

Regression Analysis of Ground Water of Afzalpur and Jewargi Talukas of Gulbarga District, Karnataka(India)

Srinivas Kushtagi*, Padaki Srinivas and S.G.Patil

Department of Civil Engineering, P.D.A College of Engineering, Gulbarga, Karnataka

*E-mail: srinivaskushtagi@yahoo.co.in

Article History:

Received: 23 December 2011

Accepted: 10 March 2012

ABSTRACT

Ground water samples from different villages of Afzalpur and Jewargi talukas of GULBARGA District of Karnataka India have been analyzed for various water quality constituents and correlation coefficients among different parameters were determined. An attempt has been made to develop regression equations to predict the concentration of water quality. The usefulness of these equations in predicting the ground water quality is discussed.

Key words: Afzalpur, Jewargi, Groundwater, Regression, Correlation, Physio-chemical.

© 2012ijCEPr. All rights reserved.

INTRUCTION

The quality of ground water depends upon its physical chemical and microbiological properties. These properties are inter linked. Therefore interpretation of correlation coefficient between water quality parameters gives good idea about the quality of water and facilitates rapid monitoring methods. Kumar et al studied quality and correlation ship among water quality parameters of ground water samples from different parts of India and developed liner regression equations for different water quality parameters [1]. The authors concluded that electrical conductivity could be used to predict the concentrations of calcium, magnesium, hardness, alkalinity, sulphate, and chloride in close proximity to real values in drinking waters in different regions of India in spite of wide variations in ground water quality. Similar studies were also carried out from Musunur mandal [2] and Reddiguddam mandal et al [3] in Krishna district of Andhra Pradesh. Singanan et al [4] also discussed the usefulness of correlations in predicting ground water quality of Rameshwaram Island in TamilNadu Jain .C.K. and et al [5] studied among correlation ship among water quality parameters of ground water of Jammu district. The developed regression equations for the parameters having significant correlation co-efficient were successfully used to estimate the concentration of other constituents, C.K.J. and et al [6]. Similar studies were also conducted in ground water of Sagar district of Madhya Pradesh.

MATERIALS AND METHODS

Study Area

The study area of Afzalpur taluka under Gulbarga district of Karnataka is located in the south west part of Gulbarga region. It is situated at a distance of 650 Kms from the state capital Bangalore and at a distance of 55 Kms from Gulbarga. The Jewargi taluka is located in the south part of Gulbarga region. It is situated at a distance of 550 Kms from Bangalore and at a distance of 40 Kms from Gulbarga. Afzalpur can be located at 17°12' north latitude and 76°21' east longitude and its elevation are about 408 m above the mean sea level. Jewargi is located at 17°01' north latitude and 77°04 east longitude and its elevation is about 393 m above mean sea level. The Afzalpur area stretched about 430 sqkms. The plateau consists of basalt rocky crust of a depth varying from 250 m to 300 m on impervious trap base. The plateau of Jewargi consists of basalt rocky crust of a depth varying from 200 m to 250 m on impervious trap base [7]. Twenty three villages in Afzalpur and 13 villages in Jewargi were chosen for sampling of water prone to be contaminated as per Jal Nirmal Project.

Methodology

The samples were collected are being used extensively for drinking and other domestic purposes. Physico-chemical analysis was conducted following standard methods [8]. The correlation coefficients among various constituents were calculated and regression equations developed for a pair of variables having strong correlation coefficient.

