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Seasonal distribution of physico- chemical parameters of ground water of Barpeta District, Assam, India

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ABSTRACT

The physico-chemical characteristics of ground level water have been studied in Barpeta district. Ground water quality of the study area was evaluated for its suitability for drinking purposes by collecting twenty samples during summer and post monsoon season in 2008 (Season A) and winter and pre monsoon season in 2008-2009(Season B). Descriptive statistics in the forms of mean, variance, standard deviation, median, range of variation, skewness, kurtosis etc. are computed for the water quality parameters. There is no earlier statistics for various water quality parameters in the study area and hence the present research is undertaken with specific view to strengthen the regional and national water quality database .The study revealed that the some water sources in the region are not suitable for drinking in regards to total hardness, calcium and magnesium content. Proper maintenance and treatment of water can give a safer life as well as improve the quality of drinking water.

Key words: Ground water quality, physico-chemical parameters, Barpeta, total hardness.

INTRODUCTION

Water quality assessment is one of the prime concerns and a major challenge in all over the world. Seasonal variation study of water quality parameters provides information about the health of the water over a period of time. Water is vital to health and it influences in socio-economic development of human being. Increasing population growth, agriculture advancement, urbanization as well as industrialization made water pollution a great problem and depleting the availability of potable water. Many parts of the world face such a scarcity of water [1]. Water-related diseases are among the most common causes of illness and death, affecting mainly the poor in developing countries. The quality of water at any monitoring location reflects several major influences, including the anthropogenic inputs, atmospheric inputs, climatic condition, etc.

Concentrations of all kinds of pollutants have an influence on the water quality and also determine the use of water. It is, therefore, necessary to monitor water quality, understand the chemical characteristics and provide a reliable assessment of water quality [2]**.** Ground water has historically been considered as reliable and safe source of water protected from surface contamination by geological filters that remove pollutant from water as it percolates through the soil [3]. Ground water is immensely used for domestic and industrial purpose. Sedimentary aquifers are the major source of groundwater in India. Groundwater quality alters due to due to rock water interaction and oxidation reduction reactions when it percolated through the aquifers. Water born pathogens, toxic and nontoxic pollutants are the major agents for water quality deterioration which are transported from recharge area to discharge area through aquifers by groundwater motion [4]. The physico-chemical analysis of ground water of the area is undertaken with a specific view to strengthen the national and regional water quality database which is wish to help the people to know about the safe drinking water.

Study area

The Barpeta District is located in lower part of Assam with two civil sub divisions Barpeta and Bajali, covers an area 3245 sq. kms. The district shares its border with Bhutan in north, Nalbari district in east, Kamrup and Goalpara districts in the south and Bongaigaon district in the west. Barpeta District lies between $90^0 40^/$ to $91^0 20^/$ East longitude and $26^o 15^/$ to $27^o 05^/$ North latitude. The general Topography of the Barpeta District varies from low-lying plains to highland having small-hillocks in the South-West-corner of the District. Barpeta has a tropical monsoon climate having two seasons, summer and winter. The river Brahmaputra flows from the southern part of the district and its many tributaries flow from north to south. The total population of the district is 1,642,420, out of which 1,517,280 live in rural areas. The climate of the district is sub-tropical and humid. The air is highly humid throughout the year and during rainy season; the relative humidity is about 90 percent. The area receives heavy rainfall every year and out of 2,051mm of annual normal rainfall, 60 to 65 % is received during June to September from south west monsoon. Hydrogeologically the entire area of the District is occupied by alluvial sediments of Quarternary age. Piedmont deposits comprising of course clastic sediments like boulder, pebble, gravel associated with sand and silt from the ground water bearing formation in the northern part of the district [5].

MATERIALS AND METHODS

A total of 20 samples were collected randomly during summer and post monsoon season in 2008 (Season A) and winter and pre monsoon season in 2008-2009 (Season B), covering flood plain areas of Barpeta District. Water sampling stations are shown in **Table 1.** The water samples were collected after 10 minutes of pumping and transferred into pre-cleaned polythene bottles and stored for further analysis. The pH, temperature, dissolved oxygen (DO) were measured in the field immediately after sampling and other parameters were determined in the laboratory following standard analytical procedure as recommended by APHA (1998) [6]. The suitability of the water from the ground water sources for drinking purposes were evaluated by comparing the value of different water quality parameters with the Bureau of Indian standards (BSI), and World Health Organization (WHO) drinking water guideline values. The complete analytical result of the water samples were transferred onto SPSS 16.0 statistical platforms, to carry out multivariate statistical analysis. The instruments were calibrated and standardized before

carrying out the analysis. Na and K in the water samples were determined by flame photometer (Systronics, Germany) whereas TH, Ca and Mg were determined by EDTA titrametric methods.

