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# STATUS OF THE DRINKING WATER QUALITY IN SCHOOLS OF BONGAIGAON AREA OF BONGAIGAON DISTRICT OF ASSAM

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## ABSTRACT

Water samples from 15 different schools of Bongaigaon area were studied to assess the suitability of drinking water. A total of 21 physico-chemical parameters including heavy metals as well as bacteriological water quality parameters have been investigated. The anions *viz*., sulphate, chloride and fluoride, and heavy metals *viz*., arsenic, lead and chromium were within the permissible limit, while mercury was present in 20%, and copper and iron in 33.3% of the total water samples studied. Sixty-seven percent of water samples were acidic, while in 40% of the samples turbidity was above the permissible limit. Water samples, particularly from ring wells, have been found bacteriologically contaminated.

## INTRODUCTION

The quality of drinking water plays an important role in maintaining sound health. A safe water is one which should be free from faecal contamination and conform to the limits of chemical contamination (Murugesan et al. 2004). Good quality water has become a precious commodity nowadays. The quality of water is getting vastly deteriorated due to unscientific waste disposal, improper water management and carelessness towards environment. This has led to scarcity of potable water affecting the human health (Agarkar & Thombre 2005). Contaminated water with faecal matter causes a number of diseases. The relation of polluted water and waterborne diseases like typhoid, dysentery and cholera through contaminated water is well known.

Bongaigaon (26°28'N and 89° 96'E), the District Headquarters of Bongaigaon district in Assam with a population of 60,550 (2001 census). However, till date drinking water supply has not been facilitated by civic authority. Every household, business establishment and institution has its own source of drinking water. Because of the different drinking water sources, the quality of it may also be different. Being an industrialized town, there might also be possibility of water contamination by chemical pollutants. Due to improper solid waste management and establishment of government and private hospitals, there are also chances of biochemical contamination of drinking water. However, no study has been made so far to know about the quality of drinking water in Bongaigaon area. It is, therefore, essential to monitor water supply and quality of water. However, due to logistic and manpower limitation, it would have been difficult for us to cover the entire Bongaigaon area to bring under our study at one time. In this regard, more emphasis has been given on the students' health, and, therefore, different drinking water sources in schools were selected for this study in Bongaigaon area.

## MATERIALS AND METHODS

Fifteen schools of Bongaigaon area have been selected randomly for the study. For physico-chemical characteristics, two drinking water samples from each of the 15 schools (denoted by S1 through S15,

Table 1) of Bongaigaon area were collected per month in clean polythene bottles and stored at 4ºC. Thus, all together 24 samples per school were collected for a period of one year from December 2005 to November 2006. The samples were analysed for various physico-chemical characteristics such as pH, turbidity, electrical conductivity, total dissolved solids, total suspended solids, total alkalinity, Ca-hardness, Mg-hardness, total hardness, chlorides, fluorides and heavy metals *viz.*, arsenic, lead, chromium, mercury, copper and iron by standard analytical methods (APHA 1995, NEERI 1986, 1988).

For microbial analyses, water samples were collected in sterilized neutral glass bottles during monsoon, i.e., June through August 2006. One sample from each school per month was collected and immediately transported to laboratory for analysis of total coliforms and *Escherichia coli*. Most Probable Number (MPN) of both coliforms and *E. coli* was determined by using MacConkey's broth using multiple tube fermentation technique at 37º C for 48 hours. MPN was expressed in terms of index/100mL by using standard tables (APHA 1995).

## RESULTS AND DISCUSSION

The results of the study are presented in Tables 1, 2 and 3. Water samples were collected from ring wells in eight schools, tara pumps in five schools, tube well in one school and deep tube well in one school.

The temperature of the water samples ranged from 15°C to 28°C. A rise in temperature of the water leads to the spreading up of the chemical reactions in water, reducing the solubility of gases and amplifies the taste and odour (Murugesan et al. 2004). The range of temperature due to seasonal variation and different sources was found to be normal.