Table -1: Characteristics of ground water of Afzalpur taluka Gulbarga district

Village Name	Samp -ling point	pH	TH mg/l	Ca mg/l	Mg mg/l	Cl mg/l	TDS Micro-mhos/cm	Fe mg/l	F mg/l	NO ₃ mg/l	SO ₄ mg/l
Anur	1	7.2	133.40	54.40	79.00	135.00	1200.00	0.40	1.50	24.30	21.00
	2	7.4	133.00	53.00	80.00	132.00	1190.00	0.30	1.40	24.60	22.00
	3	7.8	130.80	53.80	77.00	133.00	1195.00	0.50	1.20	23.00	21.00
Bilwad	4	7.5	79.00	40.00	39.00	28.00	1500.00	0.20	2.10	55.30	21.00
	5	8.2	79.00	41.00	38.00	27.00	1490.00	0.30	1.80	55.00	22.00
	6	8.0	77.50	39.00	38.50	29.00	1498.00	0.10	2.00	56.00	22.00
Bilwad (K)	7	6.9	159.60	97.60	62.00	87.60	1500.00	0.10	1.00	24.00	21.00
	8	6.8	157.80	96.80	61.00	87.00	1490.00	0.13	1.02	24.20	21.00
	9	7.2	157.10	97.10	60.00	86.90	1510.00	0.20	0.98	23.80	22.00
Bilurgi	10	7.5	77.60	49.60	28.00	96.00	1500.00	0.10	0.05	44.00	21.00
	11	7.1	77.50	52.50	25.00	94.00	1500.00	0.40	0.08	45.00	22.00
	12	7.8	83.50	53.50	30.00	98.00	1485.00	0.20	0.90	46.00	21.00
Nandarga	13	8.3	421.60	221.60	200.00	837.00	1500.00	0.10	3.00	380.00	22.00
	14	8.5	430.00	228.00	202.00	830.00	1495.00	0.10	2.90	390.00	21.00
	15	7.5	433.00	228.00	205.00	838.00	1498.00	0.20	2.80	400.00	22.00
Deval Gangapur	16	6.8	87.00	55.00	32.00	35.00	1500.00	0.10	1.00	45.00	21.00
	17	7.2	117.00	56.00	61.00	38.00	1498.00	0.20	1.20	40.00	22.00
	18	7.2	116.00	51.00	65.00	40.00	1500.00	0.30	1.25	38.00	21.00
Karajgi	19	7.3	95.60	49.60	46.00	56.00	1500.00	0.50	1.50	30.00	22.00
	20	7.4	95.50	48.50	47.00	55.00	1500.00	0.20	1.40	32.00	22.00
	21	7.5	97.00	49.00	48.00	58.00	1500.00	0.30	1.60	31.00	24.00
Kodagan-oor	22	7.8	228.00	155.00	73.00	464.00	1500.00	0.50	1.00	11.00	25.00
	23	8.2	177.00	105.00	72.00	460.00	1500.00	0.10	1.20	12.00	21.00
	24	8.2	193.00	115.00	78.00	450.00	1500.00	0.20	1.10	13.00	26.00
Mallabad	25	8.5	87.80	52.80	35.00	179.00	1500.00	0.18	2.00	17.70	26.00
	26	7.6	82.50	50.50	32.00	165.00	1500.00	0.20	2.00	16.80	25.00
	27	7.7	90.00	54.00	36.00	172.00	1500.00	0.30	2.00	16.90	24.00
Matoli	28	8.2	70.00	32.00	38.00	47.60	1500.00	0.10	1.50	22.00	25.00
	29	7.5	70.00	33.00	37.00	48.50	1500.00	0.10	1.50	24.00	22.00
	30	7.2	72.00	34.00	38.00	49.00	1500.00	0.20	1.50	20.00	21.00
Hosur	31	8.1	181.00	107.00	74.00	347.00	1500.00	0.10	1.50	12.00	21.00
	32	8.2	178.00	106.00	72.00	340.00	1498.00	0.20	1.50	13.00	28.00
	33	8.1	181.00	108.00	73.00	300.00	1499.00	0.20	1.50	14.00	25.00
Devappa Nagar	34	8.2	95.60	33.60	62.00	120.00	1500.00	0.30	2.00	11.00	24.00
	35	6.8	92.00	32.00	60.00	100.00	1500.00	0.20	2.00	12.00	23.00
	36	6.9	102.00	34.00	68.00	110.00	1500.00	0.10	2.00	10.00	22.00
Ram Nagar	37	7.0	122.00	56.00	66.00	112.00	1500.00	0.10	1.00	26.00	21.00
	38	7.3	127.00	55.00	72.00	110.00	1500.00	0.10	1.00	25.00	22.00
	39	7.3	128.00	58.00	70.00	115.00	1498.00	0.10	1.00	28.00	23.00
Sheshgiri Wadi	40	7.6	215.00	131.00	84.00	425.00	1500.00	0.20	1.00	6.00	25.00
	41	8.0	215.00	130.00	85.00	400.00	1498.00	0.10	1.00	7.00	20.00
	42	8.5	222.00	132.00	90.00	425.00	1500.00	0.10	1.00	5.80	21.00
Shivbal Nagar	43	6.2	90.00	38.00	52.00	95.00	1500.00	0.10	1.00	26.00	21.00
	44	6.7	88.00	35.00	53.00	90.00	1500.00	0.20	1.00	28.00	22.00
	45	7.0	91.00	36.00	55.00	92.00	1500.00	0.30	1.00	30.00	21.00
Kulali	46	7.6	22.00	19.00	3.00	136.00	1500.00	0.30	3.00	26.50	25.00
	47	7.2	22.80	19.00	3.80	130.00	1500.00	0.20	2.80	27.00	24.00
	48	7.1	24.00	20.00	4.00	138.00	1500.00	0.20	2.90	28.00	25.00
Revoor (K)	49	7.6	81.00	52.00	29.00	89.00	1500.00	0.30	1.00	13.70	22.00
	50	7.8	80.00	55.00	25.00	89.00	1590.00	0.10	1.20	14.00	23.00
	51	7.8	88.00	58.00	30.00	90.00	1495.00	0.20	1.00	13.80	25.00
Revoor (B)	52	7.9	50.80	46.00	4.80	100.00	1500.00	0.20	3.00	89.50	21.00
	53	8.3	69.60	48.00	21.60	102.00	1495.00	0.10	3.00	90.10	22.00
	54	8.2	78.00	50.00	28.00	98.00	1500.00	0.30	1.90	90.00	23.00