Table 1: Water sampling stations in the study area

Site	Name of the Location	Sources	Site	Name of the Location	Sources
1	Sarbhog	Tube well	11	Patacharkuchi	Tube well
2	Meda	Tube well	12	Patsala	Supply Water
3	Dekarbari	Tube well	13	Bajali	Tube well
4	Sarthebari(college road)	Tube well	14	Hawly	Tube well
5	Kamarpara	Tube well	15	Bhabanipur	Tube well
6	Belbari	Tube well	16	Simlaguri	Tube well
7	Kapla	Tube well	17	Nityananda	Tube well
8	Bainakuchi	Tube well	18	Pakabetbari	Tube well
9	Lashima	Tube well	19	Barpeta Road	Supply Water
10	Byaskuchi	Tube well	20	Sundaridia	Tube well

RESULTS AND DISCUSSION

To look into the seasonal variations and distribution patterns of the physico- chemical parameters in groundwater, data were exposed to several statistical treatments. Descriptive statistics of the studied parameters has been summarized for both season A and season B in **Table 2 – 5** respectively. The data were fitted to box plot to know the patterns of quantitative data and also to get information about the shape of the data set (**Fig 1-2**). The median is indicated by the vertical line that runs down the centre of the box. An extreme value is observed which is known as outlier in the set of the value. The temperature of the different water sources are fluctuated in the ranges of 26 to 23 ^{0}C in season A and 21 to 18 ^{0}C in season B. The pH of the water samples ranged from 8.2 to 6.1 in season A and 8.1 to 6.5 in season B. The desirable pH range necessary for drinking water is from 7.0 to 8.5. On an average, pH of all samples was in desirable limit as prescribed for drinking water standard. In all the sampling stations, the variation of pH is narrow and in general, the pH is towards the alkaline side. Water is look as if to be turbid but all the samples are within WHO permissible limit of 5 NTU^c. A total dissolved solid (TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro granular suspended form. The permissible limit of TDS of drinking water is 500 mg/l [7]. The observation shows that the TDS is within the permissible range as prescribed by WHO (2004) in both the season. Electrical conductance is the ability of a substance to conduct the electric current. The conductance of water samples under study varies between 12.4 to 1.2 mS/cm in season A and 20 to 2.2 mS/cm in season B. The DO is major parameters to access the pollution load. DO values vary from 8.1 to 4.9 mg/l in season A and 7.7 to 4.03mg/l in season B. In the present investigation DO content is higher than 4.0 mg/l in all the cases. In the current study only one sampling location Hawly exceeds WHO permissible limit of hardness in both the season. Basically Hardness is the property of water which prevents the lather formation with soap and also increased the boiling points of water. Hard water chokes water pipes, deposits incrustation on utensils and increases soap consumption. Most of the observations are on the high end of the scale, so the distribution of total hardness is skewed left. In the present study the calcium concentration exceed the maximum permissible limit of WHO (75 mg/l) in two sampling location namely Nityananda and Hawly in both season A and B. The other locations are within the limit of hardness pollution. Higher concentration of calcium is not

desirable in washing, laundering and bathing due to its suppression of formation of lather with soap. **Fig.2** (a) and (b) box plot shows the calcium distribution which is skewed right. All the studied samples are above WHO permissible limit (30 mg/l) of magnesium in both the season. Wide data range and high standard deviation in case of magnesium in both A and B season are likely to bias the normal distribution statistic. Ca & Mg are important parts of drinking water and are of both direct and indirect health significance. In the present study chloride content of water samples does not exceed the BIS value of 250 mg/l.

Table 2: Descriptive statistics of elemental concentration for the studied physical parameters for Season A

Statistics						
		Temperature	pH	TDS	Turbidity	EC
N	Valid	20	20	20	20	20
Mean		24.7500	7.2200	89.1000	2.1095	5.3900
Median		25.0000	7.1500	81.0000	2.1450	4.0000
Mode		26.00	7.50	80.00	1.30	3.90
Std. Deviation		1.37171	.46294	3.97160E1	.67271	3.25526
Variance		1.882	.214	1.577E3	.453	10.597
Skewness		-.450	-.089	3.800	.026	.986
Std. Error of Skewness		.512	.512	.512	.512	.512
Kurtosis		-1.751	1.132	15.999	-1.355	-.328
Std. Error of Kurtosis		.992	.992	.992	.992	.992
Range		3.00	2.10	195.00	2.10	11.20
Minimum		23.00	6.10	55.00	1.10	1.20
Maximum		26.00	8.20	250.00	3.20	12.40
Percentiles	25	23.0000	7.0000	71.2500	1.5000	3.1500
	50	25.0000	7.1500	81.0000	2.1450	4.0000
	75	26.0000	7.5000	91.0000	2.6750	8.8000

Table 3: Descriptive statistics of elemental concentration for the studied physical parameters for Season B

