



<http://www.e-journals.net>



ISSN: 0973-4945; CODEN ECJHAO
E-Journal of Chemistry
Vol. 5, No.3, pp. 435-446, July 2008

Ground Water Quality of Gandhinagar Taluka, Gujarat, India

MAYUR C. SHAH^{*}, PRATEEK G. SHILPKAR[§] and PRADIP B. ACHARYA[§]

Department of Chemistry,
Gujarat Vidyapith, SADRA (Dist.-Gandhinagar),
Gujarat-382 320, India.

[§]Biogas Research and Extension Centre,
Gujarat Vidyapith, SADRA (Dist.-Gandhinagar), Gujarat-382 320, India.
mayurchemistry@yahoo.co.in

Received 16 October 2007; Accepted 10 December 2007

Abstract: Present communication deals with study of physico-chemical parameters such as pH, electrical conductivity (EC), total dissolved solids (TDS), total alkalinity (TA), calcium hardness (CaH), magnesium hardness (MgH), total hardness (TH), chloride (Cl⁻), fluoride (F⁻), sodium (Na⁺), potassium (K⁺), dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD) and sulphate (SO₄²⁻) of water samples of bore wells of forty villages of Gandhinagar taluka of Gujarat state, India. The experimental values of water samples were compared with standard values given by World Health Organization (WHO) and United State Salinity Laboratory for drinking and irrigation purposes respectively. Water Quality Index (WQI) was also calculated to know the over all quality of water samples. The statistical analysis like mean, standard deviation (SD), coefficient of variance (% CV), analysis of variance (ANOVA), *t*-test, coefficient of correlation (*r*) and regression analysis of obtained data were carried out. The results show that the quality of water is poor and quite good for drinking and irrigation purposes respectively. The variance was found significant at 1% level of significance in case of sodium and potassium content and at 5% in case of total alkalinity and dissolved oxygen among the four regions (North, South, East and West) of Gandhinagar taluka. The linear relation also established for each pair of water quality parameters of studied water samples.

Keywords: Ground water, Water quality index, Irrigation water

Introduction

Water, the precious gift of nature to human being, is going to be polluted day-by-day with increasing urbanization. Although three-fourth part of earth is being surrounded by water but

a little portion of it can be used for drinking purpose. In India, around 62.5 million people are suffering from disorder of teeth or bones through fluorosis¹, which is due to consumption of fluoride-rich water. Virtually almost all the surface water in India is unfit for direct consumption. In spite of the fact that the municipal water supply in most of the cities is through treated surface water, due to over contamination, more stringent treatments would be required to make the surface water potable. The prominent source of surface water pollution is domestic sewage, industrial waste water and agricultural run-off. So, we must turn to our ground water. Application of fertilizers, pesticides, manure, lime refuse dumps etc. is the main source of bore well water pollution in many villages. Studies of physico-chemical parameters of ground water or drinking water of various villages of different talukas in Gujarat State have been carried out by various workers^{2,4}. Gandhinagar is the capital of Gujarat state. Bore well water is generally using for drinking and irrigation purposes in Gandhinagar taluka. So, we carried out study of quality of ground water of Gandhinagar taluka for drinking and irrigation purposes. The statistical analysis of water quality parameters have also been carried out.

Experimental

Water samples were collected from bore wells of forty villages of Gandhinagar taluka during May-2006. Ten villages of each region of Gandhinagar taluka (North, South, East and West) were selected for water sampling (Table 1).

Table 1. Name of villages of Gandhinagar taluka used for water sampling

Villages of various region of Gandhinagar taluka			
North Region	South Region	East Region	West Region
Piplaj	Sugad	Lavarpur	Sardhav
Dashela	Chandkheda	Chiloda	Sargasan
Chandrala	Ambapur	Dabhoda	Randheja
Jakhora	Adalaj	Dhanap	Vavol
Chhala	Valad	Isanpur mota	Shertha
Giyod	Kudasan	Lekavada	Titoda
Unava	Por	Magodi	Kolvada
Sadra	Koba	Shahpur	Uvarsad
Dolarana Vasna	Bhat	Alampur	Rupal
Chaikhlarani	Limbdiya	Palaj	Pethapur

Samples were collected in polythene bottles and analyzed for various water quality parameters as per standard procedures⁵ (Table 2). The experimental values were compared with standard values recommended by World Health Organization (WHO)⁶ for drinking purposes. The calculation of Water Quality Index (WQI) was done by Weighted Arithmetic Index method⁷. The statistical analysis⁸ such as mean, standard deviation (SD), coefficient of variance (% CV), analysis of variance (ANOVA) and *t*-test of obtained data were carried out. All possible correlation coefficient(*r*) between the water quality parameters and value of A and B in regression equation ($Y=A+BX$) were also determined. The water quality of Gandhinagar taluka for irrigation purposes is also classified into four classes-Excellent, Good, Fair and Poor according to the classification made by United State Salinity Laboratory⁹.