Water samples other than S13 were found to be colourless. Sample S13 was reddish in colour containing high degree of insoluble substances. The taste and odour in drinking water is mainly due to the dissolved impurities often organic in nature (Murugesan et al. 2004).

The pH of water samples ranged from 5.24 to 7.32. The minimum value was recorded at S13, and the maximum at S4. Most of the samples (66.7%) were acidic showing the pH value below the permissible limit (6.5-8.5).

Electrical conductivity varied from 43.10 to 504.02 µmho/cm in the samples and indicated the presence of some ionic matters in water.

The turbidity of water samples ranged from 0.13 NTU to 70.25 NTU. Samples S1, S2, S3, S6, S7 and S13 crossed the permissible limit of turbidity (5 NTU). Samples S1, S7 and S13 showed abnormally high values of turbidity. Turbidity is due to colloidal and extremely fine dispersions. Suspended matter such as clay also contributes to turbidity.

In the present study the total alkalinity, total hardness and TDS values were found to be within the permissible limit. The total alkalinity values ranged from 5.37 to 72.12 mg/L and were within the permissible limit of BIS (200 mg/L). The total hardness of water is characterized by contents of Ca and Mg salts. The total hardness of water samples in the present study ranged from 24.13 to 110.26 mg/L, which is within the permissible limit (300 mg/L). The Ca-hardness was observed with a minimum of 8.35 mg/L to maximum of 95.01mg/L, while the Mg-hardness ranged from 14.12mg/L to 48.16mg/L. The TDS values ranged from 58.12 to 276.08 mg/L, which are within the permissible limit of 500 mg/L. In the present study the TSS values varied between 1.56 mg/L and 52.74 mg/L.

Table 1: Average of Physico-chemical parameters of drinking water samples of Schools of Bongaigaon area during the period December 2005 to November 2006. (Values are in mg/L except pH, EC and Turbidity).

| Schools No. | pH | EC• µmho/ | Turbi-dity (NTU) | T.Alk. | Ca-Hard ness | Mg-Hard ness | Total Hard-ness | TDS•• | TSS* | $SO_4^{-2}$ | $Cl^-$ | $F^-$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S1 | 6.70 | 200.13 | 70.25 | 29.02 | 73.00 | 27.12 | 100.13 | 276.08 | 22.10 | 20.19 | 17.50 | BDL** |
| S2 | 6.71 | 205.32 | 10.19 | 47.05 | 95.01 | 15.27 | 110.08 | 200.21 | 05.33 | 02.25 | 03.23 | BDL |
| S3 | 5.78 | 133.21 | 09.46 | 16.28 | 20.19 | 30.38 | 050.20 | 156.14 | 02.20 | 08.34 | 25.03 | BDL |
| S4 | 7.32 | 209.24 | 00.27 | 72.12 | 18.37 | 32.02 | 050.09 | 152.39 | 02.57 | 01.00 | 25.25 | BDL |
| S5 | 5.49 | 121.04 | 0.085 | 12.42 | 10.41 | 14.12 | 024.13 | 148.61 | 02.26 | BDL | 30.05 | BDL |
| S6 | 5.90 | 237.19 | 07.00 | 34.30 | 26.10 | 22.33 | 048.31 | 130.52 | 02.95 | 18.08 | 40.32 | BDL |
| S7 | 6.04 | 426.23 | 32.57 | 52.16 | 50.05 | 48.43 | 098.31 | 247.99 | 05.14 | 24.17 | 60.42 | 0.10 |
| S8 | 6.40 | 265.05 | 00.13 | 64.06 | 76.18 | 34.09 | 110.26 | 179.87 | 02.36 | 11.09 | 46.10 | BDL |
| S9 | 6.27 | 180.17 | 00.20 | 42.23 | 34.20 | 14.32 | 048.14 | 192.36 | 01.56 | 12.76 | 39.15 | BDL |
| S10 | 6.50 | 132.83 | 00.21 | 36.17 | 38.11 | 18.20 | 056.17 | 200.09 | 02.22 | 09.06 | 41.21 | BDL |
| S11 | 6.50 | 257.42 | 00.98 | 38.07 | 54.03 | 38.07 | 092.10 | 195.92 | 02.17 | 09.71 | 43.02 | BDL |
| S12 | 6.10 | 180.17 | 00.18 | 48.05 | 30.00 | 16.02 | 046.02 | 190.07 | 02.72 | 10.02 | 32.04 | BDL |
| S13 | 5.24 | 504.02 | 66.00 | 06.07 | 08.35 | 48.16 | 056.15 | 058.12 | 52.74 | BDL | 42.20 | BDL |
| S14 | 5.61 | 043.10 | 03.07 | 05.37 | 10.07 | 38.13 | 048.24 | 080.00 | 07.03 | 03.00 | 47.28 | BDL |
| S15 | 6.05 | 106.09 | 00.15 | 32.19 | 22.16 | 20.41 | 042.34 | 117.95 | 02.38 | 04.50 | 10.39 | BDL |

