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Ground Water Quality Assessment of some parts of Brahmaputra Flood plain in Barpeta district, Assam with special focus on Fluoride, Nitrate, Sulphate and Iron analysis

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Abstract: This study is focused on ground water quality assessment of some parts of Brahmaputra flood plain in Barpeta District, Assam. Twenty different water samples are analyzed for fluoride, nitrate, sulphate and iron contamination by adopting standard analytical techniques of APHA. Fluoride was measured by the SPADNS method at 570nm and Nitrate content was measured by the phenol-disulphonic acid method at 410nm using UV–VIS spectrometer, Shimadzu 1240 model. Turbidimetric method was used for Sulphate analysis. Iron was estimated by using Phenanthroline Method (APHA-AWWA-WPCF, 1995) at 510 nm. Descriptive statistics in the forms of mean, variance, standard deviation, median, range of variation, skewness, kurtosis are computed for five water quality parameters. The study revealed that the water sources in the region are mostly polluted with iron. Proper maintenance and treatment of water is required to improve the quality of drinking water.
Key words: Water, pH, iron, nitrate, sulphate, fluoride.

INTRODUCTION

Water quality assessment is one of the prime concern and a major challenge in all over the world. Needless to say water quality criteria is directly related to the health factors. Water quality determines the 'goodness' of water for particular purposes. Water quality tests will give information about the health of the waterway. By testing water over a period of time, the changes in the quality of the water can be seen. Drinking water has a vital role in public health and this is a major driver for the development of standard to ensure the safety of drinking water and to safeguard public health. Assessment of adequacy of the chemical quality of drinking-water relies on comparison of the results of water quality analysis with guideline values. Ground water is generally considered as a safe source of fresh drinking water. A guideline value represents the concentration of a constituent that does not exceed tolerable risk to the health of the consumer over a lifetime of consumption. Guidelines for some chemical contaminants (e.g., fluoride, nitrate) are set to be protective for susceptible populations. These guidelines are also protective of the general population over a lifetime. It is assessed that potential of fluoride

(F) contamination in drinking groundwater of an intensively cultivated district in India as a function of its litho logy and agricultural activities[1]. Another contaminant that attracts public attention is nitrate. Owing to the high nitrate levels in the upper layers of agricultural land it is expected that nitrate levels in groundwater will continue to increase in the near future. The main public health concern of nitrate relates to adverse effects in bottle-fed infants[2]. Iron is found in surface and ground waters at varying concentration levels. When present, even at low concentrations it can be linked to aesthetic and operational problems such as bad taste and color, staining, as well as deposition in the water distribution system leading to incidence of high turbidity. Iron also promotes the growth of certain types of chlorine-tolerant microorganisms in water distribution systems, thus causing increase costs for cleaning and sterilizing systems in addition to odor and taste problems. The highest permitted limit of iron concentration for drinking water is 0.2mg/l.[3]. The Iron is reported in various places of Assam[4, 5, 6]. There is a need for more systematic and careful study eliminating all possible sources of error and to build up a reliable database for ground water quality analysis[7].The study area selected for the research named Barpeta is a district headquarters and with the same name a district stands in Lower Assam. Barpeta district ranks fourth in overall ranking among the districts population size in Assam. The chemical analysis of drinking water quality 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 about the concept of safe drinking water.

STUDY AREA:

Barpeta District lies between $90^0 40^/$ to $91^0 20^/$ East longitude and $26^o 15^/$ to $27^o 05^/$ North latitude. It has a fascinating, diversified, alluvial landscape of 3245 square kilometer. This district is bounded by the Bhutan Hills in North; Nalbari district in the East; Kamrup and Goalpara district in the South and Bongaigaon District in the West. The mighty Brahmaputra flows from east to west across the southernmost border of the district. Physiographically the major part of the district forms the part of vast alluvial stretch of river Brahmaputra stretching in east-west direction and its northern parts extends up to foothills of the Bhutan Himalayas. The sampling locations are shown in Fig.1.

