Biospectra : ISSN: 0973-7057, Vol. 17(2), September, 2022, pp. 111-116
An International Biannual Refereed Journal of Life Sciences

21(AS).
Animal Science

ISSN : 0973-7057

Int. Database Index: 616 www.mjl.clarivate.com

Assessment of physical, chemical and heavy metal contamination in ground water of Madhepura, Bihar

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Received : 3rd June, 2022 ; Revised : 4th July, 2022

Abstract- There are many links between water quality and chronic diseases. People's health and the social and economic growth of a country can be affected by the quality of the water they drink. Because of this, it is essential to look at water's physical and chemical quality. For example, it would be possible to find out how much heavy metal is in water sources. To learn about groundwater pollution in this area, groundwater samples from different places were tested for pH, conductivity, alkalinity, TDS, total hardness, calcium, chloride, magnesium, and fluoride. Samples of water were also tested for heavy metals. Different tube wells were used to get samples.

Key words: Ground water, physic-chemical parameters, Madhepura.

INTRODUCTION

Both urban and rural communities in India rely heavily on ground water as their primary source of potable water, making it an essential resource. Since the beginning of human history, people all over the world have used water from the ground as a source of drinking water, and even now, more than half of the world's population relies on ground water for their existence.[1] The value of ground water is not only based on the fact that it is abundantly present and accessible, but also on the fact that it maintains a consistently high quality, which makes it an excellent option for a source of drinking water. The constituents of the soil, rocks, and plants that are immediately in touch with ground water are potential contaminants since ground water is in direct contact with these sources. Studies on ground water must pay particular attention to the evaluation of water quality as one of their top priorities.[2] The Madhepura District is home to a significant amount of agricultural output, although the majority of the region's water requirements, including those for irrigation and drinking, are met by groundwater. Due to the fact that the pace of underground water withdrawal is larger than the rate of recharging, the water levels in aquifers are decreasing at an alarming rate. As a result, this region has begun to face a significant dilemma regarding the availability of safe drinking water. Because of this, it is essential to perform routine checks on the quality of the water at regular intervals.

In this study, an effort was made to evaluate the quality of groundwater based on physicochemical criteria in order to assess a variety of water quality parameters. This evaluation was carried out as part of this study. The research was carried out over three different sections of the district.

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In addition, contamination of the aquatic environment by heavy metals has caught the attention of people all over the world due to the abundance, permanence, and environmental toxicity of these contaminants.[3,4] The purpose of this study is to make an attempt to analyse the quality of the water as well as the concentration of trace elements that can be found in the ground water in the study area.

Following the completion of the project, an analysis of the water quality will reveal whether or not the ground water in the area under investigation is chemically acceptable for drinking purposes.

MATERIALS & METHODS

Study Area

The Study was conducted by taking samples from Borewell of following villages of the district.

District	Block	Village
Madhepura	Murliganj	Belo & Bishunpur
	Alamnagar	Alamnagar & Barhauna
	Madhepura	Bhelwa & Barahi

Collection of water samples

The physicochemical assessment of groundwater quality, samples were taken in a planned way. From 2019 to 2021, water samples were taken from 36 different points in 6 villages using tube wells and hand pumps in the summer, winter, before, and after the monsoon. The samples were collected in clean, sterile polythene bottles as groups. Before taking a sample, groundwater was used to wash out plastic bottles. Before being looked at, the samples were kept at a temperature below 4°C. A physic chemical analysis was done on 15 parameters, including pH, conductivity, TDS (total dissolved solids), TH (total hardness), TA (total alkalinity), Bicarbonate Alkalinity, and the major ions Ca^{+2}, Mg^{+2}, fluoride, and chloride. Reagents of analytical grade were used to test samples, and solutions were made with water that had been distilled twice. This was done to make sure that the samples were taken really showed what the groundwater was like in the chosen area.

Samples from target areas were selected for heavy metal analysis and sent Laboratory. Analysis was done for determination of potential heavy metals i.e.Iron, Cadmium, Copper, Zinc, Manganese and Lead.

