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Assessment of Physico-Chemical Quality of Groundwater in rural area nearby Sagar city, MP, India

Hemant Pathak[1]* and S. N. Limaye[2]

[1]Department of Chemistry, Indra Gandhi Govt. Engineering College, Sagar, (M.P.), India
[2]Dr. Hari singh Gour Central University, Sagar (M.P.), India

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ABSTRACT

Ground water is one of the major resources of the drinking water in Sagar city (M.P.). In the present study groundwater quality of the selected 02 Villages nearby Sagar city were taken for under investigations by forty groundwater samples collected from entire villages and assessed for their suitability for human consumption. Physico-chemical parameters were carried out during different months of the pre monsoon, monsoon and post monsoon seasons in june2007– July 2010. The statistical analysis of the collected samples yielded the range of the variation, mean, standard deviation and co-efficient of variation. The multiple regression analysis and regression equation indicated that the degraded water quality of Gambhira and Baheria is caused by anthropogenic activities and inappropriate rural water management action plan.

Keywords: Groundwater, physico-chemical quality, Multiple regression analysis.

INTRODUCTION

Ground water is the major source of water for drinking, agricultural, and industrial desires. The availability of water determines the location and activities of humans in an area and our growing population is placing great demands upon natural fresh water resources [1].

The physico-chemical contaminants that adversely affected the quality of groundwater is likely to arise from a variety of sources, including land application of agricultural chemicals and organic wastes, infiltration of irrigation water, septic tanks, and infiltration of effluent from sewage treatment plants, pits, lagoons and ponds used for storage [2]. B. Rajappa *etal.*[3], Patil Shilpa G. *etal.* [4], Pramod N. Kamble *etal.* [5], Zamxaka m. *etal.* [7], is the groups of prominent chemist importantly contributed to assessed the quality of ground water.

In this study, physico-chemical assessment of ground water samples was determined by using standard analytical methods. The objective of the study is to analyze the 14 parameters of water along 15 locations of 02 villages nearby Sagar city for 3 season's pre monsoon, monsoon and post monsoon (during 2007 - 2010). The aim of this study was to determine the physico-chemical analysis of groundwater sources of Baheria and Gambhiria village area and to compare with levels obtained with the WHO [9] and IS:10500 [11] drinking water directive.

Study area and collection of water samples

Ground water samples were collected from in and around Baheria and Gambhiria village of Sagar city. Each water sample was taken every month during June 2007 to July 2010. The samples were collected in prewashed (with detergent, diluted HNO_3 and doubly de-ionized distilled water, respectively) clean polythene bottles without any air

bubbles and tightly sealed after collection and labeled in the field. The temperatures of the samples were measured in the field on the spot at the time of sample collection. The samples were immediately analysed in the chemistry lab to minimize physicochemical changes. The error due to time has been omitted for the present study [4].

MATERIALS AND METHODS

Table 1- List of Chemical parameters and their test methods

S.N.	Parameters	Unit	Test Methods
1	pH	-	pH meter
2	Dissolved Oxygen (DO)	mg/L	Winkler method
3	Biochemical Oxygen Demand (BOD)	mg/L	5 days incubation at 20° C and titration of initial and final DO.
4	Chemical Oxygen Demand	mg/L	Open Reflux Method
5	Conductivity	ms/cm	Conductivity meter
6	Alkalinity	mg/L	Titration
7	Total dissolved Solids	mg/L	Digital conductivity meter (LT-51)
8	Chloride	mg/L	Argentometric titration
9	Orthophosphate ($P0_4^{3-}$ — P)	mg/L	Ammonium molybdate ascorbic acid reduction method
10	Nitrate -Nitrogen (NO_3 — N)	mg/L	Spectrophotometric method
11	Ammonia-Nitrogen (NH_3 — N)	mg/L	Spectrophotometric (Phenate method)
12	Total Hardness as $CaCO_3$	mg/L	EDTA titration
13	Fluoride	mg/L	Colorimetric Method
14	Iron	mg/L	Colorimetric Method

Table 2 - Multiple Regression Analysis for different Parameters in the ground water Samples of in and around Baheria village of Sagar city

Dependent variable is DO, 15 independent variables, 15 cases.

