



ASSESSMENT OF PHYSICO-CHEMICAL STATUS OF GROUND WATER TAKEN FROM FOUR BLOCKS (SUAR, MILAK, BILASPUR, SHAHABAD) OF RAMPUR DISTRICT, UTTAR PRADESH, INDIA

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ABSTRACT

The ground water quality is determined in four blocks (Suar, Milak, Bilaspur, Shahabad), that lies in district Rampur of Uttar Pradesh, where from each block fifteen villages are under studied from assessment of Physico-chemical status of ground water. One sample from each village is under assessment of Physico-chemical solution and various quality parameter are measured including pH, electrical conductivity (EC), total dissolved solids (TDS), total hardness (TH), content of calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), bicarbonate (HCO_3^-), chloride (Cl^-) and sulphate (SO_4^{2-}) concentration present in water. A systematic calculation of correlation is performed among these parameters. The chemical analysis of water samples show considerable variations and also most of the samples do not comply with WHO standards for the parameter measured. Overall the water quality is found to be not suitable for drinking purposes with any prior treatment except at eight locations out of sixty village's samples

Keywords: Ground water, water quality, correlation coefficient, Rampur District (Suar, Milak, Bilaspur, Shahabad)

INTRODUCTION

Water plays a vital role in human life. The consequences of urbanization and industrialization leads to spoil the water for agricultural purposes ground water is explored in rural especially in those areas where other sources of water like dam and river or a canal is not considerable. During last decade, this is observed that ground water get polluted drastically because of increased human activities^{1,2}. Consequently number of cases of water borne diseases has been seen which a cause of health hazards³⁻⁵. An understanding of water chemistry is the bases of the knowledge of the multidimensional aspect of aquatic environmental chemistry which involves the source, composition, reactions and transportation of water. The quality of water is of vital concern for the mankind since it is directly linked with human welfare. It is a matter of history that facial pollution of drinking water caused water-borne diseases which wiped out entire population of the studied area. The present work is an attempt to measure the water quality of various water sources of four blocks of Rampur district, Uttar Pradesh, India.

EXPREMENTAL

Study Area

The area under studied four blocks (Suar, Milak, Bilaspur, Shahabad) lies Rampur District and it is located between longitudes 78-0-54 to 69-0-28 East and latitude 28-25 to 29-10 North, and on coordinate it is lies 28.8⁰N 79.0⁰E. It is cover 2,367 km² area. It has an average elevation of 288 meters (968ft)⁷ Fig.(1,2,3). The study was undertaken in four blocks (Suar, Milak, Bilaspur, Shahabad) in 15 villages of each block of Rampur district. These villages are occupied by people who work mainly in agricultural and some government jobs in the nearest places. The population of these villages is not known actually. The ground water is considered as the source of drinking water, in addition of agricultural and home uses where there is no surface water at all. The water is extracted from hand dug wells and also transported by private

water tanker through out the four blocks of these villages. The precipitation which is the sole source of ground water recharge in the study area is very low due to average rainfall. The water table in the study area is found to vary from 3.2m to 12.86m and the aquifer is unconfined.