RESULTS & DISCUSSION

The quality of ground water depends on its physicochemical properties like TDS, pH, fluoride, alkalinity and presence of minerals as well as heavy metals. Present study involves measurement of physicochemical properties and potential heavy metals.[5]

Table 1- Physico chemical characteristics of ground water of Village Belo Block, Murliganj

Year	Period	pH	EC	TDS	TA	TH	Ca^{2+}	Mg^{2+}	Cl^-	F^-
2019	Pre monsoon	8.5	1244	982	622	489	290	198	67	2.4
	Monsoon	8.2	994	774	518	343	215	129	30	1.2
	Winter	8.3	1124	840	562	431	256	175	55	1.8
	Summer	8.4	1236	907	618	470	286	184	62	2.1
2020	Pre monsoon	8.7	1262	1002	631	497	295	201	69	2.6
	Monsoon	8.2	902	796	451	331	205	127	35	1.7
	Winter	8.4	1202	859	601	457	281	176	59	2.2
	Summer	8.5	1256	924	628	476	290	185	67	2.4
2021	Pre monsoon	8.7	1252	961	640	497	291	206	68	2.3
	Monsoon	8.3	912	754	456	331	196	135	49	1.8
	Winter	8.5	1064	817	532	392	235	157	56	2.1
	Summer	8.6	1206	886	603	473	278	195	65	2.7

Table 2- Physico chemical characteristics of ground water of Village Bishunpur Block, Murliganj

Year	Period	pH	EC	TDS	TA	TH	Ca^{2+}	Mg^{2+}	Cl^-	F^-
2019	Pre monsoon	7.9	1376	668	438	236	160	76	51	1.3
	Monsoon	7.5	976	463	238	122	89	33	28	0.9
	Winter	7.7	1188	530	344	191	135	56	40	1.2
	Summer	7.9	1336	592	418	228	157	71	51	1.3
2020	Pre monsoon	8.1	1428	693	464	267	176	91	58	1.5
	Monsoon	8.1	1416	691	458	285	188	96	59	1.5
	Winter	7.6	1126	488	313	151	106	45	36	1.2
	Summer	7.9	1288	556	394	202	124	78	41	1.3
2021	Pre monsoon	8.0	1755	618	448	255	172	84	56	1.4
	Monsoon	8.1	1394	648	447	271	180	91	63	1.7
	Winter	7.6	984	445	242	133	110	24	39	1.2
	Summer	7.8	1330	513	415	231	155	77	42	1.4

Table 3- Physico chemical characteristics of ground water of Village Alamnagar Block, Alamnagar

Year	Period	pH	EC	TDS	TA	TH	Ca^{2+}	Mg^{2+}	Cl^-	F^-
2019	Pre monsoon	7.7	1446	779	473	216	130	85	41	1.0
	Monsoon	7.5	1294	639	399	176	119	57	31	1.0
	Winter	7.7	1412	694	456	211	128	83	40	1.0
	Summer	7.9	1390	805	445	239	145	94	67	1.3
2020	Pre monsoon	7.4	1020	601	260	97	65	31	32	1.0
	Monsoon	7.6	1224	663	368	165	106	59	49	1.2
	Winter	7.7	1356	721	428	213	133	79	59	1.3
	Summer	7.9	1428	755	464	248	152	96	65	1.4
2021	Pre monsoon	7.5	968	551	234	70	57	14	27	0.6
	Monsoon	7.8	1234	619	367	161	108	53	54	1.3
	Winter	7.8	1234	619	367	161	108	53	54	1.3
	Summer	7.9	1372	676	436	233	140	93	64	1.4

Table 4- Physicochemical characteristics of ground water of Village Barhauna Block, Alamnagar

