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ASSESSING WATER QUALITY OF DIFFERENT SOURCES OF HARINGHATA BLOCK, NADIA, WEST BENGAL

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ABSTRACT

Quality of water is defined in physical, chemical or biological including microbiological terms. Thus, depending upon the purpose of particular use, physical, chemical or biological parameters are predominated in the definition. Usually the parameters of water quality which are specified as limitation of the resources are predominantly chemical and biological ones. Such specifications usually appear as “quality standard”, “quality criteria” or “quality guidelines” promulgated by international bodies and individual nations.

KEYWORDS: Assessing Water Quality of Different Sources of Haringhata Block

INTRODUCTION

In India as well as in West Bengal per head water requirement increases with increasing population pressure, urbanisation, industrialisation, agricultural activities with use of commercial fertilizers and pesticides, accompanied by a greater mechanization in every sphere of life as well as pose threat to increase in water pollution. Due to favourable climatic situation availability of fresh water is sufficient in most of the areas of India. However, water pollution is producing hazard for its use in various sectors and 70% of the available water is polluted (Dhaliwal et al., 1996).

Depending upon the situations, fresh water is available in surface and subsurface region. Water from these sources are tapped and utilized for agricultural and household including drinking purpose in rural areas. Very few works has so far been identified from the available publications in our country regarding study of inorganic pollutants in different surface and subsurface water resources. This study was therefore, proposed to undertake with the objectives; to determine the different physicochemical properties of water, to study the quality of different source of water and to judge the suitability of water for agricultural and other purposes.

Materials and Methods

Water samples were collected from different locations (table 1) from (i) surface water eg. Pond, canal etc. (ii) dug well (iii) hand tube well (iv) shallow tube well (v) mini deep tube well (vi) deep tube well. All water samples were collected before monsoon season i.e., during April-May, 2014. The water samples after collection from different sources were filtered and kept in refrigerator at a temperature of 5^0C. Few drops of toluene were added to each water samples in order to check microbial growth. Water samples were analysed for their respective pH, electrical conductivity (EC) and for composition of soluble carbonate (CO_3), bicarbonate (HCO_3), chloride (Cl), nitrate (NO_3), sulphate (SO_4), phosphate

(PO_4), sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), iron (Fe), manganese (Mn), zinc (Zn), copper (Cu), cadmium (Cd), lead (Pb) and nickel (Ni) according to the procedures mentioned below.

Table 1: Parameters Analysed and Methods Used

Serial No.	Parameters	Method
1	pH	Glass electrode pH meter
2	EC	Conductivity meter
3	CO_3 & HCO_3	Agriculture handbook no. 60, USDA, 1968
4	Cl	Standard methods, American Public Health Association.
5	SO_4	Tabatabai, 1974
6	PO_4	calorimetrically ; Jackson 1973
7	Ca & Mg	Black, 1965
8	Na	Agriculture handbook no. 60, USDA, 1968
9	K	Agriculture handbook no. 60, USDA, 1968
10	Fe, Mn, Zn and Cu	by Atomic Absorption Spectrophotometer; Lindsay and Norvell, 1978
11	Cd, Pb and Ni	Franson, 1995

Total soluble salts (TSS): TSS of water samples is estimated by the formula-

$$TSS = EC\ (dSm^{-1}) \times 640$$

It is expressed in mgL^{-1}.

Sodium adsorption ratio (SAR): SAR of water samples is estimated by the formula-

Na^+

$$SAR = \frac{Na^+}{\sqrt{(Ca^{2+} + Mg^{2+}) / 2}}$$

Where, Na^+, Ca^{2+} and Mg^{2+} contents of the water samples are expressed as mill equivalent per litre (meL^{-1}).

Soluble sodium percentage (SSP): SSP of water samples is estimated by the formula-

$$SSP = \frac{Na^+}{(Na^+ + Ca^+ + Mg^+)} \times 100$$

Where, Na^+, Ca^+ and Mg^+ contents of the water samples are expressed as mill equivalent per litre (meL^{-1}).

Residual sodium carbonate (RSC): SSP of water samples is estimated by the formula-

$$RSC = (CO_3^{2-} + HCO^{3-}) – (Ca^{2+} + Mg^{2+})$$

It is expressed as mill equivalent per litre (meL^{-1}). The values of CO_3^{2-}, HCO^{3-}, Ca^+ and Mg^+ (meL^{-1}) of water samples were obtained from previous estimation.

