Available online on www.ijpqa.com
International Journal of Pharmaceutical Quality Assurance
2009, Volume 1, Issue 1, Page 9-12

Research Article

Ground Water Quality of Piro and Jagdishpur Blocks of Bhojpur District: A Middle Gangatic Plain

Md. Shahnawaz, K.M. Singh.

P.G. Department of Chemistry H. D. Jain College, Veer Kunwar Singh University, Ara-802301

Received 27 July 2009; received in revised form 24 August 2009; accepted 19 September 2009
Available online 9 October 2009

Abstract: This communication presents an analysis of physico-chemical characteristics of groundwater quality of Piro and Jagdishpur blocks of Bhojpur District of Bihar. Total 40 numbers of groundwater samples were collected from different locations of these blocks and analysed for the parameters pH, electrical conductivity (EC), total dissolved solid(TDS), total hardness(TH), calcium(Ca^{2+}), magnesium(Mg^{2+}),fluoride(F^-), iron(Fe), sulphate(SO_4^{2-})and arsenic (As). Water samples were collected from shallow hand pumps, deep hand pumps and public water supply.

Keywords: Groundwater, contamination, quality, permissible limit, Bhojpur district

INTRODUCTION

The modern civilization, industrialization, urbanization and increased population are the main causes of fast degradation of our environment. Water is indispensable and one of the precious natural resources of this planet. Groundwater is an important source of water supply throughout the world[1]. Water is a prime need for human survival and industrial development. For many rural and small communities, groundwater is the only source of drinking water. The geology of a particular area has a great influence on quality of water and its environment. Many a time ground water carries higher mineral contents than surface water, because there is slow circulation and longer period of contact with sediment materials in case of groundwater. Changes of groundwater quality with the passage of time have hydrologic significances. The quality also varies due to a change in chemical composition of the underlying sediments and aquifer[2,3]. The groundwater chemistry is controlled by the composition of its recharge components as well as by geological and hydrologic variations within the aquifer.

Water quality plays an important role in the overall water balance of the environment. Polluted groundwater is the cause for the speed of epidemics and chronic diseases in human beings. A large no. of people has to die because of water borne diseases every year in our country. Bihar is of no exception. In Bihar the population is dependent mainly on ground and surface water sources to fulfill their daily needs related to water. Very few parts of Bihar are having a proper water supply system. Mostly, the people are dependent on their own sources for getting water. There is lack of detailed information regarding the over-all quality of water sources of this region. The water of this region has the affinity to dissolved metals and therefore trace metal contamination is also expected. Acharya et al. has reported that the groundwater of Utter Pradesh and Bihar has low concentration of iron (0-700μg/L) and on this basis, commented that the relatively low value of dissolved iron upstream of the Ganges Delta indicates that the environment may not be sufficiently reducing to mobilize iron and arsenic[4]. Study by Chakraborty et al. revealed moderate to high concentration of arsenic in Bihar in middle gangatic plain[5]. Chakraborty et al. also reported moderate to high concentration of arsenic in 2003 in Utter Pradesh[6] With this background, the present study was initiated to determine the concentration of contamination and the suitability of groundwater for drinking purpose.

Corresponding author: Md. Shahnawaz
P.G. Department of Chemistry
H. D. Jain College, Veer Kunwar Singh University,
Ara-802301
E-mail: md_shahnawaz123@rediffmail.com

EXPERIMENTAL

Location

The area and population of Bhojpur situated in middle Gangatic plain are 2474 km^2 and 1.80 million (census 2001), respectively. The climate of the district is tropical monsoon but variations exist due to differences in altitude. The majority of the population depends on farming as its main occupation. Infant mortality is below 60 (per 1000) in the region. The administrative structure of Bhojpur consists of 14 blocks each having several Gram Panchayats (GP), which are the clusters of villages. To understand the severity of contamination and consequent health effects in Bangladesh, West Bengal and Semria ojhapatti village of Shahpur block of this district, we studied Bhojpur district and undertook a detail survey in these blocks.