Year	Period	pH	EC	TDS	TA	TH	Ca^{2+}	Mg^{2+}	Cl^-	F^-
2019	Pre monsoon	6.1	1556	1308	528	348	212	137	97	1.6
	Monsoon	5.6	1176	1096	338	170	95	75	45	0.6
	Winter	5.8	1396	1158	448	270	160	110	63	1.4
	Summer	6.0	1520	1216	510	324	201	123	83	1.5
2020	Pre monsoon	6.2	1590	1330	545	361	219	143	94	1.9
	Monsoon	5.8	1190	1123	369	192	106	87	40	1.1
	Winter	6.0	1418	1192	459	278	164	114	60	1.6
	Summer	6.1	1540	1250	520	334	200	134	90	1.9
2021	Pre monsoon	5.8	1198	1085	349	188	100	88	46	1.1
	Monsoon	6.1	1438	1156	469	273	162	111	54	1.4
	Winter	6.2	1550	1215	525	335	202	134	94	1.7
	Summer	6.1	1540	1250	520	334	200	134	90	1.9

Table 5- Physicochemical characteristics of ground water of Village Bhelwa Block, Madhepura

Year	Period	pH	EC	TDS	TA	TH	Ca^{2+}	Mg^{2+}	Cl^-	F^-
2019	Pre monsoon	7.7	1102	694	301	170	98	64	55	1.6
	Monsoon	7.3	776	480	138	34	39	27	31	0.9
	Winter	7.5	964	553	232	95	54	33	40	1.4
	Summer	7.6	1074	603	287	151	86	57	48	1.6
2020	Pre monsoon	7.9	1124	720	312	184	109	67	58	1.7
	Monsoon	7.4	808	506	154	44	47	40	33	1.1
	Winter	7.6	994	579	247	110	57	44	43	1.5
	Summer	7.8	1088	629	294	149	80	60	53	1.6
2021	Pre monsoon	7.9	1144	673	322	193	112	73	57	1.8
	Monsoon	7.5	798	459	155	51	45	37	39	1.2
	Winter	7.7	1004	532	252	110	62	40	41	1.5
	Summer	7.9	1104	584	302	159	85	65	52	1.7

Table 6- Physicochemical characteristics of ground water of Village Barihi Block, Madhepura

Year	Period	pH	EC	TDS	TA	TH	Ca^{2+}	Mg^{2+}	Cl^-	F^-
2019	Pre monsoon	8.6	1000	980	250	465	260	205	210	0.9
	Monsoon	8.1	618	771	59	145	99	47	120	0.4
	Winter	8.4	828	840	164	308	175	133	145	0.6
	Summer	8.5	882	888	191	408	217	191	198	0.9
2020	Pre monsoon	8.7	1072	1009	286	489	275	214	221	1.2
	Monsoon	8.3	608	793	76	133	99	35	121	0.7
	Winter	8.5	934	869	217	332	182	150	156	1.1
	Summer	8.8	1060	918	280	465	256	209	206	1.2
2021	Pre monsoon	8.8	1084	966	292	533	297	237	232	1.3
	Monsoon	8.4	626	750	63	135	98	37	129	1.1
	Winter	8.6	942	825	221	351	193	158	162	1.2
	Summer	8.8	1044	873	272	493	279	214	211	1.3

