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Periodic Research

Water Quality of Bardhaman Circle, West Bengal

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Abstract

Ground water and surface water samples from different resources of Bardhaman circle of W.B. were sampled at block levels both for the pre-monsoon and post-monsoon seasons. Different water quality parameters were determined both at the site and laboratory. Based on the parameters evaluated the qualities of the water was judged in terms of their applications as drinking, domestic, irrigation , bathing or survival of aquatic life. Conductivity and TDS data suggests surface water to be a better choice over ground water for agricultural applications. In case of Purbasthali block, Burdwan district, water from a deeper tube well was found to be suitable as potable water compared to a shallow one as far as arsenic contamination is concerned. For Hooghly district the Khanakul blocks were found to be arsenic affected.

Keywords: Water Quality, acquifer, D.O., TDS, potable.

Introduction

Earth is like a “Soft Blue Sapphire”but for the occurrence of water in this planet. For optimum utilization of water resources, it is necessary to know both the quality as well as quantity of water. The history of human civilization reveals that water supply and civilization are almost synonymous. On an average one man should drink at least 5 litres of water a day. The other type of water consumption will vary depending upon country to country and its, climatic condition. One person in a city or a town stays in little bit better position as he / she gets treated water from corporation / municipality whereas his counterpart in a village has to depend mainly upon dug well or a tube well or even on an open pond for drinking water.

Work on arsenic contamination of groundwater for 6-7 districts of W.B. have been done by different groups.[1–7] Some techniques with regard to removal of arsenic has also been suggested (filter developed).[1] Again a model plant was set up in the removal of arsenic from water by a group. Pritam Singh et al[8]. In one reported method[9] naturally occurring laterite soil was selected as the adsorbent and was devised into an earthen kalsi for household filter (“SANTA-2006”). No systematic work has been done on the river / canal water quality which is suitable for agricultural applications. One pilot plant was developed[10] through membrane technique by a group led by S. Bandopadhyay, CGCRI, Kolkata. Arsenic poisoning of ground/surface water adversely effects the huge population of several countries including India. Bangladesh. Argentina, Mexico, Chile, Mongolia. Vietnam etc. Arsenic poisoning of ground / surface water is a serious health hazard and it affects approximately 90 million people at a global level.[11] The magnitude of the problem of Arsenic poisoning has reached such proportion in India. Bangladesh and Vietnam that it needs immediate attention.[12]

The non-renewable water resource (ground water) is limited by nature. It is to be utilized in a judicious manner and not at random.In drought prone areas the acquifers are not recharged and as a result ground water and drinking water scarcity will take place. By proper planning the good quality (from database produced of the particular region) ground water may be preserved for drinking purpose only. The renewable forms of water resources may be utilized for other purposes like irrigation etc. The proposed R & D activity is aimed at towards identifying such potential resources.

Materials and Methods

Ground water samples (both dug well and tube well) were collected from different blocks of the three districts of Bardhaman. Hoogly and Birbhum. For surface water major rivers in the region like Ganga, Damodar, Mauorakshi etc were taken into account. The samples were collected both for the premonsoon and postmonsoon seasons. Different physicochemical parameters such as temperature, pH, conductivity, hardness, turbidity, total dissolved solids, As, were determined. Instruments like pH meter cum conductivity meter, dissolved oxygen meter, water analysis kit, Guitzeit zenerator, spectrophotometer were utilized apart from classical wet chemical methods. Some of the parameters like pH, D.O. were determined at the site of sampling itself. SDDC[13] method was applied for the estimation of As in the samples.

Results and Discussion

Variation of pH and D.O.

From Tables it is observed that pH of the water samples collected from different blocks of Bardhaman district (both for the pre-monsoon and post-monsoon seasons) are within almost neutral region (6.0 - 8.0)[TablesI & II]. The D.O. (ppm) on the other hand varies over a wide range (2.5 for BWN $(GW)_6$ to 10.6 for BWN (SW)13[TablesI & II]. The higher value of D.O. signifies a good quality water for the Ganga surface water while the tap water of Parulia Bazar, Purbasthali is not upto the satisfactory level [the permissible level of D.O. in drinking water $\geq$ 5]. The intermediate level of D.O. of other water samples are of moderated qualities. The pH of the water samples of Hooghly district, lower, are within normal level (6.0 - 1.5)[TableV] . The Damodar river water of this district is again found to be having highest D.O. content both for this pre-monsoon (10.2 ppm) and post-monsoon season (10.0 ppm)[same table]. The other sources of water are having permissible level of D.O. content (6.1 ppm 8.2 ppm)[TableVI]. The pH of the Birbhum district with samples are normal. The D.O. content of this district is seen to the alarmingly low (2.7 ppm) for Maureswari-1[Table IX] from a densely populated bus stand sample and can be concluded to be of poor quality-water[14].

