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Water Quality Index due to Heavy Metal Concentration in Underground Water At Janjghir Champa Region in Chattisgarh

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Abstract

The current study is about water quality parameters of Janjghir Champa district of Chattisgarh. This study is intended to estimate water quality Index (WQI) of study area using Weighted Arithmetic water quality index method. In this study the quality of water of study area is determined using the various physico - chemical parameters such as pH , Total Dissolved Solids (TDS), Cl , SO4 , Na, K, Ca, Mg, and Total Hardness (TH). Physico - Chemical analysis of water samples was carried out at one hundred and ninety different stations of study area for pre monsoon and post monsoon seasons of 2020 which is collected and analyzed out of which nineteen samples were selected and water quality index estimated. Out of one hundred samples ten prime locations (wherein physiochemical property values were maximum) were selected and the quality index was analysed and explained in this paper. This study is to investigate the suitability of water for drinking purpose based on Water quality Index (WQI) estimated. Keywords : Water quality index (WQI) , sulphate (SO4), Sodium(Na), Potassium(K), Calcium(Ca), Magnesium(Mg), and Total Hardness (TH). Physico - Chemical parameters.

Key words: Crystalline silica, filler, rheology, fine aggregate.

Introduction

"Water" the term is more important and one of the needs of human being to survive on this global village. Most part of this global village is covered by water ,that is 2/3rd's of area. Quality of ground water present in the current study area that is vijayawada, Krishna District , Andhra Pradesh is estimated. The quality of such water is estimated using four different methods present till now in this globe are National Sanitation Foundation Water Quality Index (NSFWQI), Canadian Council of Ministries of the Environment Water Quality Index(CCMEWQI), Oregon Water Quality Index(OWQI) and Weighted Arithmetic Water Quality Index Method(WAWQI).The present study is estimation of water quality index using weighted arithmetic water quality index method. In this study the reason for choosing the WAWQI method since it has edge over other methods such as in this method multiple water quality parameters are incorporated in to a mathematical equation that rates health of water body through a number called water quality index as well as it describes the suitability of surface and ground water sources for human consumption.

Study Area

India is a one of the biggest country in the world, and Chhattisgarh is a one of the most popular and biggest state in India. Our study area is belonging with Chhattisgarh say it's one district Janjgir Chappa. We select its ten villages and take samples in this villages.

INDIA

CHHATTISGARH

Data Collection

Water samples are collected randomly from different locations of Janjgir Champa. Nearly one hundred and ninety samples were collected for pre-monsoon (April May 2020) and one hundred and ninety samples were collected for post- monsoon for the year 2020. For all those three hundred and eighty samples the physio chemical properties of that collected water samples were analyzed and reported. Out of those three hundred and eighty samples only thirty eight that is nineteen samples for pre monsoon and nineteen samples for post monsoon (September October) for the year 2020 were considered for the water quality index for those areas or locations. The locations preferred among those thirty eight samples were having high physio chemical properties. The water samples were collected in Glass bottles which were pre-cleaned by nitric acid and distilled water in the laboratory. The pre-cleaned Glass bottles were also washed twice by water sample prior to collect the samples and after taking samples we put the bottles in air tight container (thermocol boxes) after taking its temperature because of its we maintain its natural temperature. The water samples were immediately taken to the laboratory and analyzed to minimize the physicochemical and other changes.

Table – 1 Details of Pre monsoon 2020 sampling Locations and Location ID

S.No.	Sample Site	Sample ID	Latitude	Longitude
1	Janjgir	GWS1	21.9706°	82.4753°
2	khokhra	GWS2	21.9688°	82.5673°
3	Mahant	GWS3	21.9105°	82.5889°
4	Budena	GWS4	21.903°	82.6186°
5	Banari	GWS5	22.0073°	82.5335°
6	kapan	GWS6	22.0253°	82.4895°
7	Gand	GWS7	21.9609°	82.6537°
8	Hathewra	GWS8	21.9902°	82.6794°
9	Champa	GWS9	22.03°	82.6515°
10	Seoni	GWS10	22.07528°	79.54573°

CALCULATION OF WATER QUALITY INDEX (WQI)

3.1. Methodology in Calculating WQI Using WAWQI Method

Step 1: Collect data of various physico- chemical water quality parameters.

Step 2: Calculate Proportionality constant " K " value using formula

$$K = \left(\frac{1}{\sum_{i=1}^{n} s_i}\right)$$

where "s_i" is standard permissible for n^{th} parameter.

Step 3: calculate quality rating for nth parameter (q_n) where there are n parameters . This is calculated using formula

$$q_n = 100 \left\{\frac{(v_n - v_{io})}{s_n - v_{io}}\right\}.$$

where as v_n = Estimated value of the n^{th} parameter of the given sampling station. v_{io} = Ideal value of nth parameter in pure water. and s_n = Standard permissible value of the n^{th} pareameter.