Revoor (B)	55	8.3	367.00	152.00	215.00	473.20	1500.00	0.20	3.00	254.00	24.00
	56	7.8	370.00	150.00	220.00	475.00	1500.00	0.20	2.50	255.00	25.00
	57	8.0	385.00	160.00	225.00	474.00	1500.00	0.10	1.90	260.00	26.00
Sidnoor	58	8.2	417.00	174.00	243.00	851.00	1500.00	0.10	1.50	119.50	26.00
	59	8.4	410.00	170.00	240.00	851.00	1500.00	0.10	1.20	120.00	22.00
	60	7.2	415.00	175.00	240.00	850.00	1500.00	0.20	1.50	121.00	21.00
Hiriyal	61	7.3	278.00	169.00	109.00	277.00	1500.00	0.10	1.00	44.00	21.00
	62	6.8	278.00	170.00	108.00	280.00	1498.00	0.20	1.00	40.00	22.00
	63	6.5	285.00	168.00	117.00	268.00	1497.00	0.10	1.00	42.00	22.00
Shivanoor	64	6.9	210.00	115.00	95.00	308.00	1500.00	0.10	1.00	6.00	25.00
	65	8.2	215.00	116.00	99.00	300.00	1502.00	0.20	1.00	5.90	24.00
	66	8.1	210.00	110.00	100.00	309.00	1500.00	0.20	1.00	5.20	25.00
Udachan	67	8.3	172.00	75.00	97.00	280.00	1500.00	0.20	1.00	6.00	21.00
	68	8.5	174.00	76.00	98.00	285.00	1500.00	0.30	1.00	6.10	22.00
	69	8.7	164.00	74.00	90.00	300.00	1500.00	0.30	1.00	6.40	22.00
	SUM	526.6	11302.60	5858.90	5443.70	16589.8	102619.00	13.71	104.38	3922.10	1566.00
	Mean	7.63	163.81	84.91	78.89	240.43	1487.23	0.20	1.51	56.84	22.70
	SD	0.58	111.78	54.68	61.79	230.28	63.78	0.10	0.70	89.23	1.79
	CV	0.08	0.68	0.64	0.78	0.96	0.04	0.52	0.46	1.57	0.08
	Max	8.70	433.00	228.00	243.00	851.00	1590.00	0.50	3.00	400.00	28.00
	Min	6.20	22.00	19.00	3.00	27.00	1190.00	0.10	0.05	5.20	20.00