RESULTS AND DISCUSSIONS

Table 2: pH, Electrical Conductivity (EC), Calcium (Ca), Magnesium (Mg), Sodium (Na) and Potassium (K) Content of Water Samples

Sl. No.	Ph	EC (Dsm^{-1})	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}
Surface Sources						
1	7.0	0.21	1.4	0.8	0.7	0.5
2	7.4	0.31	1.9	0.8	1.2	1.0
3	7.2	0.40	3.0	1.5	1.7	0.8
4	6.7	0.22	1.0	0.3	1.6	0.4
5	7.5	0.29	2.3	1.6	0.9	0.3
6	7.4	0.33	2.6	1.8	1.1	0.3
7	7.0	0.24	1.4	1.2	1.3	0.1
8	7.6	0.38	3.0	1.6	2.7	0.5
9	5.7	0.05	0.7	0.2	0.2	0.2
10	7.2	0.33	1.7	0.9	2.9	0.4
11	7.0	0.37	1.4	2.1	1.5	0.4
Mean	7.1	0.29	1.86	1.16	1.44	0.45
cv	7.07	32.76	40.0	50.6	52.92	54.67
Dug well						
1	7.2	0.66	3.9	3.1	5.9	0.2
Hand Tube Well Samples						
1	7.5	0.42	3.5	2.2	2.1	0.1
2	7.2	0.37	4.7	1.4	0.8	0.04
3	7.6	0.38	4.7	1.2	0.7	0.1
4	7.2	0.37	1.9	0.6	3.8	Trace
5	7.7	0.38	4.5	0.7	0.5	0.1
6	7.4	0.41	4.0	1.4	0.7	0.1
7	7.7	0.35	2.0	1.7	1.0	0.1
8	7.5	0.34	3.6	1.3	0.8	0.1
9	7.7	0.33	2.5	1.4	0.7	0.1
10	7.1	0.34	2.5	1.8	0.9	0.1
11	7.4	0.47	3.6	2.9	1.4	0.1
12	7.3	0.38	2.2	2.5	1.1	0.1
13	7.5	0.26	2.4	1.0	0.8	0.1
14	7.4	0.33	2.7	3.1	1.3	0.1
15	7.7	0.35	3.1	1.9	1.0	0.2
16	7.5	0.34	2.7	1.5	0.3	0.1
17	7.7	0.34	2.5	1.0	1.4	0.1
18	7.6	0.39	3.0	1.5	2.0	0.2
Mean	7.5	0.36	3.12	1.62	1.18	0.102
cv	2.49	11.94	28.17	41.61	66.27	42.16
Shallow Tube Well						
1	7.8	0.34	4.4	0.9	0.4	0.1
2	7.2	0.35	4.3	2.0	0.4	0.1
3	7.6	0.36	3.8	1.8	0.4	0.2
4	7.5	0.42	4.3	1.4	1.0	0.1
5	7.3	0.42	4.6	1.9	1.3	0.1
6	7.2	0.35	2.9	2.3	0.5	0.1
7	7.2	0.48	3.9	3.0	2.3	0.2
mean	7.4	0.39	4.03	1.9	0.90	0.129
cv	2.97	12.5	13.15	32.32	73.33	34.88
Mini Deep Tube Well						
1	7.7	0.39	3.9	1.6	0.9	0.1
2	7.7	0.30	3.2	1.1	0.9	0.1

Mean	7.7	0.345	3.55	1.35	0.9	0.1
1	7.3	0.34	3.6	1.6	0.8	0.10
2	7.3	0.38	2.9	1.7	0.9	0.10
3	7.2	0.36	2.0	2.0	1.5	0.10
4	7.6	0.31	2.6	1.5	0.7	0.10
5	7.4	0.40	2.5	1.3	3.5	0.10
6	7.5	0.42	4.0	1.8	1.0	0.10
7	7.1	0.36	2.6	1.6	1.0	0.10
8	7.2	0.32	3.0	1.1	0.6	0.10
9	7.8	0.36	2.3	1.7	1.8	0.10
10	7.7	0.40	2.3	1.7	2.0	0.10
11	7.8	0.38	2.9	1.3	1.6	0.10
Mean	7.5	0.37	2.79	1.57	1.40	0.10
cv	3.22	9.02	20.07	15.92	57.14	

pH, EC, Ca, Mg, Na and K : The results showed (table 2) that most of the water samples are neutral in range and only one sample from a pond of this block has a pH value of 5.7.