Step 4: Calculate unit weight for the nth parameters.

$$W_n = \left(\frac{k}{s_n}\right).$$

Step 5: Calculate Water Quality Index (WQI) using formula ,

$$WQI = \left(\frac{\Sigma w_n * q_n}{\Sigma w_n}\right).$$

Water Quality Index Level	Water Quality Status
0 -25	Excellent Water Quality
26-50	Good Water Quality
51-75	Poor Water Quality
76-100	Very Poor Water Quality
>100	Unsuitable for drinking

Table – 2 Water Quality Index (WQI) and Status of water quality (Chatterji and Raziuddin,2002)

Physico-Chemical Analysis

Physico-chemical parameters like pH, turbidity, temperature, electrical conductivity, alkalinity, total hardness, calcium hardness, magnesium hardness and heavy metals like Lead and Cadmium were determined by adopting standard methods of APHA (1995) and dthe methods by Trivedi and Goel (1986). The reagents of analytical grade were used for analysis and the instruments were calibrated.

Parameters	pH		EC		TDS		TH	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST
GWS1	7.756	7.630	1217.108	951.383	727.775	1217.994	279.0231	429.4012
GWS2	7.493	7.810	924.381	1061.689	693.581	961.9676	303.0223	413.1975
GWS3	7.548	7.725	1006.909	1131.972	695.034	1116.267	246.784	431.9319
GWS4	7.119	7.782	580.934	1241.432	664.280	1258.762	315.6461	400.5508
GWS5	7.639	7.697	706.131	1238.771	673.646	1085.576	249.3186	372.5181
GWS6	7.596	7.991	573.544	1140.453	701.147	1337.938	257.3209	441.7502
GWS7	7.219	7.809	1146.390	1127.223	869.384	1036.369	344.4392	406.4864
GWS8	7.454	7.835	770.631	1405.687	716.153	933.9998	243.2135	378.3228
GWS9	7.227	8.012	606.815	936.994	697.248	1279.23	286.5485	361.0309
GWS10	7.781	7.920	996.786	1305.176	833.402	988.591	241.7473	290.1545
WHO STANDERD	6.5--8.5		1500		500		500	

Table-3 Physico chemical characteristics of ground water

Parameters	Calcium		Magnesium		Potassium		Bicarbonate		Chloride	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
GWS1	276.6459	403.693	169.787	213.3326	27.05741	31.18845	485.0251	555.2073	163.7756	195.7865
GWS2	226.2419	374.706	186.5356	233.8319	29.28283	37.24914	515.8613	527.158	167.8435	211.8867
GWS3	231.0128	444.2489	178.4753	182.296	27.97157	37.105	564.03	591.3355	158.882	183.5682
GWS4	226.4609	334.1874	172.6541	235.8413	31.03914	37.15727	556.3048	557.8181	168.2807	177.7535
GWS5	215.3555	355.9013	172.9825	215.9602	24.98549	30.71836	529.5287	560.8398	170.7909	172.0465
GWS6	314.7608	428.1623	173.2073	215.9676	31.32793	33.18571	521.0443	535.0789	161.2999	173.8649
GWS7	223.5032	312.1651	185.1308	224.1784	27.52091	31.38703	502.4576	536.4964	154.9905	174.9874
GWS8	275.8734	382.4601	188.046	216.6611	27.91364	33.20407	543.2095	566.294	155.8952	207.3399
GWS9	307.4172	385.394	187.4154	188.1375	32.1395	38.72003	550.9389	584.4399	158.4173	211.209
GWS10	263.7332	426.247	177.7902	237.3567	25.02828	29.41944	534.6205	529.7708	160.6476	182.773
WHO STANDERD	75		50		12		300		250	

Table-4(A) Chemical characteristics in (mg/l) of ground water.

Parameters	Nitrate		Iron		Cadmium		Chromium		Salfate	
	PRE	POST	PRE	POST	PRE	POST	PRE	POST	PRE	POST
GWS1	47.70016	50.04117	3.759635	4.437414	0.002197	0.003381	0.056506	0.067571	398.4636	413.1908
GWS2	44.05498	51.9012	3.447415	3.607379	0.002491	0.004322	0.055776	0.078276	397.916	515.7646
GWS3	47.69048	54.25337	2.767249	4.206171	0.002191	0.00484	0.050786	0.078155	409.519	514.1661
GWS4	46.43759	51.83211	2.854091	4.694643	0.002539	0.004944	0.05422	0.06463	402.5606	462.7008
GWS5	46.24888	51.18711	3.644687	4.216417	0.002924	0.003001	0.052452	0.075073	396.7214	482.87
GWS6	44.92811	49.1973	2.918283	4.132455	0.002982	0.004299	0.05211	0.062537	406.8462	489.0189
GWS7	43.72449	50.70952	2.34872	3.541302	0.002365	0.004335	0.052466	0.064268	407.2703	430.3119
GWS8	44.15105	50.37684	3.533505	4.240692	0.002561	0.004845	0.057395	0.064976	403.8919	423.728
GWS9	46.60631	49.31402	2.820476	4.951068	0.00235	0.00338	0.0508	0.066303	396.4775	411.0628
GWS10	43.10998	52.26627	3.5328	4.749977	0.002318	0.004881	0.057192	0.079867	402.2635	454.1457
WHO STANDERD	45		1.5		0.01		0.05		250	

Table-4(B) Chemical characteristics in (mg/l) of ground water.