Table 7- Physico chemical Parameters and trace heavy metals in Project area

Sl. No.	Location	Year	Parameters			Trace Heavy Metal					
			DO	BOD	COD	Fe	Cd	Cu	Zn	Mn	Pb
1	Belo (Murliganj)	2019	5.8	3.2	4.1	0.14	ND	ND	0.01	ND	0.31
		2020	5.4	2.2	4.4	0.13	ND	ND	0.03	0.01	0.34
		2021	5.3	3.7	4.6	0.13	ND	ND	0.02	ND	0.32
2	Bishunpur (Murliganj)	2019	6.1	3.2	3.4	0.17	ND	0.01	ND	ND	0.28
		2020	6.7	3.2	3.8	0.16	ND	0.03	ND	0.02	0.29
		2021	6.8	3.8	3.5	0.11	ND	0.04	0.13	ND	0.21
3	Alamnagar (Alamnagar)	2019	6.5	2.7	5.1	0.12	ND	ND	0.12	ND	ND
		2020	6.4	2.5	5.2	0.17	ND	ND	0.11	0.03	ND
		2021	6.3	2.1	5.3	0.14	ND	ND	0.18	ND	0.41
4	Barhauna (Alamnagar)	2019	5.7	1.4	5.8	0.15	ND	ND	0.19	0.07	0.38
		2020	5.1	1.5	5.9	0.16	ND	ND	0.21	ND	0.42
		2021	5.2	1.6	6.1	0.13	ND	ND	ND	ND	ND
5	Barihi (Madhepura)	2019	5.4	1.7	4.1	0.14	ND	ND	ND	0.02	ND
		2020	6.3	1.8	4.3	0.11	ND	ND	ND	ND	ND
		2021	6.2	2.1	3.7	0.09	ND	ND	ND	0.01	ND
6	Bhelwa (Madhepura)	2019	6.3	2.4	2.6	0.14	ND	ND	0.12	ND	0.21
		2020	6.8	2.2	2.7	0.12	ND	ND	0.15	ND	0.22
		2021	6.4	2.3	2.3	0.16	ND	ND	0.13	0.05	0.25

The physicochemical properties of ground water, such as total dissolved solids (TDS), pH, fluoride, alkalinity, and the presence of minerals and heavy metals, all contribute to the water's overall quality. The physicochemical properties and possible levels of heavy metals are being measured for this investigation at the moment.[5] As a result of the presence of carbonates and bicarbonates, the pH of all of the groundwater samples obtained from bore wells was mildly alkaline to alkaline. Even though the values are within the parameters set by the WHO, it is not recommended for the disinfection of drinking water with chloride and, as a result, the quality of the water that is consumed is negatively affected. The groundwater samples with high EC had a greater TDS than the other samples.TDS value of each and every ground water sample collected in the target area, Because it alters the flavour of the water, a higher TDS value (one that is greater than 1000 mg/L) is regarded as being of a worse quality.

Total hardness was found to vary between 54 to 533 mg/L. None of the samples crosses the maximum permissible limits of 500 mg/L of WHO standards. BIS (Bureau of Indian Standard)[6] has recommended a desirable limit of 250 mg /L of chloride in drinking water. However, groundwater having a concentration of chloride of more than 1000 mg/L is not suitable for drinking purposes. In our study, chloride was found below the permissible limit in most of the sites, which can be obviously linked to the solidity of the soil. The range of chloride content was within 31 and 232 mg/L. The alkalinity of the samples is in the range of 59-640 mg/L. The alkalinity levels of all the water samples are high, thus, resisting acidification of the groundwater samples.

Fluoride (F^-) concentration over and above the permissible limits (1.5 mg/l) in drinking water leads to human health hazards, such as dental and skeletal fluorosis, affecting millions of people in many parts of India. The source of fluoride in the groundwater is mainly from geological occurrences (i.e. fluoride-bearing minerals, viz. apatite and biotitic mica). Some of the samples show the amount a little high.

Heavy metal pollution in drinking water is one of the most serious problems in many developing countries, so checking the quality of water for the presence of heavy metal is very important Heavy metals were not detected at above said level in any sample of water which suggests these heavy metals in collected water samples are present within the permissible level as per WHO guidelines.

CONCLUSION

The groundwater plays crucial role as a decentralized source of drinking water for millions rural and urban families in Madhepura region. On the basis of higher conductivity and TDS values the groundwater quality is classified as hard water and the higher concentration of salts is injurious

to those people suffering from diseases of heart or kidney. Apart from TDS values all other parameters and potent heavy metals are within permissible limits. Fluoride level is found to be little higher in some cases.

ACKNOWLEDGEMENT

The authors are thankful to Department of Zoology, P. Sc. College and University Department of Zoology, B. N. Mandal University, Madhepura, Bihar, for providing necessary facilities and guidance.

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