Physical setting

The large-scale features of the Ganga plain correspond to major climate changes in the late Quaternary[7]. The geomorphic surfaces identified in the regional mapping of

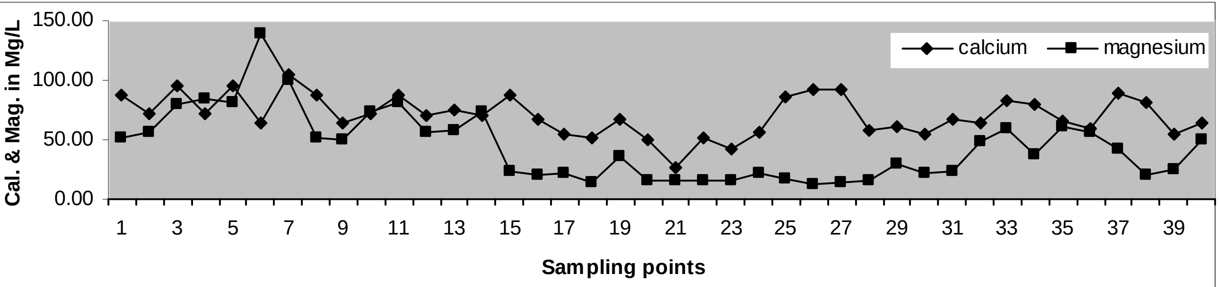

Figure 2. Variation of Ca & Mg content with different sampling points

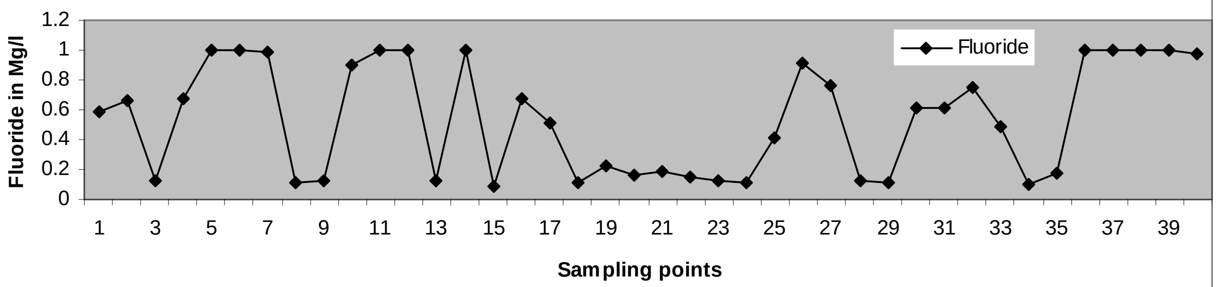

Figure 3. Variation of F content with different sampling points

the Quaternary deposits of the Ganga plain are upland interfluves surface (T_2), marginal fan upland surface (MP), mega fan surface (MF), piedmont fan surface (PF), river valley terrace surface (T_1) and active flood plain surface

(T_0). A significant aspect of these surfaces is that all of them are depositional surfaces, having a succession of overlying sediments. The Bihar Ganga plain (50–200m above the ASL, and 550–1000 km from the sea coast) shows prominent distinction between T_0, T_1 and T_2 surfaces. The Holocene aggradations, mostly due to rising base level and climate-driven sediment supply, are more pronounced here compared with U.P. plain. The Ganga plain foreland basin is a repository of sediments derived from the Himalayas and from Peninsular Craton. The weathered material brought from the Himalaya is deposited in the alluvial plain where they undergo further chemical weathering, mobilizing several anions and cations. In Ganga river sediments As, Cr, Cu, Pb, U, Th, W, etc. are concentrated significantly[7].