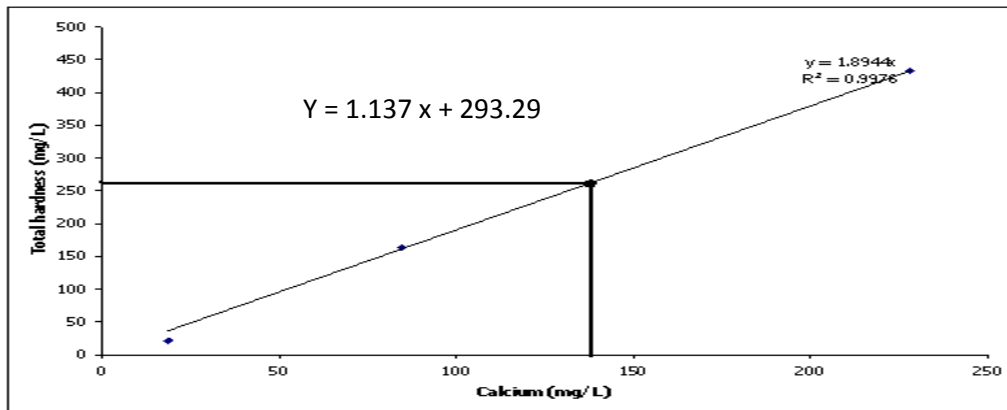


Fig-1: Regression Line for Total Hardness v/s Calcium in mg/l

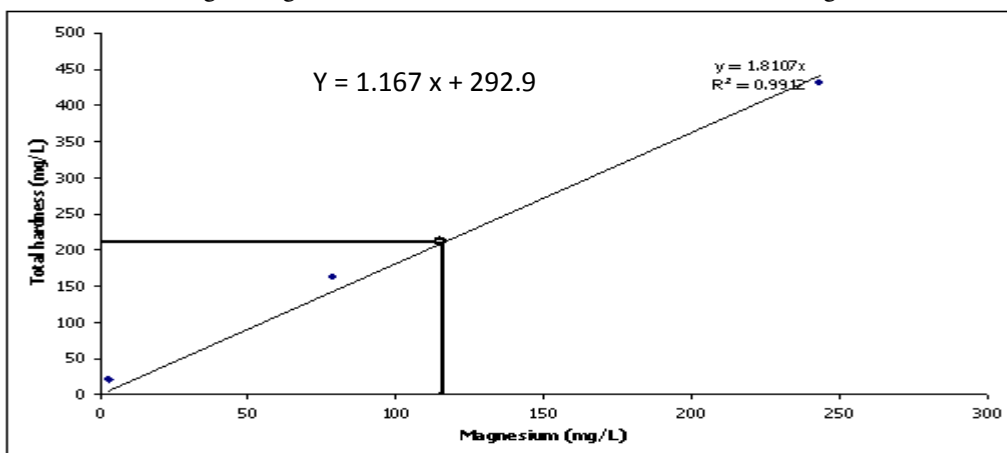


Fig-2: Regression Line for Magnesium v/s Calcium in mg/l

Table-2: Correlation co-efficient of different parameters

Parameters	pH	TH (mg/l)	Ca (mg/l)	Mg mg/l	Cl (mg/l)	TDS (M)	Fe (mg/l)	F (mg/l)	NO ₃ (mg/l)	SO ₄ (mg/l)
pH										
TH	0.257									
Ca	0.247	0.954								
Mg	0.247	0.964	0.642							
Cl	0.403	0.912	0.663	0.662						
TDS	0.063	0.045	0.109	-0.014	0.087					
Fe	0.022	-0.238	-0.248	-0.210	-0.205	-0.427				
Fe	0.245	0.119	0.073	0.150	0.212	0.033	-0.040			
NO ₃	0.226	0.701	0.644	0.698	0.647	0.063	-0.179	0.559		
SO ₄	0.280	0.076	0.066	0.079	0.155	0.169	0.068	0.221	-0.007	