Table 2. Methods used for analysis of quality parameters for water samples

Quality parameters studied	Method used
pH	Recorded by pH meter
Electrical Conductivity, EC	Measured by conductivity meter
Total Dissolved Solids, TDS	Evaporation method
Total Alkalinity, TA	Neutralising with standard HCl
Calcium Hardness, CaH	EDTA titration
Magnesium Hardness, MgH	EDTA titration
Total Hardness, TH	EDTA titration
Chloride, Cl ⁻	Mohr's method
Fluoride, F ⁻	Alizarin spectrophotometric method
Sodium, Na ⁺	Flame photometric method
Potassium, K ⁺	Flame photometric method
Dissolved Oxygen, DO	Modified Winkler's method
Biochemical Oxygen Demand, BOD	Modified Winkler's method
Chemical Oxygen Demand, COD	Titration with an excess of K ₂ Cr ₂ O ₇
Sulphate, SO ₄ ²⁻	Gravimetric method

Results and Discussion

The pH is a measure of the intensity of acidity or alkalinity and the concentration of hydrogen ion in water. pH has no direct adverse effects on health, however, higher values of pH hasten the scale formation in water heating apparatus and also reduce the germicidal potential of chlorine. High pH induces the formation of trihalomethanes which are toxic. pH below 6.5 starts corrosion in pipes, thereby releasing toxic metals such as Zn, Pb, Cd and Cu *etc.*¹⁰. The pH values of water samples of North, South, East and West region of Gandhinagar taluka ranged from 7.30 to 7.96, 7.37 to 7.91, 7.50 to 8.13 and 7.26 to 8.06, respectively. These values are within the prescribed limit of WHO. The minimum variance value (% CV=2.42) was found in the south region and the maximum variance value (% CV=9.42) was found in the west region of Gandhinagar taluka for pH (Table 3 & 4).

Electrical conductivity is a rapid method to get an idea about the concentration of ionized substances in water. Electrical conductivity values of water samples of North, South, East and West region of Gandhinagar taluka ranged from 0.272 to 1.89 mS/cm, 0.623 to 1.88 mS/cm, 0.58 to 0.996 mS/cm and 0.695 to 1.89 mS/cm, respectively. 10% water samples of North Gandhinagar, 20% water samples of South Gandhinagar and 30% water samples of West Gandhinagar showed higher electrical conductivity values than that of the prescribed limit of WHO. Statistical analysis shows that the lowest (% CV=14.55) and highest (% CV=53.20) values of % CV for electrical conductivity were found in the East and North region of Gandhinagar taluka, respectively (Table 3 & 4).

A large number of solids are found dissolved in natural waters, the common ones are carbonates, bicarbonates, chlorides, sulphates, phosphates and nitrates of calcium, magnesium, sodium, potassium, iron *etc.* In other words, TDS is the sum of the cations and anions concentration. A high content of dissolved solids elevates the density of water, influences osmoregulation of fresh water organisms, reduces the solubility of gases (like oxygen) and reduces the utility of water for drinking, irrigation and industrial purposes¹¹. TDS values of water samples ranged from 111 to 827 mg/L, 271 to 805 mg/L, 254 to 419 mg/L and 301 to 806 mg/L of North, South, East and West region of Gandhinagar taluka, respectively. These values are within the prescribed limit given by WHO. The sequence of % CV values of TDS for water samples of all regions is, East Gandhinagar (% CV=14.38) < West Gandhinagar (% CV=32.13) < South Gandhinagar (% CV=47.17) < North Gandhinagar (% CV=54.90) (Table 3 & 4).