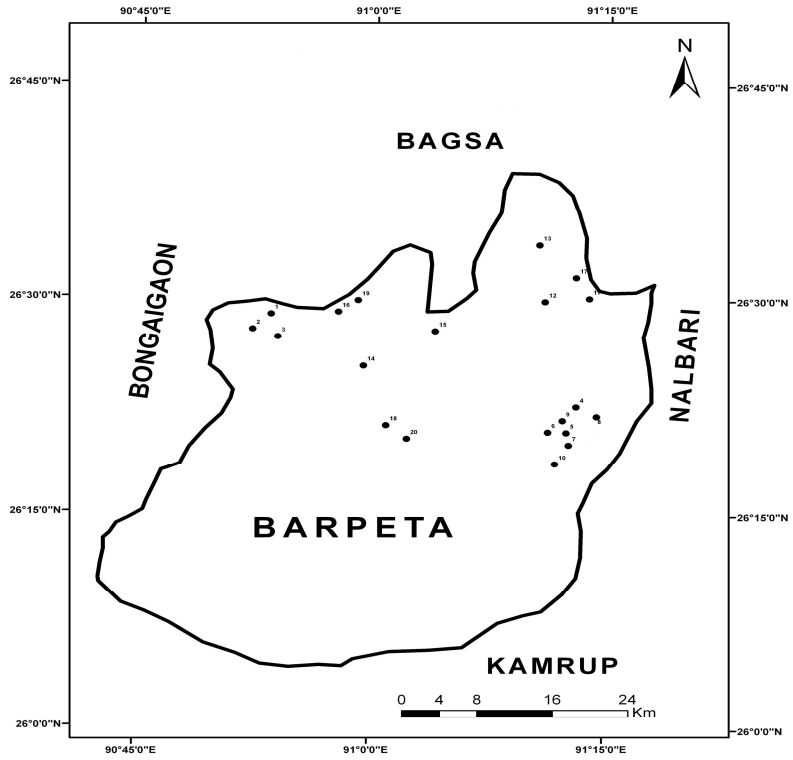

Fig.1. Sampling point of the study area

MATERIALS AND METHOD:

Different water samples were collected in summer and post monsoon period in 2008 by random selection and stored in plastic containers and then sealed. pH was determine in the laboratory immediately after sampling. The samples were then analyzed according to standard procedure[8]. Fluoride was measured by the SPADNS method at 570nm and Nitrate content was measured by the phenol-di sulphonic acid method at 410nm using UV–VIS spectrometer, Shimadzu 1240 model. Turbidimetric method was used for Sulphate analysis. Iron was estimated by using Phenanthroline Method[8] at 510 nm. The instruments were used in the limit of précised accuracy and chemicals used were of analytical grade. Doubly-distilled water was used for all purposes[8].

The observed parameters are related graphically (Figs. 2-6). Descriptive statistics in the forms of mean, variance (V), standard deviation (SD), median, range of variation, skewness and kurtosis are calculated and summarized in tabular forms (Table. 2). SPSS® statistical package (Window134 Version10.0) was used for data analysis.

RESULTS AND DISCUSSION

In the present investigation the potability of water for drinking purpose with respect to fluoride, nitrate, sulphate and iron was compared with the standards set by WHO for different chemicals in water. Table.1 shows various sampling locations of the study area.

Table 1: Water sampling stations in the study area

SL.No	Name of the Village	Sources	SL.No	Name of the Village	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(collegeroad)	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

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Table 2 Descriptive statistics of the water quality parameters

Descriptive Statistics												
		Range	Minimum	Maximum	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
	WHO Rating	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
pH	6.5-8.5	1.40	6.10	7.50	6.8850	.07007	.31334	.098	-.519	.512	1.072	.992
F^-	1.5mg/L	.94	.11	1.05	.5066	.08535	.38170	.146	.239	.512	-1.813	.992
NO3	50mg/L	11.29	.71	12.00	5.4660	.81486	3.64414	13.280	.493	.512	-.874	.992
SO4	250mg/l	24.00	8.00	32.00	18.6200	1.69165	7.56527	57.233	.308	.512	-1.214	.992
Fe	0.3mg/L	1.40	.15	1.55	.5746	.08796	.39339	.155	1.001	.512	.163	.992

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. The median is indicated by the vertical line that runs down the centre of the box. In case of pH (Fig.2) the distribution is skewed left. An extreme value is observed which is known as outlier in the set of the value. The observation is evenly split at the median in fluoride distribution. Hence the distribution is symmetric (Fig.3). Fig.4 shows the nitrate distribution which is skewed left. The distribution of sulphate is symmetric (Fig.5). Most of the observations are on the high end of the scale, so the distribution of Iron is skewed left (Fig.6).