Variation of Conductivity and TDS

The conductivity value (2ms) for the Bardhaman district varies from 0.240 for the tube well sample from Bhatar bazar to as high as 0.876 for a tube well sample of Dihat more, Katwa – II[Table III]. In general it is found that in both cases of ground water and surface water the magnitude of conductivity is lowered to some extent from the premonsoon season onto the postmonsoon season[Table III & IV].This can be attributed to the dilution effect. The TDS values (2ppt) on the other hand is seen to be very low (0.234) for the Ganga river, Kalna Municipality so also only 0.271 for the same river water sample at Katwa [same tables]. The TDS values for the ground water samples are on the higher range, upto 0.678 (2 ppt). This trend is very much distinct for the premonsoon (Table III), as well as for the post monsoon samples (Table IV). This observed behaviour can again be due to higher extent of dilution of the dissolved solids in surface water in comparison to when that is confined in ground water.

Similar pattern of behaviour is observed in case of conductivity data (2ms) for the district Hooghly. The lowest value here is seen for the Damodar river (Pursurah) sample (0.298) for the pre-monsoon and (0.253) for the post-monsoon sample Table III and Table IV. The highest magnitude here is observed for HOOG $(GW)_3$ sample, that is for a ground water (TW) sample which is again lowered in case of the corresponding post-monsoon season results. This trend in behaviour is again manifested in the TDS (2ppt) values - only 0.165 for the HOOG (SW), and 0.137 for the pre-monsoon and post-monsoon seasons respectively. The higher values in case of ground water samples is again prominent here [(0.561) and (0.489) respectively]. In case of Birbhum district, however, we could not collect the pre-monsoon samples. Here also we find the same trend in behaviour for both the parameters of conductivity (2ms) and TDS (2 ppt), viz., 0.124 andO.079 respectively for the Maurakshi river sample, Table IX. Here the highest values of these parameters occur for a ground water sample Birm $(GW)_2$ with magnitudes of 0.75 and 0.49 respectively.

This general behaviour may be due to higher extent of dilution of the different ions in case of a river sample than that of a ground water sample.

Occurrence of Arsenic

In case of Bardhaman district we have found arsenic to occur in case of the Ganga river at Katwa burning ghat both for the pre-monsoon (0.125 ppm) and post-monsoon (0.105 ppm) seasons. At Kalna, Table III and Table IV, however, downstream with respect to Katwa, arsenic was absent for the Ganga river water sample. This amount of arsenic is twice the permissible level of 0.05 ppm (ISI). Among the other ground water samples one location at Purbasthali- II block [BWN $(GW)_6$] was found to contain 0.04 ppm of As in a tap water sample only in the pre-monsoon season. Another ground water (TW) sample BWN $(GW)_1$ from Bhatar bazar bus stand was found to contain As both during the pre-monsoon (0.025 ppm) and post-monsoon (0.02 ppm) seasons. The BWN $(GW)_9$ sample from Purbasthali - I block was found to contain 0.025 ppm of As at a depth of 70 ft. TW whereas for the TW samples from the same location at higher depths (250 ft and 300 ft) had negligible As content. The Purbasthali block was earlier reported to contain As by several

workers.[1,4,5,15] The presence of As in the shallow TW in comparison to the deeper ones may be due to the higher extent of dilution at the lower acquifer containing ground water.

For the Hooghly district the blocks Khanakul - 1 and Khanakul - II were affected by ground water As contamination as is evident from the two TW samples HOOG $(GW)_4$ and HOOG$(GW)_5$ having As contents of 0.088 and 0.04 ppm respectively for the pre-monsoon season and 0.062 and 0.032 ppm respectively for the post-monsoon season Table VII and Table VIIII.