Table 3. Water quality parameters of ground water of Gandhinagar taluka

Water quality parameters	WHO Standard value	Experimental value (Range)	Mean value (n=40)	SD	%CV	Comparison of experimental value (within/exceed) with WHO standard value for drinking purpose
pH	6.5-8.5	7.26-8.13	7.59	0.39	5.14	Within, for all Villages
EC	1.400	0.272-1.890	0.95	0.38	40	Exceed, for 15% Villages
TDS	1000	117-827	412.78	171.93	41.65	Within, for all Villages
TA	120	308-1122	553.05	151.3	27.36	Exceed, for all Villages
CaH	100	40-272	88.2	42.21	47.86	Exceed, for 25% Villages
MgH	150	12-680	106.6	107.57	100.91	Exceed, for 15% villages
TH	500	72-748	194.63	120.78	62.91	Exceed, for Chhala Villages
Cl ⁻	250	67.10-642.20	207.28	144.90	69.91	Exceed, for 22.5% Villages
F ⁻	1.5	0.350-2.35	0.85	0.47	55.29	Exceed, for Palaj, Giyod, Bhat and Pethapur Villages
Na ⁺	200	37-6000	1156.08	1626.92	140.73	Exceed, for 32.5% villages
K ⁺	-	1.0-3.0	1.88	0.85	45.21	No comparison
DO	>5	4.45-9.12	6.63	1.07	16.14	Out of standard value range for 5% villages
BOD	5	0.2-3.84	1.32	0.99	75.57	Within, for all villages
COD	10	0.6-4.4	1.75	1.02	58.29	Within, for all villages
SO ₄ ²⁻	400	12.87-110.28	39.3	21.8	55.47	Within, for all Villages

Values of all parameters are in mg/L except pH and EC (mS/cm)

The major portion of alkalinity in natural water is caused by hydroxide, carbonate and bicarbonate. Alkalinity in itself is not harmful to human beings¹². The total alkalinity value of water samples ranged from 308 to 550 mg/L, 418 to 770 mg/L, 396 to 616 mg/L and 344 to 1122 mg/L for North, South, East and West region of Gandhinagar taluka. Water samples of all regions were found exceed value of total alkalinity with compare to prescribed value given by WHO. So, from alkalinity point of view quality of water samples of all regions is poor. Highest variance (% CV=32.99) showed in total alkalinity value of water samples of West region and lowest variance (% CV=10.81) showed water samples of East region of Gandhinagar taluka (Table 3 & 4).

The calcium hardness value of water samples of North, South, East and West region of Gandhinagar taluka ranged from 60 to 272 mg/L, 48 to 112 mg/L, 40 to 160 mg/L and 60 to 180 mg/L, respectively. 30% of water samples of North region, 20% of East region and 30 % of West region showed higher calcium hardness values with compare to standard values prescribed by WHO. Samples of South region showed lowest variance (% CV=31.69) and of North region showed highest variance (% CV=62.09) for calcium hardness value among all regions of Gandhinagar taluka (Table 3 & 4).

The magnesium hardness values of water samples ranged from 40 to 680 mg/L, 12 to 188 mg/L, 24 to 204 mg/L and 12 to 128 mg/L for North, South, East and West region of Gandhinagar taluka, respectively. 30%, 10% and 20% water samples showed higher value of magnesium hardness for North, South and East region of Gandhinagar taluka, respectively, as per WHO. The highest value of % CV (% CV=118.80) found in water sample of North region and lowest value (%CV=51.33) in West region for magnesium hardness (Table 3 & 4).

The total hardness of water is due to presence of cations, Ca^{2+} , Mg^{2+} , Fe^{2+} , Mn^{2+} and anions, HCO_3^- , SO_4^{2-} , Cl^- , NO_3^- . Some evidence¹³ indicates that water hardness plays role in heart diseases in human. The total hardness value of water samples of North, South, East and West region ranged from 120 to 748 mg/L, 92 to 256 mg/L, 92 to 356 mg/L and 72 to 240 mg/L, respectively. Total hardness of all water samples were within the permissible limit as per WHO except 10 % water samples of North region of Gandhinagar taluka. The value of % CV of total hardness of water samples is lowest (% CV=34.81) for West region and highest (%CV=75.85) for North region among the all studied regions (Table 3 & 4).

Excessive chloride concentration increase rates of corrosion of metals in the distribution system. This can lead to increased concentration of metals in the supply⁶. The chloride content of water samples of North, South, East and West region of Gandhinagar taluka ranged from 86.27 to 642.20 mg/L, 95.45 to 440.91 mg/L, 67.10 to 230.04 mg/L and 86.27 to 592.99 mg/L, respectively. 20 %, 30 % and 40 % water samples showed higher value of chloride content than that of permissible limit prescribed by WHO for North, South and West region of Gandhinagar taluka, respectively. The value of % CV of chloride content of water sample is lowest (% CV=35.10) for East region and highest (% CV=85.43) for North region among the all regions of Gandhinagar taluka (Table 3 & 4).