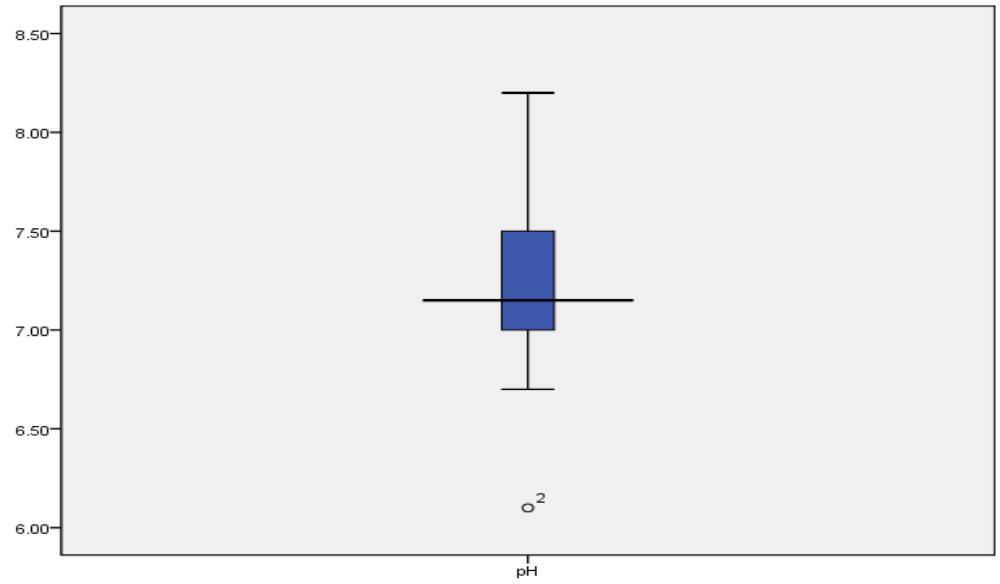

Fig .2 Box-plot showing distribution of pH in the study area.

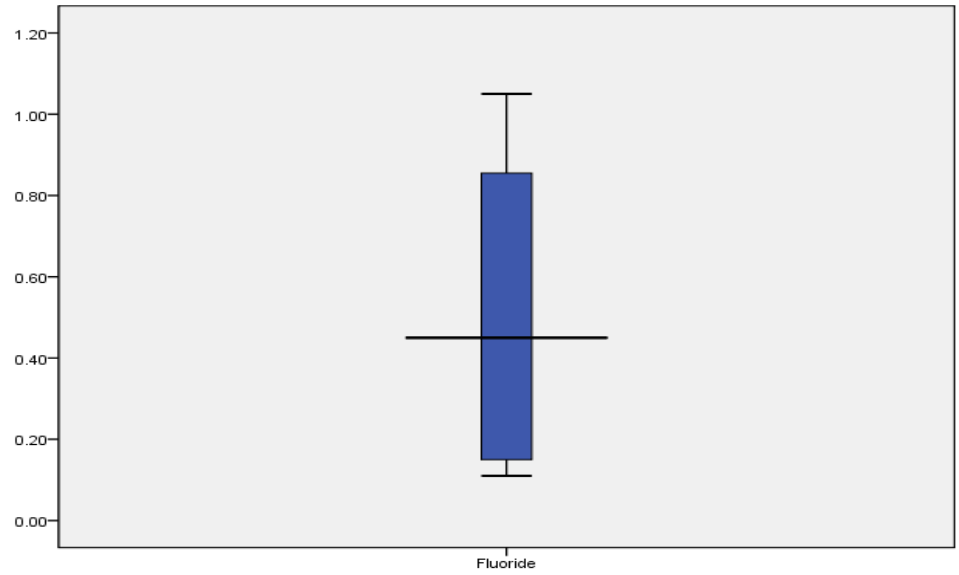

Fig.3 Box-plot showing distribution of Fluoride in the study area.