Maximum variation (cv 7.07) in pH is observed in surface samples.

The EC of surface samples are highly variable (cv. 32.76) and not so much variations were found in subsurface samples (table 2). The EC of surface, STW, MDTW and DTW water samples showed 88.9% of the water samples were under the class having the possibility of salinity hazard (c_2) and the remaining 11.1% under the class having no salinity hazard (c_1).

0Ca, Mg, Na and K content of surface water samples vary from 0.7 to 3.0, 0.2 to 2.1, 0.2 to 2.9 and 0.1 to 1.0 meL^{-1}. Amount of Ca, Mg, Na and K present in DW water is 3.9, 3.1, 5.9 and 0.2 meL^{-1}. HTW water contain Ca, Mg, Na and K from 1.9 to 4.7, 0.6 to 3.1, 0.3 to 3.8 and 0.04 to 0.2 meL^{-1} with average of 3.12, 1.62, 1.18 and 0.102 meL^{-1}. Ca, Mg, Na and K content of STW water range from 2.9 to 4.6, 0.9 to 3.0, 0.4 to 2.3 and 0.1 to 0.2 meL^{-1} with an average of 4.03, 1.90, 0.90 and 0.129 meL^{-1}. Average Ca, Mg, Na and K content of MDTW water are 3.55, 1.35, 0.90 and 0.10 meL^{-1} and vary between 1.4 to 3.2, 0.6 to 2.0, 3.0 to 10.0 and 0.04 to 0.1 meL^{-1}. DTW water sample showed average Ca, Mg, Na and K content of 2.79, 1.57, 1.40, 0.10 and 1.75 meL^{-1}. Ca, Mg, Na and K content of the water samples of both areas under study show a general trend as follows, Ca> Na> Mg> K.

Table 3: Bicarbonate, Chloride, Nitrate, Sulphate and Phosphate Content of Water Samples (mgL^{-1}) From Surface Sources

Sl No.	Bicarbonate	Chloride	Nitrate	Sulphate	Phosphate
Surface Sources					
1	152.50	18.80	0.35	Trace	0.01
2	231.800	43.60	1.45	2.2	0.10
3	384.30	38.30	1.15	3.0	0.99
4	170.80	31.90	0.75	Trace	0.10
5	250.10	12.40	050	9.9	0.02
6	286.70	29.40	0.55	Trace	0.03
7	231.80	8.90	0.75	Trace	0.04
8	420.90	48.90	1.00	5.6	0.16
9	79.30	4.60	1.50	9.8	0.005
10	231.80	57.80	0.75	Trace	0.05
11	268.40	22.30	1.15	17.1	1.06

Mean	246.20		28.80	0.90	4.35	0.23
cv	37.70		56.90	40.34	116.48	163.56
Dug Well Water Sample						
1	591.70	462.80	21.10	126.40	0.02	
Hand Tube Well						
1	591.70	24.10	0.40	Trace	0.08	
2	457.50	27.70	0.70	1.80	0.09	
3	457.50	4.60	0.55	Trace	0.08	
4	512.40	14.20	0.55	Trace	0.04	
5	420.90	4.60	0.50	Trace	0.21	
6	457.50	31.20	0.40	5.80	0.11	
7	457.50	13.50	0.55	Trace	0.02	
8	439.20	15.30	0.40	Trace	0.01	
9	457.50	4.60	0.40	Trace	0.03	
10	494.10	5.30	0.80	Trace	0.03	
11	555.10	66.10	0.60	Trace	0.02	
12	536.80	28.40	0.70	Trace	0.05	
13	250.10	10.60	0.60	7.30	0.05	
14	439.20	10.60	0.55	Trace	0.04	
15	475.80	9.90	0.55	Trace	0.05	
16	457.50	2.80	0.40	0.80	0.005	
17	494.10	6.40	0.25	2.40	0.03	
18	573.40	4.60	0.40	7.40	0.02	
Mean	474.00	16.00	0.52	1.97	0.054	
cv	15.20	95.20	25.64	206.30	87.40	
Shallow Tube Well						
1	384.30	2.80	0.50	7.50	0.13	
2	439.20	3.60	0.35	13.10	0.05	
3	420.90	11.70	0.70	15.70	0.06	
4	439.20	17.70	0.55	6.80	0.04	
5	475.80	10.60	0.55	16.50	0.07	
6	512.40	4.60	0.35	13.00	0.04	
7	591.70	93.30	0.45	6.60	0.03	
Mean	466.00	20.60	0.49	8.45	0.06	
cv	13.60	146.00	23.42	46.77	51.95	
Mini Deep Tube Well						
1	475.80	9.90	0.75	trace	0.09	
2	305.00	11.70	0.50	4.80	0.18	
Deep Tube Well						
1	475.80	9.90	0.50	Trace	0.04	
2	494.10	6.40	0.45	Trace	0.06	
3	494.10	6.40	0.70	Trace	0.13	
4	439.20	4.60	0.55	Trace	0.04	
5	475.80	8.90	0.60	34.60	0.005	
6	457.50	27.70	0.60	0.40	0.07	
7	475.80	4.60	0.75	Trace	0.03	
8	420.90	6.40	0.45	Trace	0.03	
9	512.40	9.90	0.25	4.20	0.03	
10	628.30	4.60	0.40	4.20	0.04	
11	573.40	4.60	0.15	3.90	0.04	
Mean	495.30	8.50	0.49	4.30	0.047	
cv	11.40	74.90	35.03	226.61	65.47	