Fig.-1:Location of Uttar Pradesh in India



Fig.-2;Location of Rampur in Uttar Pradesh

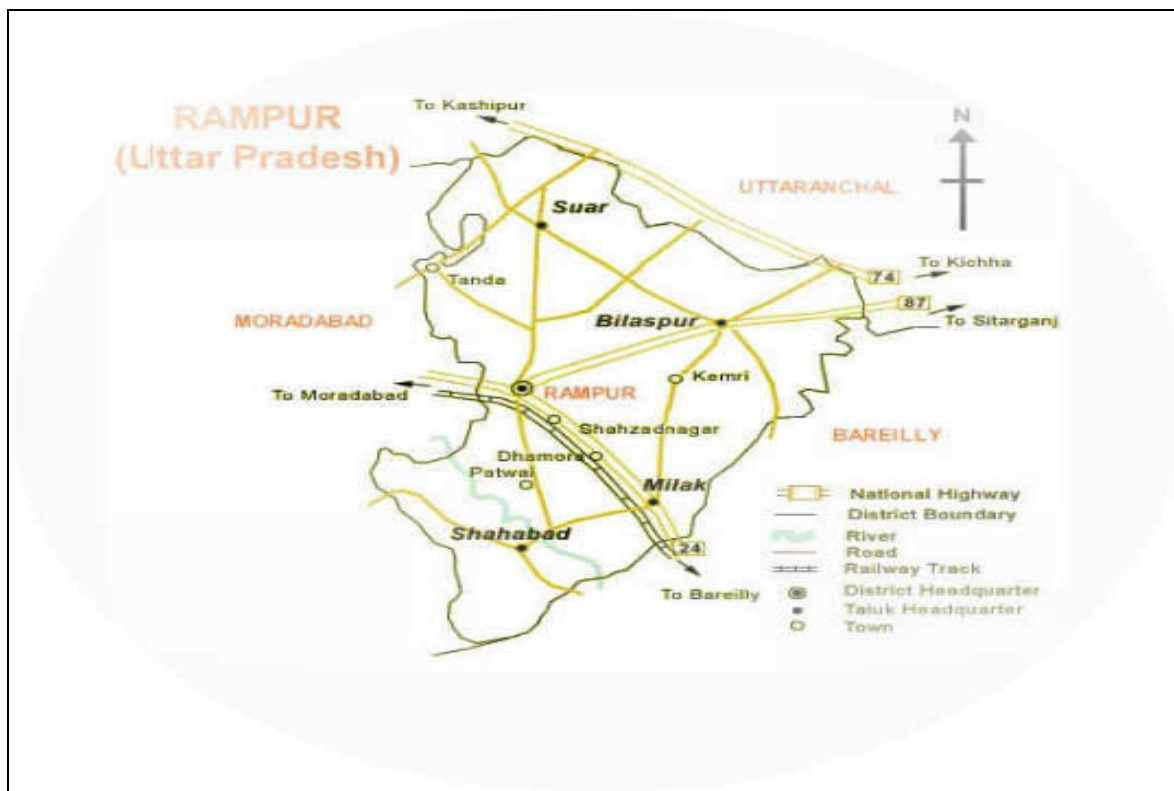


Fig.-3: Map of Rampur (Suar, Milak, Bilaspur, Shahabad)

Water Sampling

A total of 60 ground water samples are collected one each for 15 villages, in four blocks (Suar, Milak, Bilaspur, Shahabad). The samples are collected in clean polyethylene bottles and prior to collection, the samples are rinsed thoroughly with sample water⁸. The samples are analyzed for Ca^{2+} , Mg^{2+} , Na^+ , K^+ , bicarbonate, chloride and sulphate. The water samples are taken through pumping so the samples will be a representative and order to avoid only contamination from the surface⁹.

3. Methodology: - The pH and electrical conductivity (EC) are measured for each sample at well head during field study to these areas. So the pH is measured using pH-Meter Model E- 588 While EC is determined using EC -Meter Model LF 91. The TDS is calculated using a formula from the United States Salinity Laboratory, 1954¹⁰. The Chemical analysis samples are carried out at faculty of chemistry, Govt. Raza (P.G) College, Rampur (U.P.), where sodium and potassium are analyzed using a Flame Photometer, the calcium and magnesium are determined with EDTA, while the titration with mercury nitrated are used to determine chloride. Sulphate was determined nephelometrically using ELICO CL-52 Nephelometer¹¹. For bicarbonate, a titration with 0.01N sulphuric acid is used. Finally, a turbidity method is explored for the surface analysis some statistical analysis are done using Statistical Package for Social Sciences (SPSS).

RESULTS AND DISCUSSIONS

The ground water from the study areas had no color, odor and turbidity. Taste of the water showed some brackish water at most of the locations. The results of the chemical analysis of ground from these blocks are present in (Table 1-4) so, it is necessary to make a comparison of ground water quality of the study areas with drinking water standards (WHO) and these are presented in Table 5. The data of the chemical results showing consider variation which reflects their chemical composition. The pH of ground water in their area ranges from 7.14 to 8.50 these values (Table 1, 2, 3,4) reveals that samples lie with the permissible range of 6.5-9.2¹². The EC of the water samples shows a wide variation in all the villages in