The other parts of Hoohgly district are safe as far as arsenic occurrence is concerned.

Variation of total hardness and chloride

The total hardness of different samples were found to vary from 8 to 228 (mg/L) both for the Burdwan and Birbhum districts. The chloride content was found to be within 355 to 1385 (mg/L) for samples collected from different locations both for Burdwan and Birbhum districts with a higher range for the Birbhum district. The only sample from Tilpara barrange of Mourakshi river was found to contain an abnormally high value of chloride i.e., 1,17,203 (mg/L)[Table X and Table XI].

Conclusion

The pH values of all the water samples suggest them to be good for agriculture and to support aquatic life. The conductivity and TDS data suggest both to be suitable for agricultural purposes, the surface water in particular than the ground water, BIS limit for TDS being 500 - 2000 mg/L. The hardness of the water samples analysed, on the other hand, suggest them to be suitable for using in industries and for domestic purpose. [BSI limit being 300 – 600 mg/L]. According to BIS the chloride limit should be 250 – 1000 mg/L. Most of the analysed samples of Birbhum district contain chloride above the permissible limit. The chloride concentration serves as an indicator of pollution by sewage. It can also corrode concrete by extracting calcium. For potable water a deeper groundwater should be chosen as far as arsenic contamination is concerned. Purbasthali block of Burdwan district and Khanakul block of Hooghly district were found to be arsenic affected.

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Table I: Ph And D.O. Data of Bardhaman District (Premonsoon)
GW = Ground Water, SW = Surface Water, TW = Tube Well

Sl. No.	*Sample No.*	*Location*	*pH*	*D.O.(ppm)*
1	$BWN(GW)_1$	Bhatar Bazar, Bus Stand, TW	7.0	8.0
2	$BWN(GW)_2$	Nigan, Mongalkot. TW	7.5	3.5
3	$BWN(GW)_3$	Srikhanda, Katwa, TW	6.5	7.7
4	$BWN(GW)_4$	Katwa Town Municipality, TW	7.5	8.1
5	$BWN(SW)_5$	Burning Ghat. Ganga River, Katwa	8.0	9.8
6	$BWN(GW)_6$	Dihatmore, Katwa-II, TW	6.5	10.5
7	$BWN(GW)_6$	Parulia Bazar, Purbasthali-II, Tap	7.0	.2.5
8	$BWN(GW)_7$	Purbasthali-1, Depth 250 ft, TW	6.5	7.7
9	$BWN(GW)_8$	Purbasthali-1, Depth 300 ft, TW	7.0	7.9
10	$BWN(GW)_9$	Purbasthali-I. Depth 70 ft, TW	7.5	6.5
11	$BW1M(GW)_{10}$	Kalna-I, TW	6.5	9.0
12	$BWN(SW)_2$	Kalna, Municipality, Ganga River	8.0	6.0
13	$BWN(GW)_{11}$	Dhatrigram rail gate, Kalna-1, TW	6.0	7.5
14	$BWN(GW)_{12}$	Shamsundar, Raina-I. TW	6.0	6.5
15	$BWN(GW)_{13}$	Madhabdihi, Raina-II, TW	7.5	8.0
16	$BWN(GW)_{14}$	Jamalpur, Netaji Maidan, TW	8.0	6.9
17	$BWN(GW)_{15}$	Seharabazar, Khondoghosh, TW	6.5	7.3

Table II : pH and D.O. data of Bardhaman district (Postmonsoon)

Sl. No.	*Sample No.*	*Location*	*pH*	*D.O.(ppm)*
18	$BWN(GW)_{16}$	Bhatar Bazar, TW	7	8.2
19	$BWN(GW)_{17}$	Nigan, Mangalkot,TW	7.5	2.8
20	$BWN(GW)_{18}$	Srikhanda, TW	7.5	8.2
21	$BWN(GW)_{19}$	Katwa Municipality, TW	8.0	8.2
22	$BWN(SW)_3$	Katwa Burning Ghat.Ganga river	6.0	1 0.6
23	$BWN(GW)_{20}$	Parulia Bazar. Purbasthali-II, Tap	6.5	2.9
24	$BWN(GW)_{21}$	Emadpur more, Purbasthali-I. TW	6.5	2.85
25	$BWN(SW)_4$	Kalna, Ganga River	6.0	7.7
26	$BWN(GW)_{22}$	Kalna Municipality, TW	6.0	5.4