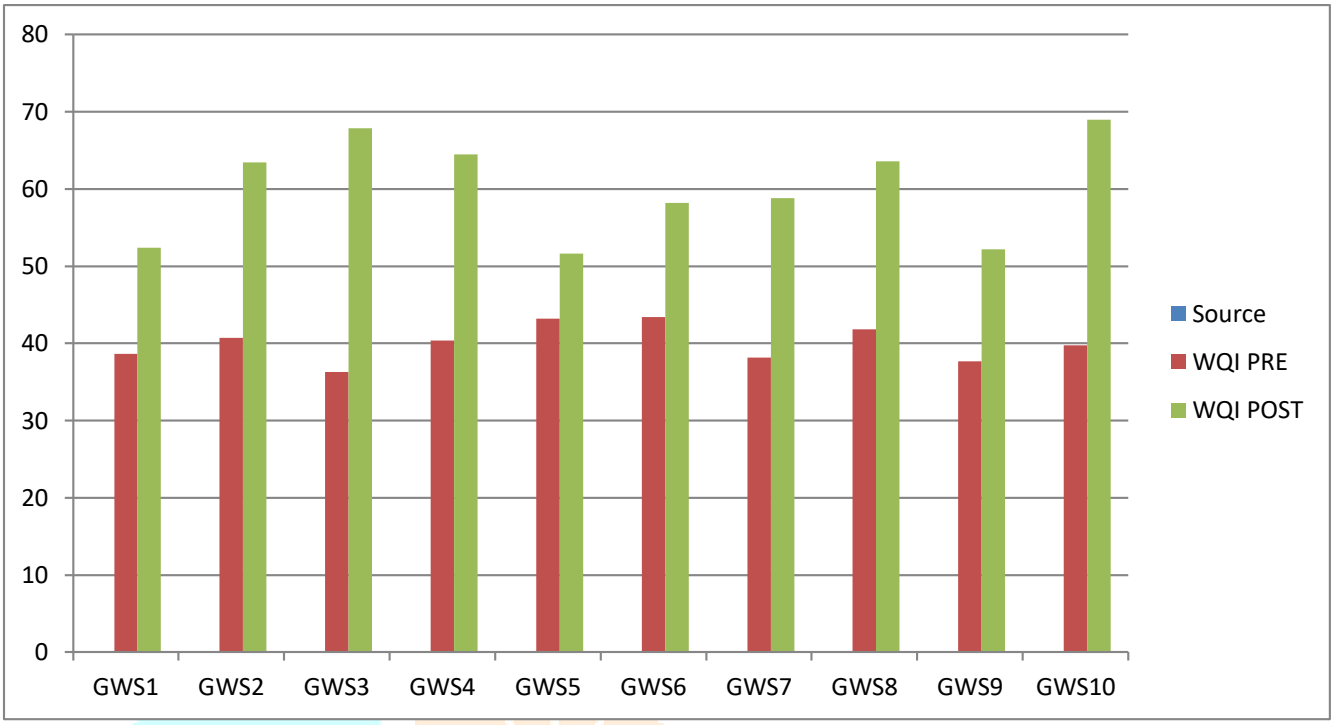
By using method providing in section 3 of this paper calculate the WQI as follows

WQI Calculation		
Source	WQI	
	PRE	POST
GWS1	38.62	52.3806
GWS2	40.7029	63.438
GWS3	36.3155	67.8949
GWS4	40.3667	64.4628
GWS5	43.2257	51.6333
GWS6	43.3741	58.2164
GWS7	38.1512	58.841
GWS8	41.8466	63.5701
GWS9	37.6847	52.1779
GWS10	39.754	68.9713

Table – 5 Calculation of Water Quality Index for Pre and Post monsoon 2020 data

RESULTS AND DISCUSSIONS

The ground water quality of present study area that is Janjghir champa district , Chhatisgarh is calculated or estimated using different physico and chemical parameters such as pH**,** Total Dissolved Solids (TDS), Cl , SO4 , Na, K, Ca, Mg, and Total Hardness (TH) at nineteen different stations of study area. The data collected regarding physicochemical parameters is during pre-monsoon 2014 and post - monsoon of 2020. Water quality index values depicted through the Weighted arithmetic water quality index method were shown in table number 5. Graph 1 the pictorial depiction clearly explains that the pre monsoon 2020 values are much suitable for drinking purpose in most of the stations where samples are collected.The pollution after monsoon is more than that of pre monsoon in current study area during the year 2020.



Graph – 1 Comparison between Pre and Post monsoon WOI

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