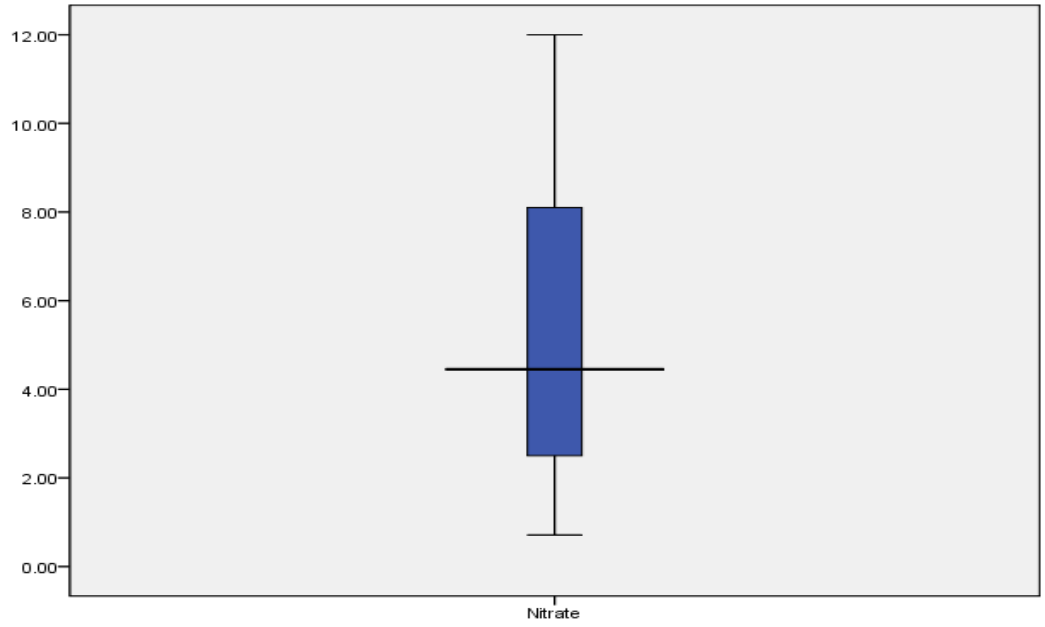

Fig .4 Box-plot showing distribution of nitrate in the study area.

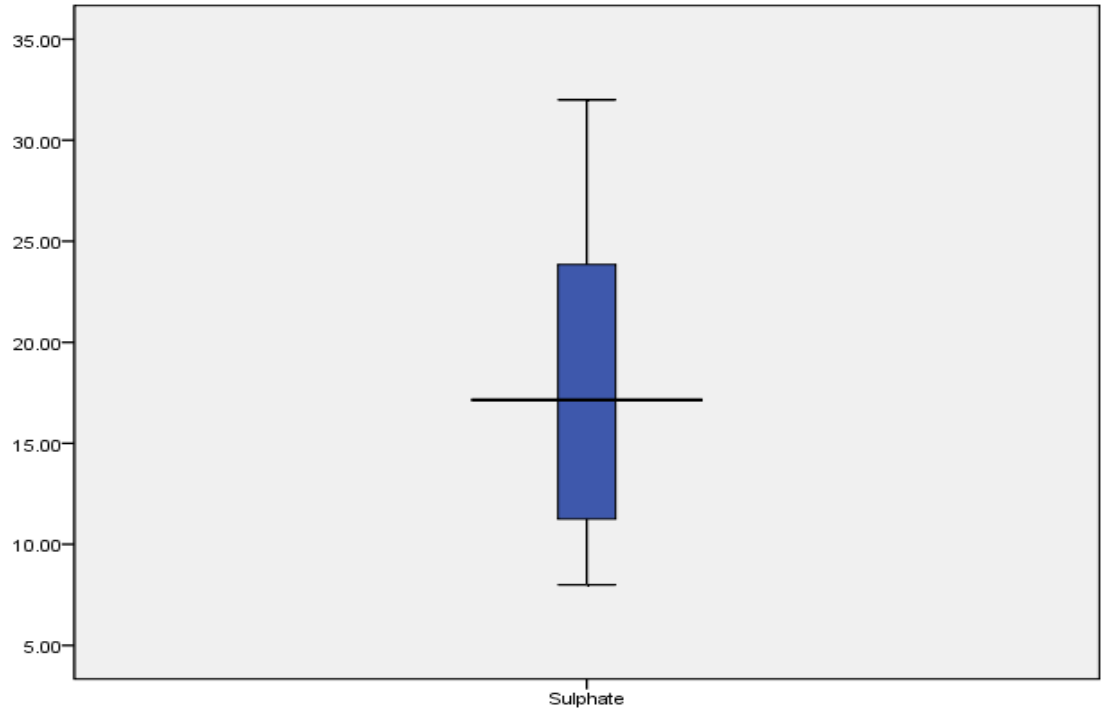

Fig.5 Box-plot showing distribution of Sulphate in the study area.