Table III: Conductivity, TDS and Arsenic data (Premonsoon) of Bardhaman district

Sample No.	*Conductivity (2mS)*	*TDS (2ppt)*	*As (ppm)*
$BWN(GW)_1$	0.325	212 (200 ppm)	0.025
$BWN(GW)_2$	0.833	0.571	Nil
$BWN(GW)_3$	0.456	0.372	Nil
$BWN(GW)_4$	0.762	0.513	Nil
$BWN(SW)_1$	0.356	0.271	0.125
$BWN(GW)_5$	0.876	0.534	Nil
$BWN(GW)_6$	0.735	0.575	0.04
$BWN(GW)_7$	0.364	0.213	Nil
$BWN(GW)_8$	0.526	0.678	Nil
$BWN(GW)_9$	0.462	0.632	0.025
$BWN(GW)_{10}$	0.723	0.597	Nil
$BWN(SW)_2$	0.310	0.234	Nil
$BWN(GW)_{11}$	0.627	0.667	Nil
$BWN(GW)_{12}$	0.617	0.549	Nil
$BWN(GW)_{13}$	0.713	0.651	Nil
$BWN(GW)_{14}$	0.521	0.632	Nil
$BWN(GW)_{15}$	0.635	0.569	Nil

Table IV : Conductivity, TDS and Arsenic data (Postmonsoon) of Bardhaman district

Sample No.	*Conductivity(2mS)*	*TDS(2ppt)*	*As(ppm)*
$BWN(GW)_{16}$	0.240	159.75 (200 ppm)	0.02
$BWN(GW)_{17}$	0.719	0.462	Nil
$BWN(GW)_{18}$	0.314	0.203	Nil
$BWN(GW)_{19}$	0.628	0.408	Nil
$BWN(SW)_{3}$	0.298	0.194	0.105
$BWN(GW)_{20}$	0.765	0.496	Nil
$BWN(GW)_{21}$	0.619	0.401	Nil
$BWN(SW)_{4}$	0.274	0.176	Nil
$BWN(GW)_{22}$	0.863	0.559	Nil

Table V : pH and D.O. data of Hooghly district (Premonsoon)

Sl.No.	*Sample No.*	*Location*	*pH*	*D.O.(ppm)*
27	$HOOG(GW)_{1}$	Arambag Bus Stand,TW	7.5	8.0
28	$HOOG(GW)_{2}$	Goghat-I, Valadighi, TW	6.5	6.5
29	$HOOG(GW)_{3}$	Khanakul-1, Ramnagar,Tap (P.H.E.)	7.0	7.3
30	$HOOG(GW)_{4}$	Khanakul-I, Ramnagar, TW	6.5	8.2
31	$HOOG(GW)_{5}$	Rajhati Bandar, Khanakul-II, TW	6.0	6.9
32	$HOOG(GW)_{6}$	Pursurah Bus Stand, TW	7.0	7.5
33	$HOOG(GW)_{7}$	Tarakeswar Bus Stand, TW	6.5	7.5
34	$HOOG(GW)_{8}$	Dhanikhali Harpur (Julantala), TW	6.5	6.7
35	$HOOG(SW)_{1}$	Pursurah Damodar River	7.0	10.2

Table VI : pH, D.O. data of Hoogly district (Postmonsoon)

Sl. No.	*Sample No.*	*Location*	*pH*	*D.O. (ppm)*
36	$HOOG(GW)_{9}$	Arambag Bus Stand, TW	*7.5*	7.3
37	$HOOG(GW)_{10}$	Goghat-I, TW	*6.5*	7.6
38	$HOOG(GW)_{11}$	Khanakul-1, Tap water	7.0	6.5
39	$HOOG(GW)_{12}$	Khanakul-I, TW	6.5	6.1
40	$HOOG(GW)_{13}$	Khanakul-II, TW	6.0	7.2
41	$HOOG(GW)_{14}$	Pursurah Bus Stand, TW	7.5	7.9
43	$HOOG(GW)_{15}$	Tarakeswar Bus Stand, TW	7.0	6.5
44	$HOOG(GW)_{16}$	Dhaniakhali, TW	7.5	7.5
45	$HOOG(SW)_{2}$	Pursurah, Damodar River	6.0	10.0