Bicarbonate, Chloride, Nitrate, Sulphate and phosphate: In surface water HCO_3, Cl, NO_3, SO_4 and PO_4 vary from 79.30 to 420.90, 4.60 to 57.80, 0.35 to 1.50, trace to 17.10 and 0.005 to1.06 mgL^{-1} with mean values of 246.20, 28.80, 0.90, 4.35 and 0.23 mgL^{-1}. HCO_3, Cl, NO_3, SO_4 and PO_4 content of DW water are 591.70, 462.80, 21.10, 126.40 and 0.02 mgL^{-1}. HTW water contain HCO_3, Cl, NO_3, SO_4 and PO_4 in the range of 250.10 to 591.70, 2.80 to 66.10, 0.25 to 0.80, trace to 15.80 and 0.005 to 0.21 mgL^{-1} with average of 474, 16, 0.52, 1.97 and 0.54 mgL^{-1}. HCO_3, Cl, NO_3, SO_4 and PO_4 content of STW samples vary from 384.3 to 591.7, 2.8 to 93.3, 0.35 to 0.70, 6.6 to 16.5 and 0.03 to 0.13 mgL^{-1} with average of 466, 20.6, 0.49, 8.45 and 0.06 mgL^{-1}. In MDTW samples the values are 3.05 to 475.8, 9.9 to 11.7, 0.50 to 0.75, trace to 4.8 and 0.09 to 1.8 mgL^{-1}. DTW samples contain HCO_3, Cl, NO_3, SO_4 and PO_4 in the range of 420.9 to 628.3, 4.6 to 27.7, 0.15 to 0.75, trace to 34.6 and 0.005 to 0.13mgL^{-1} with average of 495.3, 8.50, 0.49, 4.30 and 0.047 mgL^{-1}.

Amongst the anions analysed HCO_3 concentration is highest followed by CL, $NO_{3,}$ SO_4 and PO_4 are generally found much lower amount with occasionally higher amount of SO_4 in some water samples. Most of the samples have less Na hazard in comparison to SAR for s_1 equals to 10.0 as suggested by Richards (1968).

Table 4: Total Soluble Salt (TSS), Sodium Adsorption Ratio (SAR), Soluble Sodium Percentage (SSP) and Residual Sodium Carbonate (RSC) Content of Water Samples

Sl No.	TSS (Mgl^{-1})	SAR	SSP	RSC (Mel^{-1})
Surface Sources				
1	134.4	0.7	24.1	0.3
2	198.4	1.0	30.8	1.1
3	256.0	1.1	27.4	1.8
4	140.8	2.0	55.2	1.5
5	185.6	0.6	18.8	0.2
6	211.2	0.7	20.0	0.3
7	153.6	1.1	33.3	1.2
8	243.2	1.8	37.0	2.3
9	32.0	0.3	18.2	0.4
10	211.2	2.5	52.7	1.2
11	236.8	1.1	30.0	0.9
Mean	182.11	1.17	31.59	1.02
cv	33.72	53.85	38.05	63.73
Dug Well				
1	422.4	3.2	45.7	2.7
Hand Tube Well				
1	268.8	1.2	26.9	4.0
2	236.8	0.5	11.6	1.4
3	243.2	0.4	10.6	1.6
4	236.8	3.4	60.3	5.9
5	243.2	0.3	8.8	1.7
6	262.4	0.4	11.5	2.1
7	224.0	0.7	21.3	3.8
8	217.6	0.5	14.0	2.3
9	211.2	0.5	15.2	3.6
10	217.6	0.6	17.3	3.8
11	300.8	0.8	17.7	2.6
12	243.2	0.7	19.0	4.1
13	166.4	0.6	19.1	0.7
14	211.2	0.8	18.3	1.4
15	224.0	0.6	16.7	2.8
16	217.6	0.2	6.7	3.3