Fluoride is present universally in almost every water, earth crust, many minerals, rocks *etc.* It is also present in most of every day needs, *viz.* tooth paste, drugs, cosmetics, chewing gums, mouth washes and so on. A small amount of it is beneficial for human health for preventing dental carries. WHO recommended permissible limit for drinking purpose is 1.5 mg/L. Higher concentration of fluoride than that of 1.5 mg/L carry an increasing risk of dental fluorosis and much higher concentration lead to skeletal fluorosis⁶. The fluoride content of water samples ranged from 0.35 to 1.6 mg/L, 0.5 to 1.725 mg/L, 0.4 to 1.725 mg/L and 0.5 to 2.35 mg/L for North, South, East and West region, respectively. The water samples of Giyod village of North region, Bhat village of South region, Palaj village of East region, Pethapur and Sargasan villages of West region showed exceed value of fluoride content than that of permissible limit given by WHO. The sequence of %CV values of fluoride content for water samples of all regions is North Gandhinagar (% CV=48.69) < South Gandhinagar (% CV=50.72) < East Gandhinagar (% CV=53.27) < West Gandhinagar (% CV=72.34) (Table 3 & 4).

According to National Academy of Sciences¹⁴, the higher concentrations of sodium can be related to cardiovascular diseases and in women toxemia associated with pregnancy. The sodium content of water samples of North, South, East and West region of Gandhinagar taluka ranged from 37 to 4000 mg/L, 152 to 4000 mg/L, 146 to 180 mg/L and 149 to 6000mg/L, respectively. All water samples of East region were found within the permissible limit given by WHO. 10%, 40% and 80% water samples showed exceed value of sodium for North, South and West region of Gandhinagar taluka, respectively as per WHO. Samples of East region showed lowest variance (% CV=6.73) and of North region showed highest variance (% CV=230.53) for sodium content among all regions of Gandhinagar taluka (Table 3 & 4).

Dissolved oxygen content of water samples of North, South, East and West region ranged from 5.67 to 8.91 mg/L, 4.66 to 7.78 mg/L, 6.28 to 9.12 mg/L and 4.45 to 7.90 mg/L, respectively. All water samples of North and East regions were found within the permissible limit given by WHO. 10% water samples of South and West region showed lower value of DO than that of permissible limit given by WHO. The value of % CV of DO of water samples is lowest (% CV=12.36) for East region and highest (% CV=16.43) for South region among all regions of Gandhinagar taluka (Table 3 & 4).

Table 4. Various quality parameters of ground water of Gandhinagar taluka in Gujarat (Region wise)

