

Seasonal Variation of Groundwater Quality in Sanganer Tehsil, Jaipur (Rajasthan)

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Abstract: Water of good drinking quality is of basic importance to physiology and man's continued existence depends very much on its availability. **Objective:** This study is done to understand the seasonal variations in the physiochemical parameters of the groundwater of three sites of Sanganer Tehsil of Jaipur district, Rajasthan using statistical tools. **Methodology:** To carry out the research Groundwater samples were collected for pre monsoon, monsoon and post monsoon period of a year. Five samples were collected from each site and chemical analysis was conducted. With the help of one-way ANOVA test the difference between the three sites based on the parameters was calculated. **Findings:** This paper reveals that groundwater of these three sites shows seasonal variations in all eleven parameters using statistical methods like paired t-test and Analysis of Variance (ANOVA) tests. The groundwater of all the sites is not suitable for drinking & industrial purposes which will help the local government to take necessary action.

Keywords: Chemical Analysis, Water, ANOVA, Physicochemical parameters

1. Introduction

Water is a basic natural resource in the environment which supports life in all form. Its major use in the country is to irrigate the field crops. Irrigation is basic necessity for sustaining high production of crop in arid and semi arid regions prone to water deficit. In the state of Rajasthan, where the surface water availability is very limited due to scanty and erratic rains, farmer depend on ground water reserves both for drinking and irrigation purposes. Apart from that farmers also use polluted water which contain virus and bacteria. This polluted water adversely affects the health of human being and farm animals. Due to lack of water, farmers of south Jaipur growing vegetable crops with polluted water. The sewerage water of Jaipur city is discharged through south Jaipur and without filtration & purification it is used for irrigating vegetable crops. So the vegetable crop growing their also get polluted. Although plants are getting rich manure containing water supply which increases growth and production yet at the same time they stand exposure to the invasion of pathogenic fungi, nematodes, virus & bacteria causing fatal diseases. It also carry propagates of pathogens which get deposited in roots, stem leaves & fruits etc. These vegetable cause health hazards in animal & human populations therefore it is essential to access the amount of microbial contamination and its impact on human

& farm animals. Heavy metals contamination has been recognized as a major environmental concern due to their pervasiveness and persistence. These heavy metals are not biodegradable, hence there is a need to develop such a remediation technique, which should be efficient, economical and rapidly deployable in a wide range of physical settings.

Thus, it was thought to study ground water quality of rural areas of Sanganer Tehsil, Jaipur district, Rajasthan, India. Various samples of ground water were collected from three villages of sanganer Tehsil periodically at different type of monsoon and following pattern will followed for sample collection are in following ways: pre monsoon (June), monsoon (August), post monsoon (October), sampling will be done for 2 years and different water parameters will be examined. Water samples were collected in different glass bottles. A laboratory testing program was developed to measure water properties and to provide a basis for estimating the values of all the parameters that will be used to perform analyses of the full-scale lateral load tests.

2. Materials and Methods

2.1 Study Area

Study area comprises of Sanganer Tehsil of Jaipur district, Rajasthan, India. Jaipur district, covering geographical area of 11,061.44 sq. km and extending between north latitudes 26°25' and 27°51' and east longitudes 74°55' and 76°15' forms east-central part of the Rajasthan State.

For administrative convenience, the district is divided into 13 tehsils and 13 blocks. Sanganer tehsil is attached with the main Jaipur city. It lies between 26°49'N to 26°51' N latitude and 75°46'E to 75°51' E longitude. It covers an area of 635.5 sq. km. The climate of the area is hot semiarid with extremes of temperature (15-45°C) and rainfall 650 mm (26 inch.). It is widely known for the industry of handmade papers, textile printings as well as for the Jain temples found here. The total population of Sanganer tehsil is 573171 as per census 2011. There are about 142 villages in Sanganer tehsil. In present study various physical and chemical parameters of different villages, Ramsinghpura, Baksawala, Vatika, are analyzed statistically to predict seasonal impact on concentration of various parameters.

2.2 Collection of samples

Groundwater samples were collected for pre monsoon, monsoon and post monsoon period of a year from the Tube well and Hand pump of three different villages of Sanganer Tehsil. Five samples were collected from each site and as per APHA-Standard Methods for Examination of Ground Water Samples

analyses conducted and the mean value calculated. The mean values from each sampling site were recorded as the concentration/value for that particular month. The Fifteen Samples were used to analyze impact of variation of season on all eighteen parameters.