Table VII : Conductivity, TDS and Arsenic data (Premonsoon) of Hooghly district

Sample No.	*Conductivity(2mS)*	*TDS(2ppt)*	*As(ppm)*
$HOOGCGW)_{9}$	0.765	0.467	Nil
$HOOG(GW)_{2}$	0.623	0.497	Nil
$HOOG(GW)_{3}$	0.832	0.539	Nil
$HOOG(GW)_{4}$	0.325	0.432	0.088
$HOOG(GW)_{5}$	0.676	0.561	0.04
$HOOG(GW)_{6}$	0.721	0.478	Nil
$HOOG(GW)_{7}$	0.337	0.497	Nil
$HOOG(GW)_{8}$	0.512	0.501	Nil
$HOOG(SW)_{1}$	0.298	0.165	Nil

Table VIII : Conductivity, TDS and Arsenic data(Postmonsoon) of Hooghly district

Sample No.	*Conductivity(2mS)*	*TDS(2ppt)*	*As(ppm)*
$HOOG(GW)_{9}$	0.623	0.413	Nil
$HOOG(GW)_{10}$	0.579	0.414	Nil
$HOOG(GW)_{11}$	0.792	0.484	Nil
$HOOG(GW)_{12}$	0.276	0.387	0.062
$HOOG(GW)_{13}$	0.592	0.489	0.032
$HOOG(GW)_{14}$	0.659	0.413	Nil
$HOOG(GW)_{15}$	0.286	0.432	Nil
$HOOG(GW)_{16}$	0.476	0.485	Nil
$HOOG(SW)_{2}$	0.253	0.137	Nil

Table IX : pH, D.O., Conductivity and TDS data of Birbhum district (Postmonsoon)

SampleNo.	*Location*	*PH*	*D.O.(ppm)*	*Conductivity(2mS)*	*TDS(2ppt)*
$Birm(GW)_1$	Ham bazar, TW	7.0	6.6	0.402	0.260
$Birm(GW)_2$	Dubrajpur,TW	6.0	7.3	0.75	0.49
$Birm(SW)_1$	Tilpara barrage (Maurakshi River)	6.0	7.5	0.124	0.079
$Birm(GW)_3$	Md. Bazar, TW	6.0	8.3	0.130	0.084
$Birm(GW)_4$	Maureswar-I (Mallarpur Bus Stand)	6.0	2.7	0.596	0.385
$Birm(GW)_5$	Rampurhat-II, Tap Water	7.0	8.6	0.688	0.445
$Birm(GW)_6$	Muraroi-I, TW	7.5	7.3	0.495	0.325
$Birm(GW)_7$	Nalhati-I,TW	6.5	8.4	0.392	0.254
$Birm(GW)_8$	Suri-I, Nutanpalli, TW	6.5	7.5	0.377	0.243

Table X:Total hardness and Chloride data(Postmonsoon) of Bardhaman district

Sample No.	*Total hardness (as $CaCO_3$) (mg/L)*	*Chloride(mg/L)*
$BWN(GW)_{16}$	33.144	568.4
$BWN(GW)_{17}$	62.148	568.4
$BWN(GW)_{18}$	29.004	497.3
$BWN(GW)_{19}$	53.860	497.3
$BWN(SW)_3$	24.860	603.9
$BWN(GW)_{20}$	33.144	355.2
$BWN(GW)_{21}$	74.576	426.3
$BWN(SW)_4$	227.876	639.4
$BWN(GW)_{22}$	8.288	568.4

Table XI: Total hardness and Chloride data(Postmonsoon) of Birbhum district

Sample No.	*Total hardness (as $CaCO_3$) (mg/L)*	*Chloride (mg/L)*
$Birm(GW)_1$	61.235	1030.2
$Birm(GW)_2$	65.735	1101.3
$Birm(SW)_1$	45.645	1 17203
$Birm(GW)_3$	61.985	1385.2
$Birm(GW)_4$	55.258	1243.4
$Birm(GW)_5$	45.231	1349.9
$Birm(GW)_6$	71.125	959.2
$Birm(GW)_7$	82.350	603.9
$Birm(GW)_8$	53.256	852.6