Variable	Coefficient	Variable	Coefficient
Intercept	-480.0469	RESI.CHLORINE	-489.9956
TEMPRATURE	25.559196	PHOSPHATE	285.83398
COLOUR	-2.545898	NITRATE	-106.4254
pH	-44.6618	AMMONIA	729.48962
TURBIDITY	55.098022	TH	-2.517097
BOD	37.580643	TEMP. HARD.	-3.575142
COD	16.006485	PERM. HARD.	-7.088448
CONDUCTIVITY	-1377.068	Ca HARDNESS	7.3745384
ALKALINITY	-.005208	Mg HARDNESS	1.1140099
TS	.8262539	FLUORIDE	-334.363
TSS	.5674095	IRON	-350.0865
TDS	.7915101	Ca CONTENT	13.485321
CHLORIDE	-7.556957	Mg CONTENT	-40.9631

R-Square = 0.0 Adjusted R-Square = 2.2727

Cohen's f-square = 0.0, a small effect size.

Analysis of Variance to Test Regression Relation

Source	Sum of Sqs	df	Mean Sq	F	p-value
Regression	-2084.177	25	-83.36709	.	N.A.
Error	2104.8163	-11	.		
Total	20.639135	14			

Note: - A low p-value suggests that the dependent variable DO may be linearly related to independent variable(s).

Table 3 - Multiple Regression Analysis for different Parameters in the ground water Samples of in and around Gambhiria village of Sagar city

Dependent variable is DO, 15 independent variables, 15 cases.

Variable	Coefficient	Variable	Coefficient
Intercept	246.94531	RESI.CHLORINE	734.47852
TEMPRATURE	-8.549072	PHOSPHATE	-91.43481
COLOUR	-16.77954	NITRATE	40.910156
pH	-62.30225	AMMONIA	51.489258
TURBIDITY	5.8253174	TH	-2.757828
BOD	53.675537	TEMP. HARD.	2.0670378
COD	-9.108154	PERM. HARD.	2.2953949
CONDUCTIVITY	-167.8047	Ca HARDNESS	5.8817291
ALKALINITY	.8608627	Mg HARDNESS	3.055191
TS	.0375519	FLUORIDE	124.60889
TSS	2.8694611	IRON	128.08887
TDS	.4320412	Ca CONTENT	-5.951263
CHLORIDE	-8.212585	Mg CONTENT	-6.862015

R-Square = 0.0 Adjusted R-Square = 2.2727

Cohen's f-square = 0.0, a small effect size.

All the chemicals used were of AR grade. Analysis was carried out for various water quality parameters were measured by using Standard APHA methods [10].

Baheria and Gambhiria, village area nearby Sagar city was chosen as study area. 15 locations of 2 villages were selected based on domestic, agricultural and industrial activities. Water samples were collected from 15 stations by using standard methods (APHA) [10]. Various water samples were collected in clean and dry polyethylene bottles from bore wells after running them for 5 minutes. All the collection of samples are immediately preserved in dark

boxes and processed for the different analysis within 6 hours after collection. All water samples were collected in sterile bottles (5 liter).

Analysis of Variance to Test Regression Relation

Source	Sum of Sqs	df	Mean Sq	F	p-value
Regression	6056.0025	25	242.2401	.	N.A.
Error	-6050.039	-11	.		
Total	5.964	14			

Note:-A low p-value suggests that the dependent variable DO may be linearly related to independent variable(s).

Table 4: Statistical evaluation for different Parameters in the Ground water Samples of Baheria village in Sagar City