17	217.6	1.1	28.6	4.6
18	249.6	1.3	30.8	4.9
Mean	232.89	0.81	19.69	3.03
cv	11.91	85.19	59.65	45.55
Shallow Tube Well				
1	217.6	0.3	7.0	1.0
2	224.0	0.3	6.0	0.9
3	230.4	0.2	6.7	1.3
4	268.8	0.6	14.9	1.5
5	268.8	0.7	16.7	1.3
6	224.0	0.3	8.8	3.2
7	307.2	1.2	25.0	2.8
Mean	248.6	0.514	12.16	1.71
cv	12.49	64.20	53.72	49.12
Mini Tube Well				
1	249.6	0.5	14.1	2.3
2	192.0	0.6	17.3	0.7
Mean	220.8	0.55	15.7	1.5
Deep tube well				
1	217.6	0.5	13.3	2.6
2	243.2	0.6	16.4	3.5
3	230.4	1.1	27.3	4.1
4	198.4	0.5	14.6	3.1
5	256.0	2.5	48.0	4.0
6	268.8	0.6	14.7	1.7
7	230.4	0.7	19.2	3.6
8	204.8	0.4	12.8	2.8
9	230.4	1.3	31.0	4.4
10	256.0	1.4	33.3	6.3
11	243.2	1.1	27.6	5.2
Mean	234.47	0.97	23.47	3.76
cv	8.89	60.83	45.02	32.18

Total soluble salt (TSS), sodium adsorption ratio (SAR), soluble sodium percentage (SSP) and residual sodium carbonate (RSC): In surface water samples of Haringhata, (table 4) the mean TSS, SAR, SSP and RSC values are 182.11 mgL^{-1}, 1.17, 31.59 and 1.02 meL^{-1}; the values for DW water sample is 422.4 mgL^{-1}, 3.2, 45.7 and 2.7 meL^{-1}; for HTW samples the values are 232.89 mgL^{-1}, 0.81, 19.69 and 3.03 meL^{-1}; for STW samples the values are 248.69 mgL^{-1}, 0.514, 12.16 and 1.71 meL^{-1}; for MDTW samples the values are 220.80 mgL^{-1}, 0.55, 15.70 and 1.50 meL^{-1}; for DTW samples are the values are 234.47 mgL^{-1}, 0.97, 23.47 and 3.76 meL^{-1}.

Table 5: Iron (Fe), Manganese (Mn), Zinc (Zn) And Copper (Cu) Content of Water Samples (Mgl^{-1}) From Water Samples

Sl no.	Fe	Mn	Zn	Cu
Surface Sources				
1	2.9	3.2	13.5	1.2
2	3.7	3.5	14.5	8.7
3	4.1	4.1	12.1	2.7
4	4.8	4.2	9.9	9.6
5	3.2	5.4	4.9	6.6
6	2.2	5.0	0.2	4.0
7	1.4	4.5	9.8	9.2
8	1.6	4.8	10.3	9.3