the four blocks. According to Salinity classification by Rabinove et al.¹³ groundwater was non saline at 9 locations, slightly saline 24 locations and moderately saline at 27 locations (Table 6). According to Durfor and Backer¹⁴ classification of total hardness. Water was very hard at all the locations. The calcium and TA content was beyond acceptable limits. Carbonate was either absent or present in negligible amounts. Chloride concentration ranged from 1.7 to 2048 mg/l. Expect at 15 locations, the chloride content was higher than the WHO acceptable limits. Sulphate concentration varied from 34 to 3108mg/l and found to be in acceptable limits in nine locations. Bicarbonate ranged from 144 to 1070mg/l in these blocks villages. Expect at fourteen locations, sodium was higher than the WHO acceptable limits of 200 mg/l. Lower concentration of calcium compared to sodium indicated the absence of readily soluble calcium minerals or the action of base exchanged by sodium¹⁵. The statistical analysis (Table 8) showed that the EC has a positive and significant correlation with TDS, TH, Ca²⁺, Na⁺, So₄²⁻, and Mg²⁺. TH was positively and significantly correlated with Ca²⁺, Mg²⁺, So₄²⁻, and Cl⁻. The regression equations among the significantly correlated parameters are given in Table 9.

CONCLUSION

This study shows that ground water is the only source for people in the study area, and the results of the chemical analyses of ground water indicate considerable variation. Most of the water samples do not comply with WHO standards for drinking purpose. The water quality in the investigated area is found to be suitable for drinking only an eight locations, while as out prior treatments. It must be noted that a regular chemical analysis must be done to insure that the quality of water in this area is not contaminated, in addition to research for new wells in the area in order to get additional water for the resident people.

Table-1: Physico-chemical properties of ground water at Suar block

Village's Name	pH	EC	TDS	TH	TA	Ca ²⁺	Mg ²⁺	Na ⁺	K ⁺	CO ₃ ²⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻
Rajpura Tanda	7.66	4.1	2624	356	736	66	46	576	4	2	897	426	580
Ahamdasadurf Telipura	7.99	3.01	1926	312	777	48	46	456	4	75	796	185	267
Chaukhandi	7.64	3.78	2419	309	767	61	38	504	8	21	885	236	540
Jamal Gang	7.55	3.51	2246	577	616	65	100	456	7	2	752	298	570
Suraj Pur	8.48	3.91	2502	220	710	49	24	504	4	56	752	253	400
Ahmmad Nager	7.58	5.73	3667	848	554	90	151	636	9	2	676	787	960
Loharri Landa	7.62	6.01	3846	594	689	88	91	684	7	2	841	744	980
Bhati Khera	7.85	7.74	4954	373	596	52	59	188	5	81	562	270	170
Shamsabad khabania	8.33	3.76	2406	366	580	53	56	528	5	75	556	364	690
Khandi Khera	7.68	3.32	2125	165	793	56	30	468	5	31	904	224	567
Kundesera	7.34	4.75	3040	906	694	83	169	516	9	2	847	639	560
Parratpur	7.54	4.21	2694	488	663	74	73	528	10	2	809	440	698
Kundeser	7.66	4.32	2765	343	767	67	43	540	6	31	872	386	980
Lodipur Nayak	7.90	7.37	4717	1265	4627	106	243	732	10	68	549	1210	1000
Hassan Pur N Ath	7.73	3.01	1926	227	767	51	24	504	3	0	935	224	280

All the values are in mg/l, except pH and EC, unit of EC are $\mu\text{s}/\text{cm}$.

Table-2:Physico-chemical properties of ground water at Milak block

Village's Name	pH	EC	TDS	TH	TA	Ca ²⁺	Mg ²⁺	Na ⁺	K ⁺	CO ₃ ²⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻
Chakia Hayat Nager	7.61	7.32	4685	512	696	90	70	648	12	34	780	863	940
Mohamm adpur Qadim	7.32	4.76	3046	448	714	70	66	528	4	2	872	412	500
Sahu Nagla	8.05	6.30	4032	448	832	75	63	660	8	73	866	582	860
Shadi Nager	7.26	11.56	7066	1079	578	182	154	1164	72	2	705	1406	2640
Katra	8.26	6.49	4154	576	879	77	7	780	1	85	900	693	660
Barakhan	8.44	6.42	4109	828	592	88	148	720	12	11	700	826	1520
Harji Pur	7.78	6.18	3955	454	766	85	59	744	22	73	786	738	780
Mirzapur Chakarpu r	7.83	5.05	3232	441	630	80	58	612	6	68	631	588	1140
Patna	7.93	0.77	493	110	124	15	18	22	1	0	144	17	52
Milak Mohd.Box	7.14	7.82	5005	848	776	104	142	720	12	68	808	1003	680
Nagli Bhagwan t	7.68	2.34	1498	173	639	43	16	420	6	79	619	222	140
Suhag Nagla	7.34	1.78	965	332	531	43	55	120	1	90	464	74	240
Jangu nagar	8.00	5.59	3578	807	550	87	143	424	10	62	845	736	998
Kaga Nager	7.64	3.40	2176	587	790	57	108	772	56	68	826	284	420
Ganga Pur Kadim	7.91	4.50	2880	238	644	65	19	636	7	66	671	443	840