Statistics						
		Temperature	pH	TDS	Turbidity	EC
N	Valid	20	20	20	20	20
Mean		19.050	7.130	97.600	2.345	6.191
Median		19.0000	7.1600	88.0000	2.2500	4.3000
Mode		19.00	6.50	85.00	1.60	2.20
Std. Deviation		.88704	.42766	4.03594E1	.90247	4.76663
Variance		.787	.183	1.629E3	.814	22.721
Skewness		.398	.457	2.214	.165	1.602
Std. Error of Skewness		.512	.512	.512	.512	.512
Kurtosis		-.526	.304	4.736	-.631	2.321
Std. Error of Kurtosis		.992	.992	.992	.992	.992
Range		3.00	1.60	158.00	3.40	17.80
Minimum		18.00	6.50	62.00	.80	2.20
Maximum		21.00	8.10	220.00	4.20	20.00
Percentiles	25	18.0000	6.7425	71.2500	1.6250	2.7600
	50	19.0000	7.1600	88.0000	2.2500	4.3000
	75	20.0000	7.3375	99.2500	3.0750	9.5000

Excessive chloride gives a salty taste to water and can cause lenitive effects. Possible sources of chloride are discharge of domestic sewage, sodium chloride, bleaching powder etc. High

concentration of chloride can also damage pipes, structures & can inhibit plant growth**.** The range of sodium content of water samples varies from 52 to 6.9 mg/l in season A and 49 to 7.9 mg/l in season B which is well within the WHO permissible limits (200 mg/l).

Table 4: Descriptive statistics of elemental concentration for the studied Chemical parameters for Season A

Statistics								
		DO	TH	Calcium	Magnesium	Chloride	Sodium	Potassium
N	Valid	20	20	20	20	20	20	20
Mean		6.615	127.800	50.175	91.750	61.695	25.205	5.295
Median		7.0000	92.0000	48.0000	71.0000	58.5000	26.5000	5.0000
Mode		7.50	92.00	18.00	71.00	62.00	18.00	6.00
Std. Deviation		0.98423	7.9781	2.31137	61.02230	2.81157	1.20523	3.37381
Variance		0.969	6.365	534.244	3723.722	790.490	145.258	11.383
Skewness		-0.576	2.504	0.844	2.612	0.656	0.431	0.615
Std. Error of Skewness		0.512	0.512	0.512	0.512	0.512	0.512	0.512
Kurtosis		-1.024	6.979	0.401	7.724	0.464	-0.133	-0.649
Std. Error of Kurtosis		0.992	0.992	0.992	0.992	0.992	0.992	0.992
Range		3.20	337.00	84.00	262.00	114.00	45.10	11.00
Minimum		4.90	65.00	18.00	43.00	16.00	6.90	1.00
Maximum		8.10	402.00	102.00	305.00	130.00	52.00	12.00
Percentiles	25	5.5250	88.0000	30.7500	63.2500	45.4750	16.7750	2.4250
	50	7.0000	92.0000	48.0000	71.0000	58.5000	26.5000	5.0000
	75	7.4250	1.4250	58.2500	105.5000	79.5750	32.0000	7.0000

Table 5: Descriptive statistics of elemental concentration for the studied Chemical parameters for Season B

Statistics								
		Dissolved Oxygen	Total Hardness	Calcium	Magnesium	Chloride	Sodium	Potassium
N	Valid	20	20	20	20	20	20	20
Mean		6.618	136.900	35.706	98.798	54.546	23.250	3.350
Median		6.8200	99.5000	30.6300	73.0000	48.1950	21.0000	2.5000
Mode		6.45	90.00	9.60	73.00	14.20	20.00	1.00
Std. Deviation		.87114	97.21106	2.77297E1	70.67306	2.74607E1	1.00672E1	3.21632
Variance		.759	9449.989	768.936	4994.681	754.093	101.349	10.345
Skewness		-1.589	2.692	2.553	2.880	.634	.601	2.727
Std. Error of Skewness		.512	.512	.512	.512	.512	.512	.512
Kurtosis		3.225	8.268	7.127	9.091	.204	.781	9.158
Std. Error of Kurtosis		.992	.992	.992	.992	.992	.992	.992
Range		3.67	420.00	119.90	307.00	106.50	41.50	14.00
Minimum		4.03	62.00	9.60	46.00	14.20	7.50	1.00
Maximum		7.70	482.00	129.50	353.00	120.70	49.00	15.00
Percentiles	25	6.4500	90.0000	19.0250	63.5500	37.6250	17.0250	1.0000
	50	6.8200	99.5000	30.6300	73.0000	48.1950	21.0000	2.5000
	75	7.2000	143.5000	35.8250	106.7500	81.6500	30.5750	4.0000

Anthropogenic factors like industrial and domestic wastes also input sodium to ground water. Sampling location Bajali reported highest amount of potassium in both the season. It is seen that potassium concentration was relatively lower than those of sodium. Sodium and potassium are naturally occurring ions in ground water as a result of weathering of rocks and minerals. During

the study, slight seasonal variations are also observed for all the physico-chemical parameters under investigation.