•EC = Electrical Conductivity; ••TDS = Total Dissolved Solids; *TSS = Total Suspended Solids;
**BDL = Below detection limit
S1=Birjhora M,V. School, Bongaigaon, Source: Tara Pump
S2=Hindi H. S. School Mahavirsthan, Source: Ring well
S3=Barpara L. P. School, Barpara, Source: Tara pump
S4=Raghunathsali L.P. School, Purani Bongaigaon, Source: Ring well
S5= Sankardev Sishu Niketon, Bageswaripara, Source:Ring well
S6= Birjhora L.P. School, Barpara, Source: tube well
S7= Birjhora H.S. School, Bongaigaon, Source: Deep tube well
S8= Purani Bongaigaon High School, Deuripara, Source: Ring well
S9= Jelkajhar High School, Jelkajhar, Source: Ring well
S10= Barsangaon L.P. School, Barsangaon, Source: Ring well
S11= Gossaipara L. P. School, Gosssaipara, Source: Ring well
S12= Deuripara L.P. School, Purani Bongaigaon, Source: Ring well
S13= Kajalgaon High School, Kajalgaon, Source: Tara pump
S14= Santipara L.P. School, Kajalgaon, Source: Tara pump
S15= Manglagaon L.P. School, Kajalgaon Source: Tara pump

The concentration of sulphate in the water samples ranged from below detection limit (BDL) to 24.17 mg/L, which is within the permissible limit of 200mg/L. The sulphate ion is one of the important anions present in natural waters and produce cathartic effect on human beings (Veera Bhadram et al. 2004).

The chlorides ranged from 3.23 to 60.42 mg/L. All chloride values were within the permissible limit of 250 mg/L. Chlorides impart a salty taste and sometimes high concentration causes laxative effect in human beings (Veera Bhadram et al. 2004).

The concentration of fluorides in the water samples was within the permissible limit (1mg/L) and in all the samples except S7, it was below the detection limit.

Heavy metals *viz*., arsenic, lead and chromium were within the permissible limit of BIS (0.05 mg/L) in all the water samples (Table 2). However, except in S8, S9 (arsenic) and S15 (chromium) water samples, they were below the detection limit. In case of mercury, water samples S8, S11 and

Table 2: Average heavy metal contents of drinking water samples of schools of Bongaigaon area during the period from December 2005 to November 2006 (Values are in mg/L).