Quality parameter	WHO Standard	North Region				South Region				East Region				West Region			
		Expt value (Range)	Mean	SD	%CV	Expt value (Range)	Mean	SD	% CV	Expt value (Range)	Mean	SD	%C V	Expt value (Range)	Me an	SD	% CV
pH	6.5-8.5	7.30-7.96	7.60	0.25	3.26	7.37-7.91	7.61	0.18	2.42	7.50-8.13	7.73	0.22	2.91	7.26-8.06	7.41	0.68	9.24
EC	1.400	0.272-1.89	0.81	0.43	53.20	0.623-1.88	1.04	0.44	42.47	0.584-0.996	0.80	0.12	14.55	0.695-1.89	1.16	0.37	31.84
TDS	1000	117-827	377.8	207.43	54.90	271-805	436.6	205.96	47.17	254-419	342.1	49.21	14.38	301-806	494.6	158.90	32.13
TA	120	308-550	440	84.89	19.29	418-770	587.4	124.04	21.12	396-616	532.4	57.56	10.81	344-1122	652.4	215.25	32.99
CaH	100	60-272	104.8	65.07	62.09	48-112	74.8	23.70	31.69	40-160	82.8	32.11	38.78	60-180	90.4	36.72	40.62
MgH	150	40-680	162	192.46	118.80	12-188	92.8	53.13	57.25	24-204	102.8	61.68	60.00	12-128	68.8	35.32	51.33
TH	500	120-748	266.1	201.85	75.85	92-256	167.6	68.05	40.60	92-356	185.6	82.46	44.43	72-240	159.2	55.42	34.81
Cl ⁻	250	86.27-642.20	216.57	185.02	85.43	95.45-440.91	200.40	132.47	66.10	67.10-230.04	135.24	47.47	35.10	86.27-592.99	276.90	160.13	57.83
F ⁻	1.5	0.35-1.6	0.80	0.39	48.69	0.5-1.725	0.93	0.47	50.72	0.4-1.725	0.81	0.43	53.27	0.5-2.35	0.87	0.63	72.34
Na ⁺	200	37-4000	529.3	1220.22	230.53	152-4000	1200.4	1518.75	126.52	146-180	162.4	10.93	6.73	149-6000	2732.2	1837.96	67.27
K ⁺	-	1.0-3.0	1.8	0.79	43.82	1.0-3.0	2.1	0.99	47.35	1.0-3.0	2.4	0.70	29.13	1.0-2.0	1.2	0.42	35.14
DO	>5	5.67-8.91	7.17	1.01	14.10	4.66-7.78	6.19	1.02	16.43	6.28-9.12	7.11	0.88	12.36	4.45-7.90	6.06	0.98	16.14
BOD	5	0.4-3.84	1.50	1.33	88.96	0.2-2.31	1.10	0.80	72.59	0.6-2.84	1.58	0.78	49.23	0.4-3.65	1.09	1.01	92.63
COD	10	0.8-4.4	1.92	1.38	71.88	0.6-2.8	1.5	0.9	60	1.0-3.2	2.04	0.77	37.75	0.8-4.0	1.52	0.99	65.13
SO ₄ ²⁻	400	23.40-72.85	46.18	18.12	39.24	12.92-72.85	35.52	19.23	54.14	14.04-110.28	44.98	31.21	69.39	12.87-62.54	30.52	14.06	46.07

Values of all parameters are in mg/L except pH and EC (mS/cm)

Biochemical oxygen demand (BOD) of water samples of North, South, East and West regions ranged from 0.4 to 3.84 mg/L, 0.2 to 2.31 mg/L, 0.6 to 2.84 mg/L and 0.4 to 3.65 mg/L, respectively. These values are within the prescribed value given by WHO. The sequence of % CV values of BOD values of water samples is, West Gandhinagar (% CV=92.63) > North Gandhinagar (% CV=88.96) > South Gandhinagar (% CV=72.59) > East Gandhinagar (% CV=49.23) (Table 3 & 4).

Chemical oxygen demand (COD) of water samples of North, South, East and West regions ranged from 0.8 to 4.4 mg/L, 0.6 to 2.8 mg/L, 1.0 to 3.2 mg/L and 0.8 to 4.0 mg/L, respectively. These values are within the prescribed limit given by WHO. The %CV value of COD value of water samples is lowest (% CV=37.75) for East region and highest (% CV=71.88) for North region among all regions of Gandhinagar taluka (Table 3 & 4).

Sulphate content in drinking water exceeding the 400 mg/L impart bitter taste and may cause gastro-intestine irritation and cantharsis¹⁵. All water samples of Gandhinagr taluka showed sulphate content ranged from 12.87 to 110.28 mg/L which is within the prescribed value given by WHO. The value of % CV of sulphate content of water samples is lowest (% CV= 39.24) for North region and highest (% CV= 69.39) for East region among the all regions of Gandhinagar taluka (Table 3 & 4).

Since no prescribed standards are suggested by WHO for potassium content for drinking purpose. So, no comparison can be made from observed values. The WQI value of water samples of all region of Gandhinagar taluka ranged from 54.78 to 68.29 (Table 5). It indicates that the quality of water of Gandhinagar taluka is poor for drinking purpose (Table 6).

Table 5. Water Quality Index (WQI) of ground water of various regions of Gandhinargar taluka

Various regions	WQI	Status (According to Table 6)
North	54.78	Poor
South	64.42	Poor
East	55.07	Poor
West	68.29	Poor

Table 6. Status of water qualities based on WQI

WQI	Status
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very poor
100 and above	Unsuitable for drinking

Table 7 shows that the variance is significant at 1% in case of sodium and potassium content and at 5% in case of total alkalinity and dissolved oxygen among the all water samples of four regions of Gandhinagar taluka.