MATERIALS AND METHODS

The physico-chemical analysis of groundwater samples collected from these blocks was carried out, according to the standard method APHA[8]. A total of 60 water samples were collected in pre-monsoon season. All the samples were collecting in poly propylene bottles. Before collecting the samples, bottles were thorough cleaned by 8MHNO_3, followed by repeated washing with deionized water. Adding 1:1 HNO_3 for analysis of arsenic and other heavy elements preserved 1 L of each of the collected water samples. The reagents used in the study were all analytical grade reagents and demonized water was used throughout for the reagent preparation. The pH of the water samples was determined in the field at the time of sample collection by using portable pH meter (Merck, India). Fluoride contents were determined by SPANDS method using spectrophotometer (Analytik-Jena, Specord – 40, Germany). Sulphate was determined by spectrophotometer method (Analytik – Jena, Specord-40, Germany). Total hardness (TH) of the samples was determined by titrimetric method. The analysis of magnesium and calcium were determined by the method of titration. The concentrations of heavy elements and arsenic

***Table 1*. Results of different physico-chemical parameters.**

Block	F^- Min-Max	Fe Min-Max	SO_4^{2-} Min-Max	As Min-Max
Piro	0.07-0.51	0.11-1.11	15.2-30	0.004-0.051
Jagdishpur	0.11-1.0	0.18-0.65	12.3-80	0.03-0.04

***Table 2*. : Results of arsenic and other heavy elements in Mg/L**

Block	pH Min-Max	EC Min-Max	TDS Min-Max	TH Min-Max	Ca^{2+} Min- Max	Mg^{2+} Min-Max
Piro	6.9-8.1	0.55-1.00	270-887	214-322	27.1-91.5	14.9-60.8
Jagdishpur	6.4-7.5	0.65-0.80	311-1011	250-700	42.3-120	12.5-139

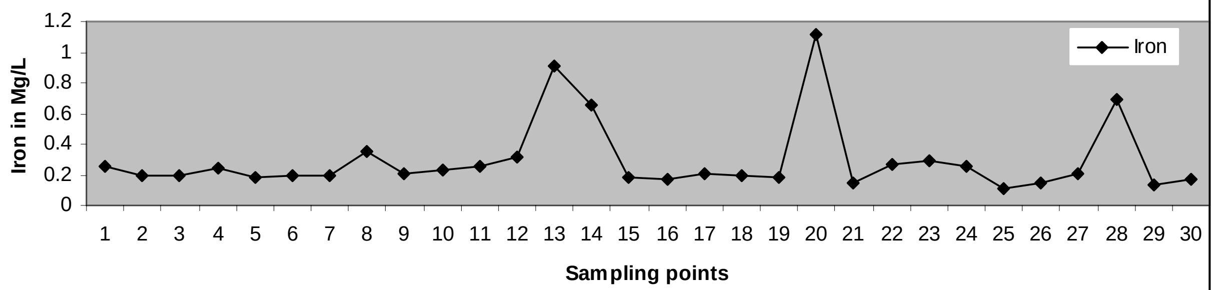

Figure 4. Variation of Fe with different sampling points

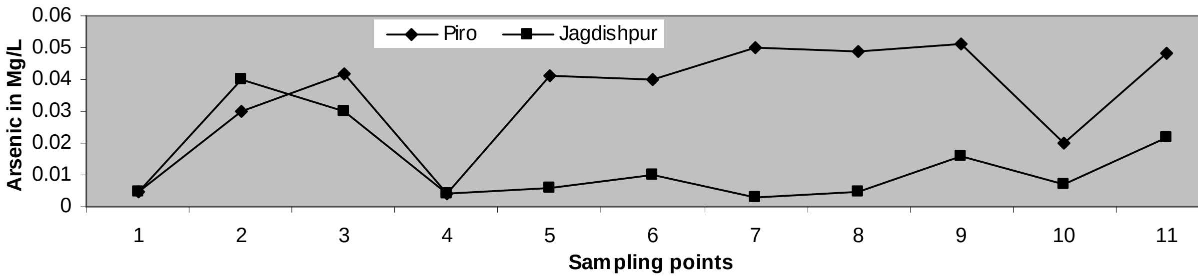

Figure 5. Variation of As content with different sampling points from diffrent blocks

in the water samples were determined by atomic absorption spectrometer (Perkin Elmer Analyst 200, USA).