| School No. | As | Pb | Cr | Hg | Cu | Fe |
|---|---|---|---|---|---|---|
| S1 | BDL | BDL | BDL | BDL | 0.01 | 01.50 |
| S2 | BDL | BDL | BDL | BDL | 0.02 | 00.55 |
| S3 | BDL | BDL | BDL | BDL | 0.03 | 00.98 |
| S4 | BDL | BDL | BDL | BDL | 0.03 | 00.03 |
| S5 | BDL | BDL | BDL | BDL | 0.03 | BDL |
| S6 | BDL | BDL | BDL | BDL | 0.03 | 00.13 |
| S7 | BDL | BDL | BDL | BDL | 0.03 | 01.30 |
| S8 | 0.05 | BDL | BDL | 0.02 | 0.06 | BDL |
| S9 | 0.01 | BDL | BDL | BDL | 0.07 | 00.03 |
| S10 | BDL | BDL | BDL | BDL | 0.06 | BDL |
| S11 | BDL | BDL | BDL | 0.01 | 0.06 | 00.05 |
| S12 | BDL | BDL | BDL | 0.01 | 0.06 | BDL |
| S13 | BDL | BDL | BDL | BDL | 0.01 | 14.36 |
| S14 | BDL | BDL | BDL | BDL | BDL | 00.03 |
| S15 | BDL | BDL | 0.05 | BDL | BDL | 00.04 |

Table 3:Microbial analysis of drinking water samples of schools of Bongaigaon area during the period from June 2006 to August 2006. (Values are in MPN/100ml)

| School No. | Coliforms | *E.coli* |
|---|---|---|
| S1 | Nil | Nil |
| S2 | 360 | Nil |
| S3 | Nil | Nil |
| S4 | 101 | 18 |
| S5 | 2400 | 460 |
| S6 | 2400 | 1100 |
| S7 | 4 | Nil |
| S8 | 1100 | 150 |
| S9 | 723 | 723 |
| S10 | 101 | 51 |
| S11 | 101 | 111 |
| S12 | 101 | 21 |
| S13 | Nil | Nil |
| S14 | Nil | Nil |
| S15 | 22 | Nil |

S12 were found above the permissible limit (0.001 mg/L). Similarly, in case of copper, water samples S8, S9, S10, S11 and S12 were observed to cross the permissible limit of 0.05mg/L.

In the present study, the iron content of water samples ranged from BDL to 14.36 mg/L. Samples S1, S2, S3, S7 and S13 were not within the permissible limit (0.3 mg/L). Sample S13 was highly objectionable with respect to iron content. Excess of iron may cause haemosiderosis.

The study reveals that all the anions *viz*., sulphate, chloride and fluoride, and heavy metals *viz*., arsenic, lead and chromium were within the permissible limit in all the water samples. Considering the overall physico-chemical parameters, only sample S4 was found to be potable. Again, sample S10 is free from contamination other than copper content (0.06 mg/L) which slightly exceeds the permissible limit. Other samples were not safe for drinking purposes without proper treatment.

The microbial parameters *viz*., MPN of coliforms ranged from nil to 2400/100 mL, and *E. coli* from nil to 1100/100 mL (Table 3) exceeding the permissible limit (both, total coliforms and *E. coli* 0 MPN/100mL, WHO 1997). The present study reveals that water from ring wells cannot be directly used for drinking as all the samples of ring wells were bacteriologically contaminated. Water samples from tara pumps except S15 were free from coliforms and *E. coli*. Water sample S6 from the tube well showed presence of both, coliforms and *E. coli* in large scale due probably to unhygienic maintenance. Sample S7, collected from deep tube well, was free from *E. coli* but contained coliforms (4 MPN/100 mL) probably due to lack of proper cleanliness. Presence of *E. coli* represents for a number of widespread epidemics of diarrhoea and gastroenteritis in infants and children, and showed significant antibiotic resistance against commonly used antibiotics (Patil & Tambekar 2003). The mechanism of enteric infection due to *E. coli* involves production and action of enterotoxin and colonization of the organism in small intestine (Moon et al. 1979).

## CONCLUSION

Physico-chemical parameters *viz*., pH, turbidity, Fe, Cu and Hg did not fall within the permissible limit. Moreover, microbial parameters like MPN of total coliforms and *E. coli* in ring wells were found to be above the permissible limit. Though S4 was safe for drinking from physico-chemical characteristics, but due to presence of coliforms and *E. coli*, water is to be treated properly. From our study, we have come to the conclusion that drinking water quality of all the studied schools was not satisfactory and not acceptable directly for drinking purposes. Therefore, the school administrations should seriously deal with the drinking water supply by monitoring the quality and proper treatment continuously.

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