Table 8 reveals that the difference of mean value of TA is significant at 5 % and at 1% for North-South, East-West regions and North-West region, respectively. The difference of mean value of sodium content is significant at 1% for North-West, East-West regions and 5% for South-West region. The difference between mean values of potassium content is significant at 1% for South-West and East-West regions. The difference between mean values of DO content is significant at 5% for North-South, North-West, South-East and East-West regions of Gandhinagar taluka.

Table 7. F value of various quality parameters of ground water of all regions of Gandhinagar taluka in Gujarat

Water quality parameters	F-value
pH	1.13
Electrical Conductivity	2.41
Total Dissolved Solids	1.59
Total Alkalinity	4.48*
Calcium Hardness	0.91
Magnesium Hardness	1.40
Total Hardness	1.73
Chloride	1.70
Fluoride	0.15
Sodium	7.19**
Potassium	4.61**
Dissolved Oxygen	3.69*
Biochemical Oxygen Demand	0.66
Chemical Oxygen Demand	0.71
Sulphate	1.22

*Significant at 5% level of significance

**Significant at 1% level of significance

Table 8. Difference of mean values of various quality parameters of ground water among the various region of Gandhinagar taluka

Water quality parameter	Region	Difference of mean value between two regions		
		North	South	East
TA	South	147.44*	-	-
	East	92.4	55	-
	West	212.4**	65	120*
Na ⁺	South	671.1	-	-
	East	366.9	1038	-
	West	2202.9**	1531.8*	2569.8**
K ⁺	South	0.3	-	-
	East	0.6	0.3	-
	West	0.6	0.9**	1.2**
DO	South	0.98*	-	-
	East	0.06	0.92*	-
	West	1.11*	0.13	1.05*

*Significant of 5% level of significance

**Significant of 1% level of significance

Correlation coefficient and value of A and B of least square fitting of equation $Y=A+BX$ amongst various parameters of water samples of Gandhinagar taluka are presented in Table 9. pH bears significant positive correlation with TA and DO ($r=0.33$ and $r=0.36$, respectively). Electrical conductivity bears significant positive correlation with TDS, TA, Cl⁻ and Na⁺ ($r=0.96$, $r=0.54$, $r=0.78$ and $r=0.77$, respectively) and negative correlation with F⁻ and K⁺ ($r=-0.38$ and $r=-0.61$, respectively). TDS bears significant positive correlation with TA, MgH, TH, Cl⁻ and Na⁺ ($r=0.50$, $r=0.34$, $r=0.39$, $r=0.84$ and $r=0.72$, respectively) and significant negative correlation with F⁻ and K⁺ ($r=-0.44$ and $r=-0.66$, respectively). It indicates that electrical conductivity of water samples depends on dissolved solids which

depend on NaCl and MgCl₂. Total hardness bears significant positive correlation with CaH, MgH and Cl⁻ (r=0.47, r=0.94 and r=0.50, respectively) and significant negative correlation with F⁻ (r= -0.38) only. It reveals that total hardness of water samples depends on CaCl₂ and MgCl₂. Sulphate does not bear significant positive correlation with studied water parameters. Chloride bears significant positive correlation with Na⁺ (r=0.58) and significant negative correlation with F⁻ and K⁺ (r= -0.43 and r= -0.58, respectively). Fluoride bears significant positive correlation with K⁺ (r=0.44). They suggest that chloride and fluoride were present in water samples as NaCl and KF forms, respectively. DO bears significant positive correlation with BOD and COD (r=0.63 and r=0.64, respectively). BOD bears significant positive correlation with COD (r=0.99) of water samples.

Table 9. Correlation coefficient and values of A and B of least square fitting of the equation $Y=A+BX$ amongst various parameters of water samples of Gandhinagar taluka