3. Results and Analysis

3.1 Baksawala

Table 1 (a) gives values obtained in the experiments done for water samples in different seasons and its comparison with BIS standards. It is evident from Table 1(a) In the post monsoon season all parameters except nitrate, alkalinity and fluoride concentration are within the permissible limits. Values of parameters analyzed in during monsoon are found to be slightly higher than pre-monsoon season. After monsoon the some values again goes slightly down

Table 1(a). Experimental values of physico-chemical parameters of Baksawala

	Parameters	Premonsoon					monsoon					Postmonsoon				
		S.no, 1	S.no 2	S.no, 3	S.no, 4	S.no, 5	S.no, 1	S.no ,2	S.no, 3	S.no, 4	S.no, 5	S.no, 1	S.no .2	S.no, 3	S.no, 4	S.no, 5
1	pH	7.11	7.38	7.34	7.35	7.38	7.13	8	6.95	8.21	7.1	7	6.7	7	6.9	7.3
2	Hardness	340	236	390	370	348	580	232	620	200	400	372	248	212	240	168
3	Chloride	228.01	114.01	361.02	356.27	342.02	296.26	104.9	383.68	330.25	330.25	243.29	133.9	103.73	216.88	353.61
4	TDS	1033	751	1688	1735	1702	1324	736	1646	1557	1779	641	563	496	836	1000
5	Sulphate	47.22	10	110	140	171.43	120.78	9.44	124.67	87.78	97.78	37.56	21.75	31.5	53.12	84.38
6	Nitrate	96.59	72.98	28.04	118.27	91.57	173.37	82.72	200.54	106.19	160	103.48	68.69	77.61	108.04	99.78
7	Fluoride	0.5	0.38	1.46	1.14	1.51	0.25	0.34	0.19	1.54	0.84	0.2	0.36	0.45	0.81	2.09
8	Alkalinity	291	326	539	592	552	241.8	327.6	336.38	401.7	766.35	313.92	414.2	366.24	518.84	523.2
9	Electrical conductivity	1589	1155	2597	2669	2619	2037	1132	2532	2396	2736	1224	1002	824	1452	1991
10	Salinity	0.8	0.6	1.3	1.4	1.3	1	0.6	1.3	1.2	1.4	0.8	0.7	0.4	1	1.3
11	Temperature	30	30	29	30	29	28	27	28	27	28	28	27	27	27	27

All the values are in mg/l except for pH

Table 1(b) . Permissible limite of physico-chemical parameters as per BIS standards

S. No	Parameters	Permissible limit as per BIS standards
1	pH	6.5-8.5
2	Total Hardness	600
3	TDS	2000
4	Fluoride	1.5
5	Nitrate	100
6	Sulphate	400
7	Calcium	200
8	Alkalinity	600
9	Magnesium	100
10	Chloride	1000

Table 2. Paired t-test results for difference in the physiochemical parameters of pre monsoon , monsoon and post monsoon of Baksawala

S.NO.	Parameters	BAKSAWALA			
		Premonsoon-monsoon		monsoon-post monsoon	
		Value of T	Value of P	Value of T	Value of P
1	pH	-0.62667	0.274169	1.7952	0.055179
2	Hardness	-0.77084	0.231478	1.70829	0.062981
3	Chloride	-0.12922	0.450186	1.20727	0.130904
4	TDS	-0.09662	0.462701	3.40688	0.004633
5	Sulphate	0.21075	0.419176	1.80266	0.054555
6	Nitrate	-2.37464	0.02246	2.29356	0.02549
7	Fluoride	1.05219	0.161728	-0.35195	0.366985
8	Alkalinity	0.40779	0.347062	-0.12459	0.451961
9	Electrical conductivity	-0.09632	0.462818	2.4957	0.018595
10	Salinity	-0.09387	0.463762	1.2597	0.121641
11	Temperature	5.7735	0.000209	1.26491	0.120752

*Significant at 5% level

From the table we can clearly see that the calculated values of paired t-test for conductivity, TDS, nitrate and temperature are significantly higher than the tabulated value at 5% level of significance. This implies that null hypothesis is rejected i.e. there is a significant difference in the pre monsoon , monsoon and post monsoon values of groundwater parameters. Also it is evident from the table

that the calculated values of paired t-test for pH, total hardness, chloride sulphate , alkalinity, salinity and fluoride are less than the tabulated value at 5% level of significance. This result in the acceptance of null hypothesis i.e. there is no significant changes in *pH, total hardness, chloride sulphate , alkalinity, salinity and fluoride* values before and after monsoon.