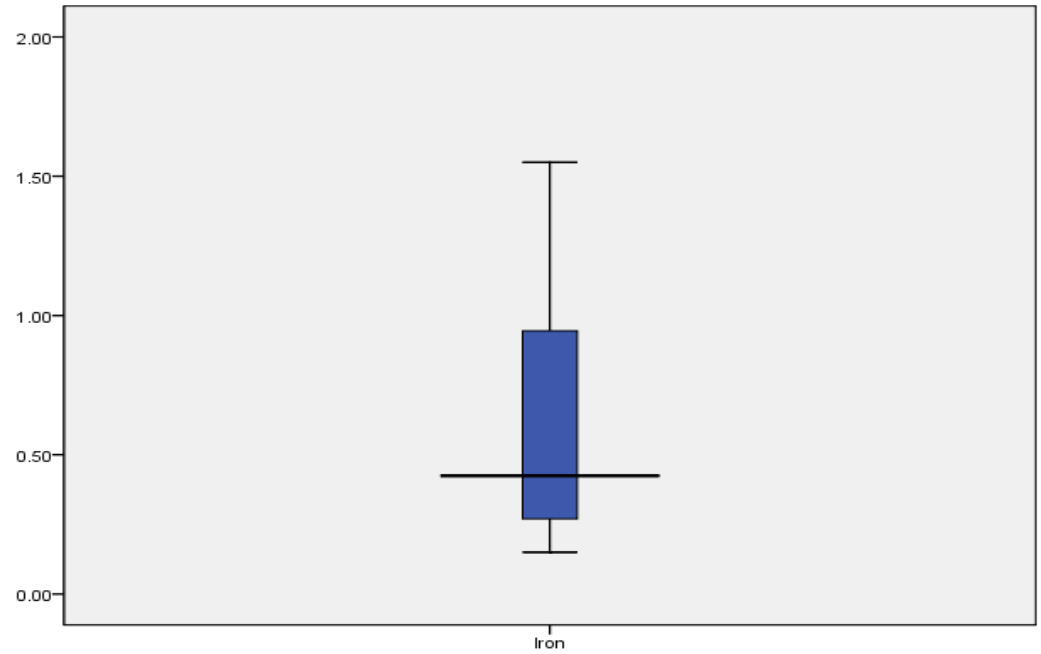

Fig .6 Box-plot showing distribution of nitrate in the study area.

In all the sampling stations, the variation of pH is narrow and in general, most water samples are alkaline in nature. Fluoride is a normal constituent of natural waters and its concentration varies depending on the water source. Different parts of India have different values of fluorides in groundwater. In the present investigation, the fluoride concentrations were found to be within the permissible limit of W.H.O., fluoride concentration in drinking water produces divergent health effects on the consumer depending upon their relative proportions. The concentrations of sulphate and nitrate in water under study are within the approved WHO guide line values for safe drinking water. About 65% of the sampling locations are contaminated by iron as they exceed the WHO guideline value of 0.3 mg/L. Piped water supply susceptible to internal corrosion and leaching of iron into water as well as forming iron scales that may produce particulate iron compound in water rendering "red water" that adversely affects the water quality[9]. The concentration of iron in water in the area is not suitable for food processing, dyeing, bleaching and many activities.

CONCLUSION

The intrinsic quality of waters in different parts of Barpeta district, Assam is to some extent poor and there is a need to improve the water quality management system. Presence of iron in higher amount may cause problems in near future. Therefore the water of the areas is not properly protected from potential contaminants, and so that appropriate treatment should be selected for future use of water in the region. This study could provide useful information for water quality assessment and sustainable water management.

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