TH – Total Hardness in mg/l Ca – Calcium Hardness in mg/l Mg – Magnesium Hardness in mg/l
 Cl – Chloride in mg/l TDS – Total dissolved solids in mg/l Fe – Iron in mg/l
 F – Fluoride in mg/l NO₃ – Nitrate in mg/l SO₄ – Sulphate in mg/l.
 S.D – Standard deviation C.V – Co-efficient of variation %.

Table-3 Computation of regression line for various samples in Flat Plate Collector

Sample	X-axis	Y-axis	N	\bar{X}	δX	\bar{Y}	δY	$r = \frac{(\sum XY/N - \bar{X}\bar{Y})}{\delta X \delta Y}$	$Y = r \frac{\delta Y}{\delta X} (X - \bar{X}) + \bar{Y}$
Ca & TH	Ca	TH	69	84.91	31.68	163.81	51.51	0.954	$Y = 1.137 X - 293.29$
Mg & TH	Mg	TH	69	78.78	36.74	163.81	51.51	0.964	$Y = 1.167 X - 292.9$

Table-4: Chemical characteristics of ground water in Jewargi taluka

Village Name	Samp li-ng point	pH	TH (mg/l)	Ca (mg/l)	Mg mg/l	Cl (mg/l)	TDS (Micro-mhos/cm)	Fe (mg/l)	F (mg/l)	NO ₃ (mg/l)	SO ₄ (mg/l)
Balundagi	1	7.30	177.00	102.00	75.00	38.00	1100.00	0.38	1.50	55.00	21.00
	2	7.40	175.00	101.00	74.00	39.00	1120.00	0.36	1.50	58.00	23.00
	3	7.20	183.00	105.00	78.00	36.00	1107.00	0.37	1.50	56.00	22.00
Belur	4	7.50	100.00	48.00	52.00	106.00	1260.00	0.40	1.00	37.60	24.00
	5	7.80	105.00	50.00	55.00	108.00	1220.00	0.39	1.00	38.30	23.00
	6	7.90	107.00	55.00	52.00	107.00	1275.00	0.36	1.00	37.80	28.00
Nedalgi	7	7.30	133.00	80.00	53.00	126.00	1200.00	0.40	0.50	55.00	26.00
	8	7.80	137.00	85.00	52.00	128.00	1240.00	0.37	0.50	56.00	24.00
	9	7.60	144.00	88.00	56.00	125.00	1230.00	0.36	0.50	53.00	28.00
Channur	10	7.80	59.00	38.00	21.00	75.16	1360.00	0.43	1.50	15.00	30.00
	11	8.00	59.00	36.00	23.00	76.00	1390.00	0.41	1.50	16.00	29.00
	12	7.90	65.00	40.00	25.00	77.00	1320.00	0.39	1.50	18.00	28.00
Gudur (SA)	13	8.00	82.60	51.60	31.00	165.00	1320.00	0.43	0.50	118.00	30.00
	14	7.70	90.30	58.30	32.00	162.00	1370.00	0.46	0.50	121.00	31.00
	15	7.40	93.20	59.20	34.00	164.00	1390.00	0.38	0.50	119.00	29.00
Katti-Sangavi	16	7.60	64.00	32.00	32.00	120.00	1390.00	0.38	0.10	85.00	28.00
	17	7.30	72.00	38.00	34.00	121.00	1380.00	0.36	0.10	83.00	27.00