Descriptive Statistics

	Range	Minimum	Maximum	Sum	Mean		Std.	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
TEMPRATUR	6.30	22.30	28.60	506.50	5.3250	.3269	.46211	2.138	.091	.512	.409	.992
COLOUR	14.00	10.00	24.00	298.00	4.9000	.7674	.43205	11.779	1.179	.512	1.295	.992
pH	1.86	6.51	8.37	148.47	7.4235	.1203	.53783	.289	-.256	.512	-.784	.992
TURBIDITY	10.00	8.00	18.00	219.00	0.9500	.5452	.43818	5.945	1.347	.512	2.638	.992
DO	4.60	3.25	7.85	118.28	5.9140	.2563	.14626	1.314	-.898	.512	.888	.992
BOD	7.29	3.02	10.31	104.19	5.2095	.3146	.40701	1.980	2.424	.512	9.618	.992
COD	17.10	8.25	25.35	221.32	1.0660	.8357	.73726	13.967	3.222	.512	12.033	.992
CONDUCTI	.33	.45	.78	11.82	.5911	.0186	.08302	.007	.858	.512	.464	.992
ALKALINITY	174.00	104.00	278.00	900.00	5.0000	0.3115	.11427	26.526	.420	.512	-.381	.992
TS	227.24	281.47	508.71	597.52	9.8760	2.8426	.43397	98.660	.662	.512	-.009	.992
TSS	61.87	3.36	65.23	378.92	8.9460	3.2345	.46497	09.235	1.756	.512	4.579	.992
TDS	201.31	274.95	476.26	218.60	0.9300	1.3274	.65748	66.180	.863	.512	.470	.992
CHLORIDE	108.75	28.64	137.39	136.87	6.8435	5.6457	.24846	37.485	1.916	.512	4.587	.992
RESICHLOR	.26	.05	.31	2.95	.1475	.0156	.06995	.005	.703	.512	.032	.992
PHOSPHATE	3.13	1.51	4.64	48.50	2.4250	.1366	.61102	.373	2.536	.512	9.416	.992
NITRATE	5.63	1.06	6.69	39.61	1.9805	.2930	.31018	1.717	2.768	.512	8.778	.992
AMMONIA	.34	.11	.45	4.06	.2030	.0187	.08367	.007	1.309	.512	2.595	.992
TH	117.87	150.19	268.06	130.55	6.5275	5.9582	.64606	10.013	.366	.512	.743	.992
TEMP. HARD	116.09	96.60	212.69	158.14	7.9070	6.4247	.73225	25.542	-.304	.512	.072	.992
PERM. HARI	76.33	14.36	90.69	972.41	8.6205	4.2379	.95236	59.192	.060	.512	.177	.992
Ca HARDNE	94.69	114.36	209.05	204.22	0.2110	6.3270	.29535	00.627	-.101	.512	-1.203	.992
Mg HARDNE	56.50	18.77	75.27	926.33	6.3165	3.6065	.12864	60.133	-.093	.512	-.967	.992
FLUORIDE	1.35	.21	1.56	17.15	.8575	.0944	.42206	.178	-.034	.512	-1.296	.992
IRON	1.94	.04	1.98	8.78	.4390	.0879	.39322	.155	3.370	.512	13.666	.992
Ca CONTEN	37.95	45.83	83.78	284.17	4.2085	2.5359	.34095	28.617	-.101	.512	-1.203	.992
Mg CONTEN	13.73	4.56	18.29	224.99	1.2495	.8764	.91952	15.363	-.092	.512	-.966	.992

Table 5: Statistical evaluation for different Parameters in the Ground water Samples of Gambhiria village in Sagar City