RESULTS AND DISCUSSION

The result of pH, EC, TDS, TH, Ca^{2+} and Mg^{2+}, are presented in *table 1* and arsenic and other heavy elements such as F^-, Fe, and SO_4^{2-} are presented in *table 2***.**

Ph : The pH of 90% of the water samples analyzed were within the desirable limit of 6.5 – 8.5 given by WHO standard and most of the samples were slightly alkaline in nature. In this study

pH of water samples from Piro and Jagdishpur blocks varied from 6.9 to 8.1 and 6.4 to 7.5 respectively. The minimum value recorded was 6.4 in Jagdishpur and maximum 8.1 in Piro.

Electrical conductivity and Total dissolved solid: The EC which is highly correlated with TDS is ranged from 0.55 to 1.00 mmho cm^{-1}. Indian standards for drinking water propose no standards for EC, however, the standard for T.D.S are proposed which are 500 to 2000 Mg/L.

From *table 1* it is seen that T.D.S of water samples from Piro and Jagdishpur varies from 270 to 887 and 311 to 1011Mg/L respectively. The minimum value recorded is 270 from Piro Block and the maximum value recorded is 1011 Mg/L from Jagdishpur block.

Total Hardness: It is the measure of the capacity of water to precipitate soap. Though hardness is not harmful to health, it has been suspected to be plying some role in heart disease. In this study, total hardness of all samples found to be below the permissible limit 600 Mg/L for drinking water. From *table 1* it is seen that total hardness of water samples from Piro and Jagdishpur blocks varies from 214 to 322 and 250 to 700 Mg/L respectively. The minimum and maximum values recorded were 214 and 700 Mg/L from Piro and Jagdishpur block respectively.

Calcium: In order of abundance it is the fifth element which is commonly present in all water bodies where it usually comes from the leaching of rocks. Calcium is very essential for nervous systems and for formation of bones. In this study calcium concentration of water samples from Piro and Jagdishpur blocks varied from 27.1 to 91.5 and 42.3 to 120 Mg/L, respectively. The concentration of calcium in potable water ranges from 75 to 200 Mg/L. The maximum value recorded was 120 Mg/L in Jagdishpur block.

Magnesium: Magnesium tolerances by human body are lower than that of calcium. High concentration of magnesium in drinking water gives unpleasant taste to the water. The concentration of magnesium in potable water ranges from 30-100 Mg/L. In this study magnesium concentration of water samples from Piro and Jagdishpur block varied from 14.9 to 60.8 and 12.5 to 139 Mg/L, respectively. The minimum and maximum-recorded values of magnesium were minimum 12.5 and maximum 139 Mg/L in Jagdishpur block. The variation of calcium and magnesium content with different sampling point are given in *figure 2*.

Fluoride: High concentration of fluoride in drinking water can cause an adverse effect on human beings. Continuous consumption of water having high fluoride content can cause diseases, like fluorosis, dental carries and bone diseases[9]. The concentration ranges observed in this study were 0.07 to 0.51 and 0.11 to 1.0 Mg/L for Piro and Jagdishpur block, respectively. Maximum value recorded was 1.0 Mg/L in Jagdishpur block. The variation of fluoride content with different sampling points is shown in *figure 3*.

Iron: Iron is considered to be the most essential element to all organisms. It is present in hemoglobin and myoglobin systems. Presence of iron in water can cause staining laundry and porcelain. It gives stringent taste to water when water contains iron concentration above the permissible limit 1 Mg/L of drinking water. In this study iron concentration of water samples from Piro and Jagdishpur block varied from 0.11 to 1.11 and 0.18 to 0.65 Mg/L respectively. The maximum concentration observed was 1.11 Mg/L in Piro block. The variation of iron content with different sampling points is presented in *figure 4*.

Sulphate: It is the common ion in water. Sulphate can produce bitter taste at high concentration. Sodium and magnesium sulphate exert a cathartic action in human beings. It is also associated with respiratory diseases. The permissible limit and desirable limit of sulphate in drinking is 200 to 400 Mg/L, respectively. In this study minimum recorded value of sulphate were 12.3 Mg/L and maximum 80 Mg/L in Jagdishpur block. From *table 2* it shows that sulphate content of the two blocks of Bhojpur district are all within the permissible limit of drinking water.