All the Values are in mg/l, expect pH and EC, unit of EC are $\mu\text{s/cm}$.

Table-3:Physico-chemical properties of ground water at Bilaspur block

Village's Name	pH	EC	TDS	TH	TA	Ca ²⁺	Mg ²⁺	Na ⁺	K ⁺	CO ₃ ²⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻
Ahraula	8.41	2.32	1299	334	834	45	45	140	1	56	905	31	156
Bhogpur	7.82	3.76	2547	370	1032	65	53	475	8	93	1070	271	488
Chandpur	8.05	3.30	3874	322	775	89	9	567	4	56	828	345	701
Dalki	7.86	6.04	2663	176	826	73	27	710	6	146	1011	602	1160
Gada	7.26	4.49	3458	258	788	32	8	601	4	84	859	349	605
Hamidabad	7.74	5.42	800	200	550	72	13	550	6	67	823	614	639
Inderpur	8.08	1.18	2495	116	908	93	18	104	1	68	537	1.7	70
Jamnupur	8.03	3.85	4769	254	955	63	46	576	3	82	942	356	622
Ishwerpur	7.93	7.45	1889	422	784	37	20	840	6	138	885	835	580
Mankara	7.54	2.82	1285	267	730	31	32	496	4	2	955	210	480
Pajawa	8.50	2.00	998	113	634	42	24	130	166	56	778	28	260

Qadri Ganj	8.34	1.68	1296	176	779	43	22	118	1	82	609	18	80
Salehpur	7.90	2.09	1286	194	550	87	21	190	3	81	804	99	240
Talmahawar	7.94	2.40	959	215	730	57	29	180	4	37	815	118	250
Umri	7.76	6.70	1446	376	604	65	39	720	4	62	608	809	880

All the Values are in mg/l, expect pH and EC, unit of EC are $\mu\text{s/cm}$.

Table-4: Physico-chemical properties of ground water at Shahabad block

Village's Name	pH	EC	TDS	TH	TA	Ca ²⁺	Mg ²⁺	Na ⁺	K ⁺	CO ₃ ²⁻	HCO ₃ ⁻	Cl ⁻	SO ₄ ²⁻
Tejpur Lakhani	7.31	9.59	6138	1357	855	158	233	888	24	90	860	1480	1500
Chhitauni	7.93	1.27	813	134	400	35	35	98	03	62	361	62	79
Saddiq Nager	7.46	7.87	5037	319	630	102	15	912	03	56	654	1218	660
Karan Pur	8.24	1.96	986	173	362	36	20	141	02	62	315	176	170
Lahtaura	7.70	8.51	5446	800	719	112	126	840	12	107	659	1281	1820
Sarai Mahesh	8.37	0.67	424	109	193	11	29	21	02	28	144	26	34
Dariyapur	7.85	5.76	3686	234	743	86	6	570	07	2	906	719	830
Tejpur	7.88	7.05	4512	539	672	97	72	828	06	45	728	892	1440
Saifini	8.12	3.44	2202	238	494	56	24	984	03	56	487	324	540
Madhupuri	7.30	13.56	8662	1540	855	220	306	1244	33	73	895	2048	3108
Tejpur Behta	7.96	5.40	3456	373	710	79	43	648	05	68	728	608	780
Bisauli	8.43	1.98	1267	197	353	37	25	102	02	45	338	122	230
Bal Pura	8.04	1.52	973	217	376	33	33	92	03	39	378	60	200
Jat Pura	7.68	5.77	3693	454	597	75	65	612	06	51	625	704	730
Chandpur kalan	8.10	2.03	1299	200	432	43	23	171	02	51	424	185	280

All the values are in mg/l; expect pH and EC, unit of EC are $\mu\text{s/cm}$.