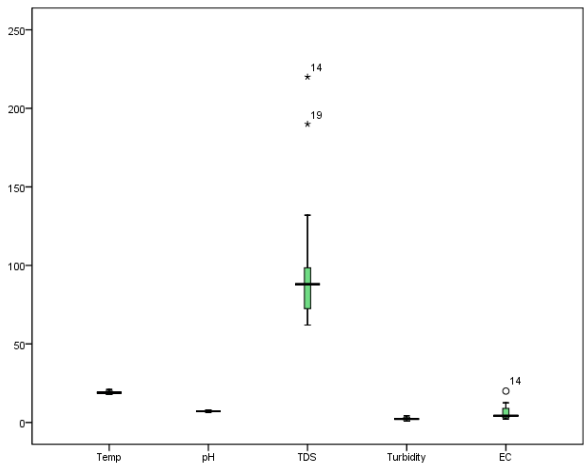

Fig. 1(a)

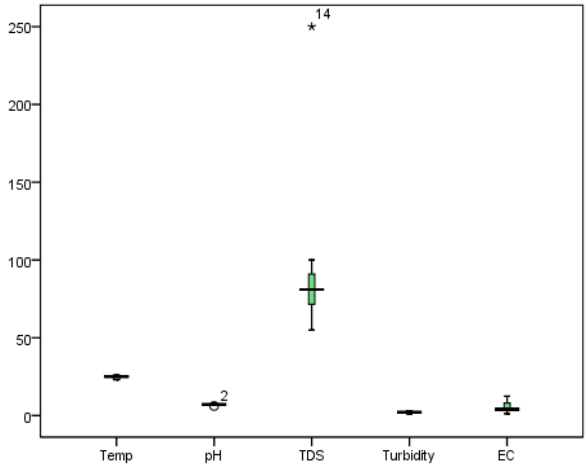

Fig. 1(b)

Fig .1 Box-plot showing distribution of physical parameters in the study area in Season A [1. (a)] and Season B[1.(b)]

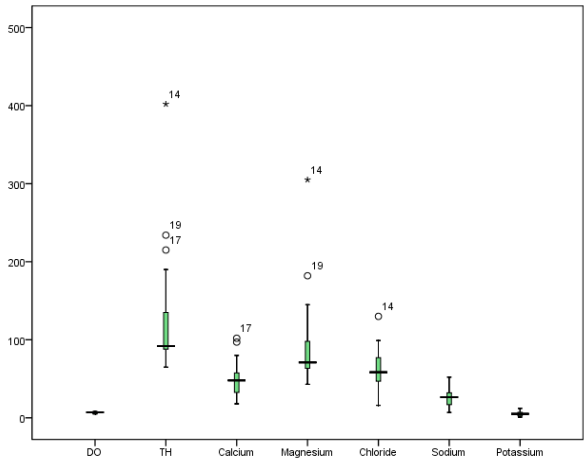

Fig. 2(a)

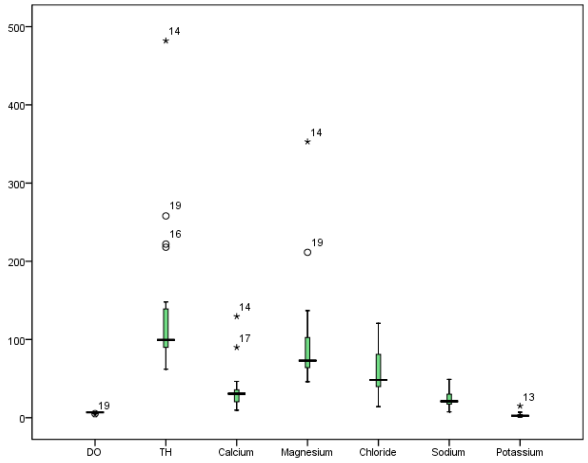

Fig. 2(b)

Fig .2 Box-plot showing distribution of chemical parameters in the study area in Season A [2.(a)] and Season B[2.(b)]

CONCLUSION

The study shows that the quality of water varies from locations to locations. Higher values of certain parameters at certain location indicate that the water of those locations is not suitable for drinking as such. In the present situation, few water sources are not safe for use in respect to total hardness, higher magnesium and calcium content which may lead to poor drinking water quality. It is suggested that ground water should be analyzed to check pot ability so that it become suitable for domestic purposes. It can reveal from the present study that contamination problem is not alarming at present but ground water quality may deteriorate with time. Therefore periodical monitoring can help to avoid contamination of ground water of the region.

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