	18	7.40	70.00	39.00	31.00	122.00	1320.00	0.33	0.10	82.00	22.00
Jeratgi	19	7.20	138.00	99.00	39.00	131.00	1360.00	0.40	0.10	55.00	28.00
	20	7.30	139.00	101.00	38.00	136.00	1200.00	0.36	0.50	58.00	25.00
	21	7.50	140.00	104.00	36.00	133.00	1280.00	0.38	0.50	57.00	26.00
Kallur-B	22	7.50	96.00	72.00	24.00	84.00	1100.00	0.36	0.50	143.00	21.00
	23	7.30	99.00	74.00	25.00	85.00	1120.00	0.40	1.00	140.00	23.00
	24	7.10	99.00	73.00	26.00	86.00	1107.00	0.39	1.00	142.00	22.00
Kallur-K	25	7.90	103.40	70.40	33.00	86.80	1100.00	0.33	1.00	79.60	21.00
	26	7.30	105.20	71.20	34.00	87.00	1120.00	0.35	1.00	78.00	24.00
	27	7.40	104.20	72.20	32.00	85.00	1127.00	0.34	1.00	80.00	25.00
Kolkur	28	7.50	75.40	22.40	53.00	44.80	1100.00	0.38	1.00	59.70	21.00
	29	7.40	74.80	22.80	52.00	45.20	1110.00	0.36	1.00	58.50	22.00
	30	7.30	74.00	23.00	51.00	46.30	1108.00	0.39	1.00	57.50	24.00
Gounahalli (River)	31	7.30	76.00	48.00	28.00	81.00	1120.00	0.36	1.00	99.00	24.00
	32	7.20	75.00	46.00	29.00	82.00	1130.00	0.33	1.00	97.00	23.00
	33	7.50	77.00	47.00	30.00	85.00	1110.00	0.37	1.00	96.00	22.00
Gounahalli	34	7.10	104.40	54.40	50.00	86.80	1120.00	0.33	1.00	59.00	23.00
	35	7.40	107.00	56.00	51.00	84.40	1125.00	0.31	1.00	58.60	22.00
	36	7.30	106.00	53.00	53.00	85.00	1109.00	0.36	1.00	56.50	25.00
Wadgera	37	7.30	92.00	43.00	49.00	168.00	1112.00	0.31	2.00	19.00	20.00
	38	7.50	92.00	44.00	48.00	165.00	1110.00	0.28	2.00	18.00	21.50
	39	7.40	92.00	45.00	47.00	166.00	1120.00	0.36	2.00	16.00	22.00
	Sum	291.60	3985.50	2347.50	1638.00	3948.46	46880.00	14.41	36.90	2631.10	957.50
	Mean	7.48	102.19	60.19	42.00	101.24	1202.05	0.37	0.95	67.46	24.55
	SD	0.25	32.17	24.26	14.71	38.84	107.94	0.04	0.51	35.58	3.04
	CV	0.03	0.31	0.40	0.35	0.38	0.09	0.09	0.54	0.53	0.12
	Max	8.00	183.00	105.00	78.00	168.00	1390.00	0.46	2.00	143.00	31.00
	Min	7.10	59.00	22.40	21.00	36.00	1100.00	0.28	0.10	15.00	20.00

Table-5: Correlation co-efficient of different parameters.

Parameters	pH	TH (mg/l)	Ca (mg/l)	Mg (mg/l)	Cl (mg/l)	TDS	Fe (mg/l)	F (mg/l)	NO ₃ (mg/l)	SO ₄ (mg/l)
pH										
TH	-0.277									
Ca	-0.229	0.901								
Mg	-0.230	0.700	0.322							
Cl	0.167	-0.119	0.001	-0.263						
TDS	0.473	-0.265	-0.124	-0.375	0.442					
Fe	0.337	-0.068	0.034	-0.204	-0.009	0.521				
Fe	0.021	0.020	-0.143	0.280	-0.231	-0.481	-0.261			
NO ₃	-0.231	-0.085	0.136	-0.410	0.010	-0.064	0.186	-0.523		
SO ₄	0.456	-0.186	-0.033	-0.352	0.341	0.642	0.635	-0.390	-0.003	