Arsenic: Water contaminated by arsenic is a burning problem affecting the whole world. Arsenic at high concentrations in water can cause skin lesion, cancers, vascular diseases, and hypertension and diabetes mellitus[10]. It is observed that drinking water with more than 300 µg/L arsenic for several years may cause arsenic skin lesions[11]. Ingestion of Inorganic As is an established cause of skin bladder and lung cancer[12, 13]. In this study, As of water samples from Piro and Jagdishpur block vary from 0.4 to 0.051 and 0.03 to 0.04 respectively. The minimum and maximum value recorded was 0.004 and 0.051 from Piro block respectively. The variation of arsenic content in different sampling points from different blocks of Bhojpur district is shown in *figure 6*

CONCLUSIONS

Analysis of groundwater samples collected from these blocks shows that pH of 90 % water samples analyzed were within the desirable limit of 6.5-8.5 given by WHO standard and most of the samples were slightly alkaline in nature. Similarly TDS, TH, Ca^{2+} and Mg^{2+} concentration in the water samples are all within the permissible limit of drinking water. SO_4^{2-}, F^- and Fe content in the groundwater samples from these blocks are also found within the permissible for drinking water. The analysis report of as in groundwater of Jagdishpur block shows normal range at all. Although As of groundwater samples of Piro block is also in range, 54.54% of the total samples have As at border line i.e. 0.05 Mg/L. Previous experiences of Bangladesh and West Bengal and also of this district suggest that the arsenic problem tend to grow with passage of time. Hence a scientific and periodic measure to combat this problem is the demand of the hour.

ACKNOWLEDGEMENT

The authors are thankful to all villagers for their participation and assistance.

REFERENCES

1. Mariappan, et al. 2005. A systemic study of water quality index among the physico-chemical characteristics of groundwater around Thanjavur town. Indian J.Env. prot., 25(6):551-555.
2. Jameel, Abdul. 2002. Evaluation of drinking water quality in Thiruchirapalli, Indian J. Env. prot., 44(2): 108-112.
3. Rajmohan, et al. 2002. Major correlation in groundwater of Kancheepuram region, South India. Indian J. Env. Health. 45(1):1-5.
4. Acharya SK, Chakraborty P, Lahiri S, Raymahashay BC, Guha S, Bhowmik A. 1999.Arsenic poisoning in the Ganges Delta. Nature 401:545
5. Chakraborti D, Mukherjee SC, Pati S, Sengupta MK, Rahman MM, Chowdhury UK, et al. Arsenic groundwater contamination in Middle Ganga Plain, Bihar, India:afuture danger. Environ Health Perspect 2003; 111(9):1194–201.
6. Groundwater arsenic contamination and arsenocosis patients in Utter Pradesh(UP).India: first report, Kolkata: School of Environmental studies, Jadavpur University,2004:1-7
7. Singh, A.K. 2004. Arsenic contamination in groundwater of north eastern India. 11th National symposium on Hydrology with focal theme on water quality. Roorkee, Proceeding, pp 255-262.
8. APHA. 2005. Standard Methods for the examination of water and wastewater (21St edn). American Public Health Association, Washington.
9. Rao, et al. 2004. Physico-chemical analysis of water samples of A. Konduru Mandal, Krishna district. Indian J. Env. Prot., 24(9): 695-704.
10. Das, et al, 1996. Water quality of north eastern region. *Technical Bulletin.* Defence Research Laboratory, Tezpur.
11. Chakraborti D, Rahman MM, Paul K, Chowdhury UK, Sengupta MK, Lodh D, et al. Arsenic calamity in the Indian sub-continent-what lessions have been learned? Talanta 2002;58:3–22.
12. NationalResearchCouncil. Arsenic in drinking water. Washington, DC: National Academy Press, 1999. 330 p.
13. National Research Council. Arsenic in drinking water: 2001 update. Washington, DC: National Academy Press, 2001. 244 p.