Descriptive Statistics

	Range	Minimum	Maximum	Sum	Mean		Std.	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
TEMPRATURE	4.40	23.20	27.60	513.00	25.6500	.2618	1.17092	1.371	-.534	.512	-.115	.992
COLOUR	9.00	12.00	21.00	315.00	15.7500	.6604	2.95359	8.724	.653	.512	-.889	.992
pH	1.21	7.44	8.65	162.06	8.1030	.0868	.38814	.151	-.417	.512	-.876	.992
TURBIDITY	15.00	10.00	25.00	263.00	13.1500	.7789	3.48342	12.134	2.127	.512	6.486	.992
DO	3.77	4.05	7.82	129.18	6.4590	.2455	1.09805	1.206	-.973	.512	-.098	.992
BOD	7.55	2.74	10.29	116.42	5.8210	.3733	1.66933	2.787	.392	.512	2.009	.992
COD	11.79	7.85	19.64	220.72	11.0360	.5636	2.52062	6.354	2.195	.512	6.689	.992
CONDUCTIVIT	.29	.40	.68	10.07	.5034	.0144	.06449	.004	1.100	.512	2.245	.992
ALKALINITY	220.00	105.00	325.00	4224.00	211.2000	13.2642	59.31947	3518.800	.039	.512	-.773	.992
TS	157.63	278.54	436.17	6597.16	329.8580	9.1703	41.01093	681.896	1.368	.512	1.383	.992
TSS	35.81	5.64	41.45	450.70	22.5350	2.3725	10.61000	112.572	.166	.512	-.783	.992
TDS	175.23	242.02	417.25	6146.46	307.3230	8.7806	39.26811	1541.985	1.097	.512	2.233	.992
CHLORIDE	115.00	38.97	153.97	1373.07	68.6535	6.5343	29.22219	853.937	1.819	.512	3.485	.992
RESICHLORIN	.43	.01	.44	2.98	.1490	.0189	.08441	.007	2.040	.512	7.418	.992
PHOSPHATE	3.26	1.04	4.30	36.29	1.8145	.1490	.66643	.444	2.877	.512	10.681	.992
NITRATE	7.86	.93	8.79	44.19	2.2095	.3926	1.75579	3.083	3.127	.512	10.972	.992
AMMONIA	.28	.11	.39	4.20	.2100	.0140	.06274	.004	1.074	.512	2.281	.992
TH	142.22	153.34	295.56	4008.06	200.4030	8.1028	36.23695	1313.116	1.838	.512	3.038	.992
TEMP. HARD.	40.33	118.64	158.97	2791.38	139.5690	2.4731	1.06015	122.327	-.312	.512	-.552	.992
PERM. HARD.	141.80	17.82	159.62	1216.68	60.8340	8.6359	38.62106	491.586	1.666	.512	2.270	.992
Ca HARDNESS	113.29	113.16	226.45	3068.52	153.4260	7.7382	34.60647	197.607	1.144	.512	.387	.992
Mg HARDNES	58.71	16.48	75.19	939.54	46.9770	3.3730	15.08453	227.543	.106	.512	-.356	.992
FLUORIDE	1.15	.21	1.36	18.41	.9205	.0893	.39930	.159	-.473	.512	-1.203	.992
IRON	3.95	.02	3.97	24.05	1.2025	.3330	1.48903	2.217	1.081	.512	-.696	.992
Ca CONTENT	45.41	45.35	90.76	1229.78	61.4890	3.1016	13.87062	192.394	1.144	.512	.387	.992
Mg CONTENT	14.27	4.00	18.27	228.22	11.4110	.8198	3.66617	13.441	.106	.512	-.356	.992

Table 6. Regression Analysis of chemical Parameters in Ground water Samples of in and around Sagar city (Monsoon 2007 to Pre Monsoon 2010)

	Dependent Variable	Independent Variable	Regression equation	Slope	R^2
•	DO_{mean}	BOD_{mean}	DO = 0.213 + 0.665 * BOD	0.665	0.410
•	DO_{mean}	COD_{mean}	DO = 0.858 * COD + 4.309	0.858	0.327
•	DO_{mean}	$BOD_{mean,}$ COD_{mean}	DO = 2.72493 + .3759247 * BOD + .2181811 * COD		0.387
•	DO_{mean}	pH_{mean}	DO_{mean} = 0.272 * pH + 6.036	0.272	0.437
•	DO_{mean}	$Alkalinity_{mean}$	DO = - 61.45 + 38.54 * alkalinity	38.54	0.483
•	DO_{mean}	TDS_{mean}	DO =267.3 - 5.936 * TDS	- 5.94	0.038
•	DO_{mean}	$Chloride_{mean}$	DO = 62.79 - 2.446 * Chloride	-2.446	0.015
•	DO_{mean}	Residual $Chlorine_{mean}$	DO = 0.103 + 0.005 * Residual Chlorine	0.005	0.008
•	DO_{mean}	o-$Phosphate_{mean}$	DO = 0.868 + 0.066 * o-Phosphate	0.066	0.100
•	DO_{mean}	$Nitrate_{mean}$	DO= 2.249 - 0.075 * Nitrate	-0.075	0.011
•	DO_{mean}	$Ammonia_{mean}$	DO = 0.243 - 0.008 * Ammonia	-0.008	0.054
•	DO_{mean}	$Chloride_{mean,}$ Residual $Chlorine_{mean}$	DO = 5.9765169 + .0047626 * Chloride + 3.590613 * Residual Chlorine		0.053t
•	DO_{mean}	$Chloride_{mean,}$ Residual $Chlorine_{mean}$ o-$Phosphate_{mean}$	DO = 2.2624403 - .0008274 * Chloride+ 6.6164193 * Residual Chlorine+ 2.7109191 * o-Phosphate		0.347
•	DO_{mean}	$Chloride_{mean,}$ Residual $Chlorine_{mean}$ o-$Phosphate_{mean}$ $Nitrate_{mean}$	DO = 1.6943142 - .0070552 * Chloride + 6.5763704 * Residual Chlorine + 2.6775632 * o- Phosphate + .519642 * Nitrate		0.555
•	DO_{mean}	$Chloride_{mean,}$ Residual $Chlorine_{mean}$ o-$Phosphate_{mean}$ $Nitrate_{mean}$	DO = 2.9387562 -.0077354 * Chloride+ 6.6220172 * Residual Chlorine + 2.8740215 * o-Phosphate + .7809133 * Nitrate-10.17392 * Ammonia		0.562