3.2 Vatika

Table 3. Experimental values of physico-chemical parameters of Vatika Area

S.N O.	Parameters	Premonsoon					monsoon					Postmonsoon				
		S.no ,6	S.no ,7	S.no ,8	S.no ,9	S.no, 10	S.n o,6	S.no ,7	S.no ,8	S.no ,9	S.no, 10	S.n o,6	S.n o,7	S.n o,8	S.n o,9	S.no, 10
1	pH	7.51	7.26	8.14	7.29	7.29	7.76	7.59	7.58	7.5	7.78	6.5	6.7	6.9	6.6	6.7
2	Hardness	192	450	300	544	136	130	280	116	580	360	408	510	276	480	132
3	Chloride	129.21	874.06	940.56	988.06	147.26	111.7	398.25	121.42	825.63	534.23	348.9	801.5	513.9	811	132.02
4	TDS	926	2720	2599	2910	1437	1240	1615	1400	2786	2083	1160	1980	1570	2010	960
5	Sulphate	19.71	77.14	70	98.57	25.14	27.22	84.44	24.8	93.33	68.89	113.1	58.75	42	73.13	22.5
6	Nitrate	46.81	189.4	30.88	248.29	13.72	54.57	36.52	18.11	188.85	99.24	148.3	210.4	87.61	248.3	18.8
7	Fluoride	0.78	1.49	2.4	2.35	2.21	1.24	1.54	1.2	1.28	1.61	1.06	1.81	2.47	1.96	1.83
8	Alkalinity	465	613	561	590	730	705.9	629.85	951.6	585	639.6	688.9	730.3	752.1	784.8	1242.6
9	Electrical conductivity	1425	4185	3999	4477	2211	1907	2485	2154	4286	3205	2147	3905	2515	3980	1585
10	Salinity	0.7	2.2	2.1	2.4	1.1	1	1.3	1.1	2.3	1.7	1.4	2.3	1.6	2.4	1.1
11	Temperature	30	29	29	29	29	27	27	27	27	28	27	27	27	27	27

All the values are in mg/l except for pH

Table 3 indicates experimental values of various physicochemical parameters of water samples of Vatika area in different seasons. From Table 3, it is observed that values of these eleven parameters are higher in post-monsoon season than pre-monsoon season. All the parameters are in permissible limit except pH, TDS, Fluoride, Nitrate, Alkalinity content. In order to test whether there is any significant difference in the parameters of the water samples before and after monsoon, the following null hypothesis was framed: H₀: There is no significant difference in the pre monsoon and post monsoon values. To test the hypothesis paired t- test was applied. The results of the test are given in Table 4. From the table we can

clearly see that the calculated values of t-test pH, temperature, Fluoride are significantly higher than the tabulated value at 5% level of significance. This implies that null hypothesis is rejected i.e. there is a significant difference in the water parameters before and after monsoon. Also it is evident from the table that the calculated values of paired t-test for *total hardness, alkalinity, chloride, sulphate, nitrate, alkalinity, salinity and conductivity* are less than the tabulated value at 5% level of significance. This result in the acceptance of null hypothesis i.e. there is no significant changes in *total hardness, alkalinity, chloride, sulphate, nitrate, alkalinity, salinity and conductivity*.

Table 4. Paired t-test results for difference in the physico-chemical and parameters of pre monsoon and post monsoon of Vatika Area

S.NO.	Parameters	VATIKA			
		Premonsoon-monsoon		monsoon-post monsoon	
		Value of T	Value of P	Value of T	Value of P
1	pH	-0.082108	0.217692	11.19513	0.00001
2	Hardness	0.27231	0.396139	-0.6167	0.277285
3	Chloride	0.91663	0.193068	-0.65692	0.264837
4	TDS	0.60807	0.280002	0.82461	0.216744
5	Sulphate	-0.07741	0.470099	0.10321	0.46017
6	Nitrate	0.46804	0.326121	-1.2311	0.126625
7	Fluoride	1.45772	0.091513	-1.8768	0.048692
8	Alkalinity	-1.41781	0.096999	-1.13506	0.144605
9	Electrical conductivity	0.60847	0.279875	-0.02953	0.488583
10	Salinity	0.53452	0.303756	0.80494	0.222057
11	Temperature	7.07107	0.000052	1	0.173297