9	2.3	5.1	11.3	9.8
10	1.9	6.5	7.0	7.8
11	1.2	6.8	0.8	9.3
Mean	2.66	4.83	8.57	7.11
cv	42.18	22.13	53.59	41.27
Dug Well				
1	4.2	10.1	10.8	7.0
Hand Tube Well				
1	2.8	2.1	12.5	9.4
2	3.0	2.3	14.7	0.1
3	3.3	2.2	14.3	1.5
4	4.0	3.5	13.0	7.4
5	4.4	3.9	11.4	8.6
6	5.0	4.8	7.9	0.3
7	2.8	4.1	3.5	9.1
8	2.3	3.9	2.2	9.6
9	1.9	4.0	2.9	0.5
10	1.3	3.4	9.9	8.9
11	1.3	3.1	10.1	6.6
12	1.2	3.1	11.1	7.8
13	1.1	2.9	10.8	9.5
14	1.1	3.0	10.5	9.6
15	1.4	4.1	11.1	2.7
16	2.8	5.2	11.2	6.5
17	3.0	5.9	7.7	8.4
18	1.4	7.1	3.2	5.5
Mean	2.45	3.81	9.33	6.22
cv	47.90	33.25	41.05	55.45
Shallow Tube Well				
1	3.3	4.3	12.4	6.3
2	3.0	4.1	12.8	9.3
3	4.2	8.0	6.4	9.4
4	1.8	4.9	5.8	9.0
5	1.1	4.5	10.8	9.4
6	3.3	8.2	11.1	6.3
7	3.9	8.7	9.3	7.0
Mean	2.94	6.67	9.80	8.10
cv	35.11	28.91	26.23	17.03
Mini Deep Tube Well				
1	3.9	4.4	13.1	2.3
2	1.5	5.1	9.4	6.7
Mean	2.7	4.75	11.25	4.5
Deep Tube Well				
1	3.1	4.1	13.7	9.4
2	3.0	4.4	14.1	9.2
3	4.9	5.2	9.1	9.4
4	1.7	5.4	8.1	8.9
5	1.5	5.3	10.2	6.4
6	1.8	5.9	10.8	7.2
7	2.1	6.1	10.5	6.3
8	2.5	6.3	10.9	6.1
9	1.6	8.4	6.5	1.0
10	1.1	9.8	1.4	4.4
11	1.1	9.0	2.8	6.5
Mean	2.22	6.36	8.92	6.80

cv	48.05	28.28	43.00	35.54

Iron (Fe), Manganese (Mn), Zinc (Zn) and Copper (Cu): In case of surface sources the Fe, Mn, Zn and Cu content of surface water samples (table 5) are 2.66, 4.83, 8.57 and 7.11 mgL^{-1}; for DW samples the values are 4.2, 10.1, 10.8 and 7.0 mgL^{-1}; for HTW samples the values are 2.45, 3.81, 9.33 and 6.22 mgL^{-1}; STW samples' values are 2.94, 6.67, 9.80 and 8.10 mgL^{-1}; the mean values of MDTW samples are 2.70, 4.75, 11.25 and 4.50 mgL^{-1}; in case of DTW samples the mean values are 2.22, 6.36, 8.92 and 6.80 mgL^{-1}.

Table 6: Lead (Pb), Cadmium (Cd) and Nickel (Ni) Content of Water Samples

Sl No.	Pb	Cd	Ni
Surface Sources			
1	0.12	ND	Trace
2	0.45	ND	0.2
3	0.73	ND	Trace
4	0.06	ND	Trace
5	0.06	ND	0.2
6	0.27	ND	0.2
7	Trace	ND	0.1
8	Trace	ND	0.2
9	0.19	ND	0.3
10	Trace	ND	Trace
11	1.51	ND	Trace
Mean	0.31	ND	0.11
Dug Well			
1	0.08	ND	Trace
Hand Tube Well			
1	Trace	ND	Trace
2	0.70	ND	Trace
3	0.80	ND	Trace
4	0.13	ND	0.3
5	0.11	ND	Trace
6	Trace	ND	Trace
7	Trace	ND	0.1
8	0.32	ND	Trace
9	Trace	ND	0.1
10	0.35	ND	Trace
11	Trace	ND	Trace
12	1.62	ND	0.1
13	Trace	ND	0.1
14	Trace	ND	Trace
15	Trace	ND	Trace
16	Trace	ND	Trace
17	0.81	ND	0.2
18	0.45	ND	0.1
Mean	0.294	ND	0.056
Shallow Tube Well			
1	0.29	ND	Trace
2	0.23	ND	0.2
3	Trace	ND	Trace
4	Trace	ND	0.1
5	Trace	ND	Trace
6	1.24	ND	0.1

7	1.45	ND	Trace
Mean	0.46	ND	0.057
Mini Deep Tube Well			
1	0.37	ND	0.2
2	Trace	ND	0.3
Mean	0.185		0.25
Deep Tube Well			
1	Trace	ND	0.2
2	Trace	ND	Trace
3	0.47	ND	Trace
4	Trace	ND	0.1
5	Trace	ND	0.1
6	0.90	ND	0.1
7	Trace	ND	Trace
8	0.35	ND	Trace
9	0.51	ND	Trace
10	Trace	ND	Trace
11	Trace	ND	Trace
Mean	0.203	ND	0.046

[ND- not detected]

Lead (Pb), Cadmium (Cd) and Nickel (Ni): The mean values of Pb, Ni of surface sources are 0.31 and 0.11 mgL^{-1}; for DW samples the values are 0.08 mgL^{-1} and trace ; the values of HTW samples are 0.294 and 0.056 mgL^{-1}; for STW samples the mean value are 0.46 and 0.057 mgL^{-1}; for MDTW samples the mean values are 0.185 and 0.25 mgL^{-1}; the values for DTW samples are 0.203 and 0.046 mgL^{-1}. The Cd content of all the samples found to be below the detectable amount.