Table-5: Comparison of ground water quality at the study areas with drinking water standards (WHO.1993)

Parameters	Values from collected samples			WHO
	Minimum	Maximum	Mean	
pH	7.14	8.50	7.85	6.5-9.2
EC	0.66	13.53	4.67	-
TDS	424	8662	2987	500
TH	110	1540	445	500
TA	124	4627	741	-
Ca ₂ ⁺	11	200	68	75
Mg ²⁺	6	306	72	150
Na ⁺	21	1244	518	200
K ⁺	1	166	11	200
CO ₃ ²⁻	2	146	52	200
HCO ₃ ⁻	144	1070	720	-
Cl ⁻	1.7	2048	498	500
SO ₄ ²⁻	34	3108	688	-

All the values are in mg/l, expect pH and EC, unit of are $\mu\text{s/cm}$.

Table-6: Classification of the water samples in the study area on the basis of TDS

Sample No.	Classification of Ground water	Total Dissolved solid (mg/l)	No. of Samples
1	Non-saline	<1000	9
2	Slightly saline	1000-3000	24
3	Moderately saline	3000-10,000	27
4	Very saline	>10000	-

Table-7: Classification of the water samples in the study area on the basis of TH

Sample no.	Description	Hardness(Mg/l)	No. of Samples
1	Soft	0-60	-
2	Moderately hard	61-120	4
3	Hard	121-180	6
4	Very hard	>180	50

Table-8: Correlation matrix for different water quality parameters

	Ph	EC	TDS	TH	Ca ²⁺	Mg ²⁺	Na ⁺	K ⁺	Hco ₃ ⁻	Cl ⁻	So ₄ ²⁻	
pH	1.0	-0.4697	-0.5004	-0.0502	-0.569	-0.446	-0.4198	0.0326	-0.3033	-0.4669	-0.3894	
EC		1.0	0.7755	0.2606	0.9417	0.6601	0.8589	0.1568	0.3726	0.9503	0.8562	
TDS			1.0	0.2626	0.9417	0.6601	0.8589	0.1568	0.3725	0.9503	0.8562	
TH				1.0	0.4016	0.8442	0.6336	0.5925	0.2384	0.8191	0.7690	
TA					1.0	0.2588	0.4213	0.2472	0.2002	0.3042	0.1601	
Ca ²⁺						1.0	0.7273	0.2155	0.4068	0.9526	0.9221	
Mg ²⁺							1.0	0.5378	0.1509	0.7123	0.6596	
Na ⁺								1.0	0.4684	0.8567	0.8095	
K ⁺									1.0	0.1253	0.2354	
HCO ₃										1.0	0.3029	
Cl ⁻											1.0	
So ₄ ²⁻												1.0

Table-9: Least square of the relation (X=A+BY) among significantly correlated parameters

X(dependent)	y(independent)	Correlation	A	b
EC	TH	0.7755	1.905	0.0064
EC	Ca ²⁺	0.9417	-0.313	0.0708
EC	Na ⁺	0.8589	0.55	0.0079
EC	Cl ⁻	0.9503	1.77	0.0058

EC	SO ₄ ²⁻	0.8562	1.98	0.0039
TH	TDS	0.7755	-3.15	0.147
TDS	Ca ²⁺	0.9417	-200.5	45.35
TDS	Na ⁺	0.8589	353.88	5.08
TDS	Cl ⁻	0.9503	1133.99	3.72
TDS	SO ₄ ²⁻	0.8562	1270.65	2.496
TH	Ca ²⁺	0.8442	-103.76	7.65
TH	Mg ²⁺	0.9819	110.514	5.182
TH	Cl ⁻	0.8191	130.85	0.608
TH	SO ₄ ²⁻	0.7690	145.146	0.421
Ca ²⁺	Mg ²⁺	0.7273	44.229	0.4234
Ca ²⁺	Na ⁺	0.8689	14.966	0.1068
Ca ²⁺	Cl ⁻	0.9526	31.566	0.077
Ca ²⁺	SO ₄ ²⁻	0.9221	31.66	0.0558
Mg ²⁺	Cl ⁻	0.7123	12.698	0.1003
Na ⁺	Cl ⁻	0.8567	235.65	0.566
Na ⁺	SO ₄ ²⁻	0.8095	243.7	0.398
Cl ⁻	SO ₄ ²⁻	0.8785	48.196	0.654

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