Parameters		Correlation coefficient	A	B
X	Y			
pH	EC	0.12	0.049474	0.11867
	TDS	0.10	78.50681	44.06528
	TA	0.33*	-397.435	125.2987
	CaH	-0.24	283.1019	-25.6932
	MgH	-0.14	390.1076	-37.3737
	TH	-0.21	675.9697	-63.4538
	Cl ⁻	-0.06	378.1736	-22.5286
	F ⁻	-0.26	3.243079	-0.31539
	Na ⁺	0.13	-2984.93	545.893
	K ⁺	-0.05	2.641795	-0.10108
	DO	0.36*	-0.71234	0.967945
	BOD	0.21	-2.60347	0.516524
	COD	0.24	-2.96008	0.620252
	SO ₄ ²⁻	-0.03	52.02322	-1.67719
EC	TDS	0.96**	2.534163	431.9802
	TA	0.54**	349.4555	214.3834
	CaH	0.26	60.61096	29.05103
	MgH	0.12	74.89582	33.38424
	TH	0.20	135.2098	62.56375
	Cl ⁻	0.78**	-74.7374	296.9594
	F ⁻	-0.38*	1.29074	-0.46344
	Na ⁺	0.77**	-1944.36	3264.73
	K ⁺	-0.61**	3.173035	-1.36682
	DO	-0.12	6.948462	-0.33507
	BOD	0.093	1.084504	0.242447
	COD	0.08	1.539389	0.216507
	SO ₄ ²⁻	-0.17	48.62906	-9.8227
	TDS	TA	0.50**	372.594
CaH		0.24	64.14903	0.058267
MgH		0.34*	18.54936	0.213314
TH		0.39*	82.41367	0.271846
Cl ⁻		0.84**	-85.1955	0.708553

Contd....

	F ⁻	-0.44 ^{**}	1.347638	-0.0012
	Na ⁺	0.72 ^{**}	-1674.17	6.856618
	K ⁺	-0.66 ^{**}	3.220205	-0.00326
	DO	-0.17	7.066447	-0.00106
	BOD	0.035	1.231716	0.000201
	COD	0.022	1.690683	0.000132
	SO ₄ ²⁻	-0.12	45.71648	-0.01554
TA	CaH	-0.26	128.3297	-0.07256
	MgH	-0.15	166.9684	-0.10916
	TH	-0.23	294.9191	-0.18135
	Cl ⁻	0.46 ^{**}	-36.386	0.440581
	F ⁻	-0.36 [*]	1.473467	-0.00113
	Na ⁺	0.50 ^{**}	-1793.19	5.332722
	K ⁺	-0.43 ^{**}	3.227238	-0.00245
	DO	-0.07	6.91828	-0.00052
	BOD	0.36 [*]	0.021347	0.002339
	COD	0.34 [*]	0.475553	0.002295
	SO ₄ ²⁻	-0.14	50.58973	-0.02041
CaH	MgH	0.14	75.56678	0.351851
	TH	0.47 ^{**}	75.17671	1.354289
	Cl ⁻	0.34 [*]	103.0575	1.181632
	F ⁻	-0.32 [*]	1.166763	-0.00358
	Na ⁺	0.10	807.0917	3.956727
	K ⁺	-0.12	2.092103	-0.00246
	DO	0.04	6.546052	0.000955
	BOD	-0.04	1.39265	-0.00088
	COD	-0.08	1.905935	-0.00182
	SO ₄ ²⁻	-0.05	41.68091	-0.02699
MgH	TH	0.94 ^{**}	82.3791	1.052963
	Cl ⁻	0.43 ^{**}	145.631	0.578297
	F ⁻	-0.3	0.991283	-0.00132
	Na ⁺	-0.03	1207.22	-0.47978
	K ⁺	-0.15	2.000431	-0.00118
	DO	-0.05	6.682101	-0.00049
	BOD	-0.04	1.356101	-0.00039
	COD	-0.07	1.814892	-0.00066
	SO ₄ ²⁻	0.041	38.39539	0.008491
TH	Cl ⁻	0.50 ^{**}	89.83821	0.603413
	F ⁻	-0.38 [*]	1.141298	-0.00149
	Na ⁺	0.01	1133.757	0.114671
	K ⁺	-0.18	2.117836	-0.00125
	DO	-0.03	6.685693	-0.00028
	BOD	-0.05	1.399754	-0.00044
	COD	-0.09	1.89354	-0.00076
	SO ₄ ²⁻	0.018	38.65188	0.003333
Cl ⁻	F ⁻	-0.43 ^{**}	1.141849	-0.0014

Contd....