Table 7: Water Quality for Irrigation

Sl No.	EC (Msm^{-1})	SAR	RSC	Water Class
Surface Sources				
1	21	0.7	0.3	C_1S_1
2	31	1.0	1.1	C_2S_1
3	40	1.1	1.8	C_2S_1
4	22	2.0	1.5	C_1S_1
5	29	0.6	0.2	C_2S_1
6	33	0.7	0.3	C_2S_1
7	24	1.1	1.2	C_1S_1
8	38	1.8	2.3	C_2S_1
9	5	0.3	0.4	C_1S_1
10	33	2.5	1.2	C_2S_1
11	37	1.1	0.9	C_2S_1
Dug Well				
1	66	3.2	2.7	C_2S_1
Hand Tube Well				
1	42	1.2	4.0	C_2S_1
2	37	0.5	1.4	C_2S_1
3	38	0.4	1.6	C_2S_1
4	37	3.4	5.9	C_2S_1
5	38	0.3	1.7	C_2S_1
6	41	0.4	2.1	C_2S_1
7	35	0.7	3.8	C_2S_1
8	34	0.5	2.3	C_2S_1
9	33	0.5	3.6	C_2S_1

10	34	0.6	3.8	C_2S_1
11	47	0.8	2.6	C_2S_1
12	38	0.7	4.1	C_2S_1
13	26	0.6	0.7	C_2S_1
14	33	0.8	1.4	C_2S_1
15	35	0.6	2.8	C_2S_1
16	34	0.2	3.3	C_2S_1
17	34	1.1	4.6	C_2S_1
18	39	1.3	4.9	C_2S_1
Shallow Tube Well				
1	34	0.31	1.0	C_2S_1
2	35	0.3	0.9	C_2S_1
3	36	0.2	1.3	C_2S_1
4	42	0.6	1.5	C_2S_1
5	42	0.7	1.3	C_2S_1
6	35	0.3	3.2	C_2S_1
7	48	1.2	2.8	C_2S_1
Mini Deep Tube Well				
1	39	0.5	2.3	C_2S_1
2	30	0.6	0.7	C_2S_1
Deep Tube Well				
1	34	0.5	2.6	C_2S_1
2	38	0.6	3.5	C_2S_1
3	36	1.1	4.1	C_2S_1
4	31	0.5	3.1	C_2S_1
5	40	2.5	4.0	C_2S_1
6	42	0.6	1.7	C_2S_1
7	36	0.7	3.6	C_2S_1
8	32	0.4	2.8	C_2S_1
9	36	1.3	4.4	C_2S_1
10	40	1.4	6.3	C_2S_1
11	38	1.1	5.2	C_2S_1

[C_1S_1 – little danger for salinity problem and harmful effect of exchangeable Na.

C_2S_1 – moderate leaching is required to avoid salinity problem and little danger for exchangeable sodium.]

All the samples found to be not of optimum class for irrigation but the majority of the samples were under the class C_2S_1 which can be used after moderate leaching.

CONCLUSIONS

Summarising all of the above it can be concluded that Ca and HCO_3 are the most two abundant cation and anion found in most of the water samples analysed. Considerable amount of Na ion is also found in almost all the samples. Under favourable situation $Ca(HCO_3)_2$ may be transformed to $CaCO_3$ and get precipitated in soil. In that condition, if $NaHCO_3$ or Na_2CO_3 becomes dominant, unfavourable condition may develop for normal growth of plants. Therefore, adequate drainage facilities should be ensured in medium and lowland conditions of the areas under study in order to avoid such situation in the long run ; dug well and hand tube well water commonly used for drinking and house hold purposes are in general not potable if chemical analysis of heavy metals are considered; periodical analysis of water at a regular interval or at least analysis before and after rainy season is necessary for making firm conclusion regarding the quality.

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