		Ammonia $_{mean}$			
•	DO $_{mean}$	Temporary hardness $_{mean}$	DO = 6.1845483 - .0033188 * Temporary hardness	- .003	.0042
•	DO $_{mean}$	Permanent hardness $_{mean}$	DO = 7.5829673 -.0188653 * Permanent hardness	- .018	.1346
•	DO $_{mean}$	Calcium hardness $_{mean}$	DO = 256.3 - 15.56 * Calcium hardness	- 15.56	0.530
•	DO $_{mean}$	Magnesium hardness $_{mean}$	DO = 72.29 - 3.844 * Magnesium hardness	-3.844	0.111
•	DO $_{mean}$	Temporary hardness $_{mean}$ Permanent hardness $_{mean}$	DO = 7.1144908 + .0030887 * Temporary hardness - .0188273 * Permanent hardness		.1382
•	DO $_{mean}$	Calcium hardness $_{mean}$ Magnesium hardness $_{mean}$	DO = 7.8835417 +.0045428 * Calcium hardness - .0405569 * Magnesium hardness		.1978
•	DO $_{mean}$	Fluoride $_{mean}$	DO = - 1.155 + 0.299 * Fluoride	0.299	0.217
•	DO $_{mean}$	Iron $_{mean}$	DO = 0.010 + 0.048 * Iron	0.048	0.233
•	DO $_{mean}$	Fluoride $_{mean}$ Iron $_{mean}$	DO = 4.4334597 + .666462 * Fluoride + 5.0073845 * Iron		.6086

Table 7. Regression Analysis of chemical Parameters in Municipal water Samples of in and around Sagar city (Monsoon 2007 to Pre Monsoon 2010)

Dependent Variable	**Independent Variable**	**Regression equation**	**Slope**	**R^2**
DO $_{mean}$	BOD $_{mean}$	DO = - 23.17 + 4.320 * BOD	4.320	0.871
DO $_{mean}$	COD $_{mean}$	DO = 0.175 * COD + 8.356	0.327	0.013
DO $_{mean}$	BOD$_{mean,}$ COD $_{mean}$	DO = 10.310156 + .253079 * BOD -.5406958 * COD		0.995
DO $_{mean}$	Alkalinity $_{mean}$	DO = 29.46 + 21.34 * alkalinity	21.34	0.993
DO $_{mean}$	pH$_{mean}$	DO = 0.174 * pH + 6.629	0.174	0.022
DO $_{mean}$	TDS $_{mean}$	DO = - 351.6 + 93.55 * TDS	93.55	0.828
DO $_{mean}$	Chloride $_{mean}$	DO= - 165.5 + 33.61 * Chloride	33.61	0.689
DO $_{mean}$	Residual Chlorine $_{mean}$	DO = - 0.519 + 0.1 * Residual Chlorine	0.1	0.343
DO $_{mean}$	o-Phosphate $_{mean}$	DO = - 0.659 + 0.311 * o-Phosphate	0.311	0.882
DO $_{mean}$	Nitrate $_{mean}$	DO= 2.327 - 0.153 * Nitrate	-.153	0.253
DO $_{mean}$	Ammonia $_{mean}$	DO = 0.649 - 0.070 * Ammonia	-.070	0.598
DO $_{mean}$	Chloride $_{mean,}$ Residual Chlorine $_{mean}$	DO = 5.2898461 + .0014619 * Chloride + 7.3416583 * Residual Chlorine		0.995
DO $_{mean}$	Chloride $_{mean,}$ Residual Chlorine $_{mean}$ o-Phosphate $_{mean}$	DO = 4.9030929 -.0002217 * Chloride + 7.3140616 * Residual Chlorine+ .3584516 * o-Phosphate		0.0
DO $_{mean}$	Chloride $_{mean,}$ Residual Chlorine $_{mean}$ o-Phosphate $_{mean}$ Nitrate $_{mean}$	DO = 11.367188 + .0188141 * Chloride - 2.865234 * Residual Chlorine - 1.897461* o- Phosphate + 1.9199219 * Nitrate		0.0
DO $_{mean}$	Chloride $_{mean,}$ Residual Chlorine $_{mean}$ o-Phosphate $_{mean}$ Nitrate $_{mean}$ Ammonia $_{mean}$	DO = 3.9335938 - .0105438 * Chloride -2.738281 * Residual Chlorine + 2.193573* o-Phosphate + 3.0136719 * Nitrate - 11.80859 * Ammonia		0.592
DO $_{mean}$	Temporary hardness $_{mean}$	DO = 7.349073 - 0.005019988 * Temporary hardness	- .005	0.009
DO $_{mean}$	Permanent hardness $_{mean}$	DO = 7.6280614 - .0218256 * Permanent hardness	- .022	0.180
DO $_{mean}$	Calcium hardness $_{mean}$	DO = 428.2 - 41.19 * Calcium hardness	- 41.19	0.949
DO $_{mean}$	Magnesium hardness $_{mean}$	DO = 72.49 - 4.656 * Magnesium hardness	- 4.656	0.177
DO $_{mean}$	Temporary hardness $_{mean}$ Permanent hardness $_{mean}$	DO = 10.037029 - .0161477 * Temporary hardness - .0253295 * Permanent hardness		0.187
DO $_{mean}$	Calcium hardness $_{mean}$ Magnesium hardness $_{mean}$	DO = 11.803454 - .01078 * Calcium hardness - .0887259 * Magnesium hardness		0.11
DO $_{mean}$	Fluoride $_{mean}$	DO = - 1.539 + 0.35 * Fluoride	0.35	0.217
DO $_{mean}$	Iron $_{mean}$	DO = 0.535 - 0.030 * Iron	-0.030	0.018
DO $_{mean}$	Fluoride $_{mean}$ Iron $_{mean}$	DO = 5.120312 + 2.2574179 * Fluoride - 1.356825 * Iron		0.564