	Na ⁺	0.58**	-187.252	6.480812
	K ⁺	-0.58**	2.582412	0.00341
	DO	-0.26	7.031004	-0.00193
	BOD	0.11	1.155748	0.000767
	COD	0.08	1.622148	0.000593
	SO ₄ ²⁻	-0.13	43.40118	-0.01978
F ⁻	Na ⁺	-0.27	1935.414	-916.195
	K ⁺	0.44**	1.202166	0.790988
	DO	-0.05	6.726092	-0.11267
	BOD	-0.11	1.518844	-0.23993
	COD	-0.07	1.888175	-0.16832
	SO ₄ ²⁻	-0.006	39.534	-0.27451
Na ⁺	K ⁺	-0.65**	2.266859	-0.00034
	DO	-0.28	6.841688	-0.00018
	BOD	-0.092	1.379751	-5.6
	COD	-0.11	1.823055	-6.8
	SO ₄ ²⁻	0.021	43.60093	-0.00372
K ⁺	DO	0.09	6.41607	0.114229
	BOD	-0.03	1.382564	-0.03617
	COD	-0.02572	1.802819	-0.03084
	SO ₄ ²⁻	0.021	38.28602	0.541057
DO	BOD	0.63**	-2.58054	0.587503
	COD	0.64**	-2.32471	0.613809
	SO ₄ ²⁻	0.1	26.27669	1.964302
BOD	COD	0.99**	0.402378	1.0212
	SO ₄ ²⁻	0.1	36.41323	2.196057
COD	SO ₄ ²⁻	0.1	35.45537	2.203512

*Significance at 5% level, $r > 0.32$

**Significance at 1% level, $r > 0.41$

The linear relation for each pair of parameter can be obtained by substituting numerical values of A and B in equation $Y=A+BX$ from Table 9. This linear relation can be used to find out value of one parameter of the pair when the other is known from experiment. The classification of water quality of Gandhinagar taluka for irrigation purpose is presented in Table 10. It suggests that water samples of 72.50% villages of Gandhinagar taluka were quite good (fair) for irrigation purpose due to high salinity of water.

Table 10. Classification of water quality of Gandhinagar taluka for irrigation purpose (According to the classification made by United State Salinity Laboratory)

Electrical conductivity, $\mu\text{S/cm}$	Category of water	%Villages of Gandhinagar taluka
<250	Low salinity (Excellent)	0
250 to 750	Medium Salinity (Good)	27.50
750 to 2250	High Salinity (Fair)	72.50
>2250	Very High Salinity(Poor)	0

Conclusion

Present study shows that the water quality of bore wells of Gandhinagar taluka is poor for drinking purpose as per Water Quality Index. So, this water can be used for drinking purpose after purification treatment. Results also show that quality of water for irrigation purpose is quite good. 52 pairs and 53 pairs of water quality parameters bear positive and negative correlation, respectively out of 105 pairs studied.

References

1. Susheela A K, *Curr. Sci.*, 1999, **77** (10), 1250-1256.
2. Pandit B R and Oza F, *Int. J. Bioscience Reporter*, 2004, **2**(2), 232-234.
3. Joshi J D, Vora J J, Sharma S S, Patel N , Kothari O and Salvi K, *Int. J. Chem. Sci.*, 2004, **2**(3), 337-344.
4. Bhoi D K, Raj D S, Mehta Y M, Chauhan M B and Machhar M T, *Asian J. Chem.*, 2005, **17**(1), 404-408.
5. APHA, Standard methods for the examinations of water and wastewater, American Public Health Association, Washington, DC, 1992, 18th Ed.
6. WHO, The guideline for drinking water quality recommendations, World Health Organization, Geneva, 2002.
7. Brown R M, Mecleiland N J, Deinmger R A and O'Connor M F, *Proc. Int. Conf. on Water Poll. Res.*, Jerusalem, 1972, **6**, 787-797.
8. Rangaswami R, A textbook of agricultural statistics, New Age International Publishers Ltd, New Delhi, 1995.
9. Richards L A, Diagnosis and Improvement of Saline and Alkali Soils, Oxford and IBH Publishing Co., Calcutta, 1954, 69.
10. Trivedy R K and Goel P K, Chemical and Biological Methods for Water Pollution Studies, Environmental Publications, Karad, 1986, 7.
11. Maiti S K, Handbook of methods in environmental studies, Vol. 1, Water and waste water analysis, ABD Publishers, Jaipur, 2004.
12. Surve P R, Ambore N E and Pulle J S, *Eco. Env. and Consv.*, 2005, **8**(1), 87-90.
13. Peter A K, Sources and classification of water pollutants in industrial pollution, Edlrving Sax. Van Nostrand Reinhold Company, 1974.
14. National Academy of Science, Drinking Water and Health, Federal Register, 1977, **43**(132), 35764.
15. Kakar Y P, Hydrochemistry and pollution of ground water in Faridabad area, Haryana, C G W B Min.of Irrig. New Delhi, 1989,1-30.



Hindawi

Submit your manuscripts at
<http://www.hindawi.com>