Table-6: Computation of regression line for various samples in Flat Plate Collector
Jewargi Taluka

Sample	X-axis	Y-axis	N	\bar{X}	δX	\bar{Y}	δY	$r = \frac{(\sum XY/N - \bar{X}\bar{Y})}{\delta X \delta Y}$	$Y = r \frac{\delta Y}{\delta X} (X - \bar{X}) + \bar{Y}$
Ca & TH	Ca	TH	39	60.19	20.52	102.19	32.03	0.901	$Y = 1.137 X - 293.29$
Mg & TH	Mg	TH	39	42.00	21.97	102.19	32.03	0.700	$Y = 1.167 X - 292.9$

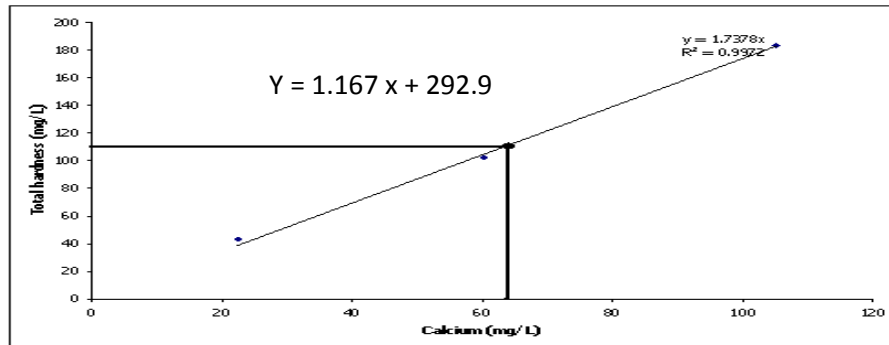


Fig.-3: Regression Line for Total Hardness v/s Calcium in mg/l

RESULTS AND DISCUSSIONS

The characteristics of ground water samples are given in Table 1 and 4, along with mean and standard deviations for each parameter. In Afzalpur taluka pH value lies in the range of 6.20 to 8.70. TH varies from 22 to 433 mg/ltr. The Ca 19 to 228 mg/ltr, Mg 3 to 243 mg/ltr, Chloride 27 to 851 mg/ltr, TDS 1190 to 1590 micro-mhos/cm, Fe 0.10 to 0.50 mg/ltr, Fluoride 0.05 to 3.00 mg/ltr, NO₃ 5.20 to 400 mg/ltr and Sulphate 20 to 28 mg/ltr. In Jewargi taluka pH lies between 7.10 to 8, TH varies from 59 to 183 mg/ltr, Ca varies between 22.40 to 105.00 mg/ltr, Mg varies from 21 to 78 mg/ltr, Chloride 36 to 168 mg/ltr, TDS were 1100 to 1390 micro-mhos/cm, Fe 0.28 to 0.46 mg/ltr, Fluoride lies between 0.1 to 2 mg/ltr, NO₃ varies between 15 to 143 mg/ltr, SO₄ lies between 20 to 31 mg/ltr.

Correlation Analysis[10-12]

The systematic calculation of correlation co-efficient between water quality variables and regression analysis provides an indirect means of rapid monitoring of water quality[13].

In the present study area the correlation co-efficient (r) between appropriate parameter pairs computed by taking the average values. Correlation co-efficient (r) between any two parameters X and Y is calculated for parameters such as pH, Ca, Mg, Cl, TDS, Fe, F, NO₃ and SO₄ of the ground water.

The degree of line association between any two of the water quality parameters as measured by the simple correlation co-efficient (r) is represented in Table no .3 and 4 as 10X10 correlation matrix.

In Afzalpur taluka the highest positive correlation (r=0.964) is found between Mg and TH, highest negative correlation (r=-0.427) is found between Fe and TDS. High values of correlation co-efficient (r≥0.67) between Mg and TH (0.964). Ca and TH (0.954) as shown in Table no 2 and 3. were observed and for the same regression equations were formed and regression lines are drawn in Fig.-1 and 2.

