.00	244.00	224.93	104.52	108.33	0.54
GB6	Post2007-08	1726	7.27	66.13	134.98	165.49	1.62	0.00	298.90	257.42	123.87	115.00	0.54

(B): Physico- Chemical Parameters of Groundwater of KHETRI Nagar Area during 2015 to 2017

Code	**Season**	**DO**	**BOD**	**COD**	**TH**	**TDS**	**%Na**	**SAR**	**RSC**	**WQI**
GA1	Pre 2006-07	7.00	2.90	10.00	850.66	1666	46.38	5.00	-8.75	81.0267
GA2	Mon 2006-07	7.20	3.00	12.00	645.54	1054.00	25.84	1.73	-7.50	78.0998
GA3	Post 2006-07	6.80	3.10	8.00	800.63	1241.98	24.39	1.80	-9.70	87.6781
GA4	Pre 2007-08	6.80	3.10	8.00	810.63	1299.36	31.21	2.54	-6.20	111.8089
GA5	Mon2007-08	7.68	2.91	6.22	570.45	1006.42	37.20	2.79	-3.60	91.8933

GA6	Post2007-08	7.57	3.00	4.44	685.54	1165.58	33.60	2.61	-4.10	89.0590
GB1	Pre 2006-07	7.30	3.30	10.00	600.45	760.17	23.45	1.46	-8.58	82.0565
GB2	Mon 2006-07	6.90	3.00	12.00	550.44	951.00	36.88	2.71	-5.00	95.0051
GB3	Post 2006-07	7.00	2.90	9.00	665.51	1125.08	35.77	2.85	-6.30	111.1249
GB4	Pre 2007-08	7.00	2.90	9.00	830.64	1136.61	31.58	2.64	-11.50	77.7757
GB5	Mon2007-08	6.61	2.62	11.25	615.48	892.79	36.48	2.84	-8.30	66.7879
GB6	Post2007-08	6.90	2.81	9.00	720.56	1013.96	33.46	2.68	-9.50	67.0116

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Assistant Professor
S S Jain Subodh PG(Autonomous) College
****Lecturer***
Govt. College, Khetri (Jhunjhunu)
*****Associate Professor,***
Vivekanad Global University, Jaipur
******HM UPSS***
PremPura, Jharkhand Mahadev, Jaipur

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