3.3 Ramsinghpura Area

Table 5 gives experimental values of eleven physico-chemical parameters obtained from water samples of Ramsinghpura Area. From Table 5, it is observed that all the parameters in pre-monsoon season were found to be within permissible limits except Total hardness, Nitrate, Alkalinity. Concentration of all the parameters is slightly greater in post-monsoon season. To test whether there is any significant difference in the parameters of the water samples

before and after monsoon, the following null hypothesis was framed: H₀: There is no significant difference in the pre monsoon and post monsoon values. To test the hypothesis paired t- test was applied. The results of the test are given in Table 6.

Table 5. Experimental values of physico- chemical parameters of Ramsinghpura Area

S.N O.	Paramet ers	Premonsoon					monsoon					Postmonsoon				
		S.no, 11	S.no, 12	S.no, 13	S.no, 14	S.no, 15	S.no, 11	S.no, 12	S.no, 13	S.no, 14	S.no, 15	S.no, 11	S.no, 12	S.no, 13	S.no, 14	S.no, 15
1	pH	7.24	7.24	7.65	7.14	7.82	7.24	7.45	7.94	6.98	7.82	6.4	6.8	6.3	6.7	6.6
2	Hardnes s	720	600	720	620	580	800	540	104	600	580	810	730	580	670	695
3	Chloride	261.3	223.3	351.5	209	251.8	320.5	242.8	42.74	223.4	251.8	320.61	348.9	212.17	268.75	286.15
4	TDS	1472	1174	1330	1168	1107	1470	1079	234	1168	1107	995	909	750	902	889
5	Sulphate	227.1	118.6	135.7	79.29	187.1	183.1	94.44	20.65	88.89	181.4	138.75	115.63	58.75	148.75	119
6	Nitrate	103.2	91.2	90.47	82.31	72.39	120.3	86.3	2.2	97.93	72.39	125	118.04	121.09	113.91	117.95
7	Fluoride	0.69	0.47	0.25	0.33	0.35	0.19	0.33	0.26	0.28	0.35	0.24	0.27	0.35	0.46	0.35
8	Alkalini ty	500	447	462	450	496	172.6	312	91.65	438.8	496	446.9	414.2	534.1	643.1	536.25
9	Electrica l conductivity	2265	1807	2047	1797	1703	2262	1660	360	1797	1703	1890	1652	1370	1825	1720
10	Salinity	1.2	1	1.1	0.9	0.8	1.2	0.8	0.2	0.9	0.8	1.2	1.1	1	1.2	1.1
11	Temper ature	27	28	27	27	27	28	28	28	28	27	27	27	27	29	27

All the values are in mg/l except for pH

Table 6. Paired t-test results for difference in the physico-chemical parameters of pre monsoon and post monsoon of

		RAMSINGHPURA			
		Premonsoon-monsoon		monsoon-postmonsoon	
S.NO.	Parameters	Value of T	Value of P	Value of T	Value of P
1	pH	-0.30539	0.383932	4.60839	0.000868
2	Hardness	1.04156	0.164033	-1.42999	0.095295
3	Chloride	0.8191	0.218223	-1.36884	0.104124
4	TDS	1.09969	0.151728	0.58314	0.287932
5	Sulphate	0.88883	0.200016	-0.07153	0.472366
6	Nitrate	0.58522	0.287266	-0.19219	0.42619
7	Fluoride	1.66674	0.067063	-1.09383	0.152934
8	Alkalinity	2.17928	0.030466	-2.460667	0.019639
9	Electrical conductivity	1.10042	0.151578	-0.40869	0.346746
10	Salinity	1.24153	0.124787	-2.03918	0.037885
11	Temperature	-2.12132	0.033344	0.89443	0.198602

From the table we can clearly see that the calculated values of Student's t-test for pH, alkalinity, salinity and temperature are significantly higher than the tabulated value at 5% level of significance. This implies that null hypothesis is rejected i.e. there is a significant difference in the parameters of water after monsoon. Also it is evident from the table that the calculated values of paired t-test for *total hardness, TDS, chloride,*

sulphate, nitrate, fluoride and conductivity are less than the tabulated value at 5% level of significance. This result in the acceptance of null hypothesis i.e. there is no significant changes in for *total hardness, TDS, chloride, sulphate, nitrate, fluoride and conductivity*. We test whether there is a significant difference in the three sites using ANOVA model. In order to test the three sites, the following null hypothesis is framed: H₀:

There is no significant difference in the three sites based on the concentration of all eleven parameters. To test the hypothesis one way ANOVA was applied. The results of the test are: From Table 7, we can conclude that there is a significant difference in the concentration of the water parameters in all the three sites as the calculated value of F test is more than the tabulated value

Table 7. Anova tests results

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	218609611.4	10	21860961	169.6198	3.5927E-151	1.850265
Within Groups	62378956.36	484	128882.1			
Total	280988567.8	494				

*Significant at 5% level.

4. Conclusion

The study reveals that groundwater of all the sites is not suitable for drinking & industrial purposes. Technical suitability has been checked by comparing values with BIS Standards. Statistical suitability has been verified using statistical methods like paired t-test methods and ANOVA method. The t-test used for all parameters showed that the calculated t-values of many parameters especially TDS, nitrate and fluoride are more than the tabulated values resulting in rejection of null hypothesis which indicated that there is a significant difference between pre monsoon,

($F_{tab} (10,484) = 1.850265$) which implies that the null hypothesis is rejected i.e. there is a significant difference in the three sites based on concentration of all the water parameters considered in the study.

monsoon and post monsoon values. High concentration of TDS, Alkalinity, fluoride and nitrate in all water samples is due to mixing of various types of salts in post monsoon groundwater samples through infiltration which leads to poor water quality. Moreover, ANOVA method showed that there is a significant difference in the concentration of all eleven parameters in all the three sites under consideration. Hence the results and discussions carried out confirm the chemical and statistical suitability of groundwater of all the three sites Sanganer Tahsil.

5. References

- Thienes, C., and T.J. Haley. (1972): Clinical Toxicology. 5th ed. Philadelphia: Lea and Febiger, pp.169.
- Jacobson, G. and Lau, I.E. (1988): Australia's groundwater systems under stress. Water Quality Bulletin, 13(4): 107-116
- Foster, S.S.D. (1988): Impacts of Urbanisation on groundwater. Proc. Symp. Hydrobiological Processes and Water Management in Urban Areas, Duisburg, FRG, April 24-28, D1-D24.
- EDBERG "Enumeration of Total Coliforms and Escherichia coli from Source Water by the Defined Substrate Technology" APPLIED AND ENVIRONMENTAL MICROBIOLOGY, 366-369, 1990.
- ANNE K. CAMPER "Growth Kinetics of Coliform Bacteria under Conditions Relevant to Drinking Water Distribution Systems" APPLIED AND ENVIRONMENTAL MICROBIOLOGY, 2233-2239, 1991
- Kataria, H.C. (1996): BOD and COD contents in bore-well water of Bhopal (M.P). J. Nature Conserv. 8(1): 69-72.
- K. Staubmann "Correlation of microbiological water quality parameters with chemical-physical and meteorological data at a karstic spring used as a source for drinking water supply" 441-444, 2002
- UNEP GEMS/Water Programme. (2005): Workshop report: Development and use of global water quality indicators and indices. Vienna, Austria 4-6th May 2005.
- Gallardo "Modeling the dynamics of the freshwater-saltwater interface in response to construction activities at a coastal site" Int. J. Environ. Sci. Tech, 285-294, 2007
- Olaitan "Physico-Chemical and Bacteriological Analyses of Water Used for Drinking and Swimming Purposes in Abeokuta, Nigeria" African Journal of Biomedical Research, 285 - 290, 2008
- Amusa T.S "Physico-Chemical and Bacteriological Analyses of Water Used for Drinking and Swimming Purposes in Abeokuta, Nigeria" African Journal of Biomedical Research, 285 -290, 2008
- Charmaine Jerome "Evaluation of water quality index and its impact on the quality of life in an industrial area in Bangalore, South India", 595- 603, 2010
- Olusegun Peter Abiola "Lead and coliform contaminants in potable groundwater sources in Ibadan, South-West Nigeria" Journal of Environmental Chemistry and Ecotoxicology Vol. 2(5), pp. 79-83, June 2010
- CHIN YIK LIN "Assessment of Selected Chemical and Microbial Parameters in Groundwater of Pulau Tiga, Sabah, Malaysia" 337-345, 2010