In Jewargi taluka the highest positive correlation (r=0.901) is found between Magnesium and Total Hardness and the highest negative correlation (r=-0.523) is found between Fe and TDS. High values of correlation co-efficient (r≥0.67) between Mg and TH.(0.700) between Ca and TH (0.901) as shown in table no 5 and 6, were observed and for the same regression equations were formed and regression lines are drawn as shown in Fig.-3 and 4.

CONCLUSIONS

It is concluded that the linear regression equations developed for the constituents having strong correlation co-efficient and can be successfully used for predicting the concentrations of constituents in ground water of Afzalpur and Jewargi talukas of Gulbarga district of Karnataka. Similar linear regression approach can be applied for other talukas of the district.

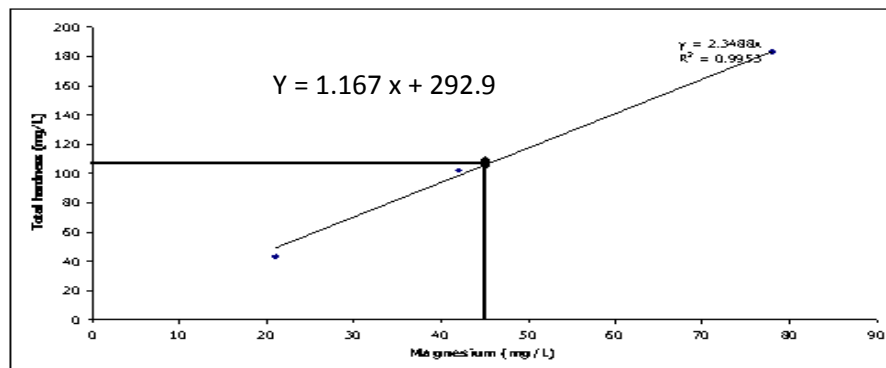


Fig-4: Regression Line for Magnesium v/s Calcium in mg/l

REFERENCES

1. Kumar S . Garg and Gopal K, Indian Journal of Environment Protection, **14** (1994) 595.
2. Rao K.S. and Rao B.S., Indian. J. Environ. Protection,**14** (1994) 528
3. Krishna J.S.R, Rambabu K. and Rambabu C., Indian Journal Environ.Protection, **15** (1995) 914.
4. Singanan M., Rao K.S. and Rambabu C.A., Indian Journal Environ.Protection., **15** (1995) 212.
5. Jain C.K. and Sharma M.K. : Relationship among water quality parameters of ground water of Jammu district. **16** (1997) 241.
6. Jain C.K.and Sharma M.K., Indian Journal of Environmental Health, **42** (2000) 159.
7. Ground water Information Booklet Gulbarga District, Karnataka, Govt of India Ministry of water Resources, Central Ground water Board, South western region Bangalore. November 2008.
8. Bureau of Indian Standard Methods (IS 10500:1991) : **21** (1993)
9. Statistical Software Package for Social Services (SSPSS); Correlation analysis.
10. Achak Dasgupta M. and Purohit K.M., Indian Journal of Environmental Protection, **20** (2000) 681.
11. Jain Ritesh, Singh Jaspal and Singh .S.K., Journal of the Institution of Public Health Engineer's India, **6** (2000) 38.

[IJCEPR-207/2012]

Water: Research & Development

[Water R&D]

www.waterrnd.com

ISSN: 2249-2003

[Abstracted in : Chemical Abstracts Service, USA and CAB(I) , UK]

WaterR&D is an international Research Journal, dedicated to 'Water'. It is a truly interdisciplinary journal on water science and technology. It'll showcase the latest research related to Water in the field of chemistry, physics, biology, agricultural, food, pharmaceutical science, and environmental, oceanographic, and atmospheric science. It includes publication of reviews, regular research papers, case studies, communications and short notes.

Manuscript Categories: Full-length paper, Review Articles, Short/Rapid Communications.

Manuscripts should be addressed to:

E-mail: waterrd@gmail.com