Taking DO as dependent variable for all the 26 water sampling points of water sources at critical and logical analysis of given regression equations reveal important facts regarding correlation studies (see annexure F) among various physicochemical parameters.

To study the correlation between various water quality parameters, the regression analysis was Carried out using computer software SPSS, version–11. Regression coefficient measures the degree of association exists between two variables, DO taken as dependent variable. The greater the value of regression coefficient, the better is the fit and more useful the regression variables.

The following regression models have been obtained from the results of analysis of water samples. Considering a mean DO (dependent variables) and important chemical parameters taken as independent variables, regression equations can be obtained for the entire study area for all season.

RESULTS

Table 4 and table 5 represented statistical evaluation for different parameters in the ground water samples of Baheria village and Gambhiria villages of Sagar city. It can be concluded from ground water quality of Baheria and Gambhiria village of Sagar city, variables viz. TDS, TH are slightly higher and Alkalinity, Cl are lower in the post monsoon period than in the PreMonsoon. On the other hand parameters – BOD, COD, Ammonia and Nitrate are clearly higher in all the season showed a clear cut temporal effect. BOD is out of the highest desirable limit or maximum permissible limit set by WHO except TH, Alkalinity and conductivity which recorded high values. . It was reported that groundwater was contaminated from nitrate fertilizers and manures used in agriculture. Furthermore, nitrate is used by microorganisms as food resources. In addition, high nitrate levels are often accompanied by bacterial and pesticide contamination. Hence, these sample water can be absolutely fit for drinking after disinfectants treatment. A total of 30 samples had slightly more pH levels as per Indian standards. Possible sources of this contamination may be intensive agriculture and urbanization in Gambhiria and Baheria village. In rural areas, drinking water generally supplied groundwater through individual or community wells.

CONCLUSION

30 groundwater samples collected for physico-chemical analysis of water samples of Gambhiria and Baheria villages of sagar city. Physico-chemical parameters are out of the highest desirable limit or maximum permissible limit set by IS: 10500 [14]. Hence, these sample water cannot be absolutely fit for directly drinking. Some essential treatment needed to convert in drinkable water. In conclusion, from the results of the present study it may be said that the people in these rural areas are therefore at higher potential risk of contacting water-borne and/or sanitation-related diseases. Both villages water is not absolutely fit for directly drinking purpose need treatments to minimize the contamination. It is recommended that water analysis should be carried out from time to time to monitor the rate and kind of contamination.

It is need of human to expand awareness among the people to maintain the cleanness of water at their highest quality and purity levels to achieve a healthy life.

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