Indian Journal of Hygiene and Public Health
Publication of All India Institute of Hygiene & Public Health, Kolkata.
ISSN : 2455-1813

Short Communication

Chemical quality of Drinking Water in the Service Area of Rural Health Unit & Training Centre, Singur under All India Institute of Hygiene and Public Health

Amal Dutta*, Onkarnath Chattopadhyay **

Abstract:

Background & Objective: Water quality monitoring has been accorded a high priority and institutional mechanisms have been developed at national, state, district, block and panchayat levels. Accordingly, The Government of India launched the National Rural Drinking Water Quality Monitoring and Surveillance Programme in February 2006. The objectives of this study were – (1) to investigate drinking water quality of service area of Rural Health Unit & Training Centre (under A.I.I.H & P.H.) with respect to chemical parameters like pH, EC, Total Hardness, Total Alkalinity, Iron, Turbidity, Total Chloride (2) to make a Comparison with the standard values of BIS Standards and (3) to study its implication on Public Health.

Method: pH, EC, Total Hardness, Total Alkalinity, Iron, Turbidity, Total Chloride in drinking water of service area of R.H.U & TC, Singur were studied. Ground water is the main source of drinking water of this area. Hundred samples were collected from different Units of the service area. Water samples were analysed by adopting Standard procedure of APHA (1998).

*** M.Sc. (Chemistry). Chemist, Sanitary Engineering Section, Rural Health Unit & Training Centre, Singur. All India Institute of Hygiene & Public Health, Kolkata.**
**** MD. Consultant Public Health Specialist, Rural Health Unit & Training Centre. Singur, All India Institute of Hygiene & Public Health, Kolkata.**
Corresponding Author: Amal Dutta
Email: amal.dutta14@gmail.com.

Results: Data reveal that pH, EC, Hardness, Alkalinity, Total Chloride Value of all the samples were within the Permissible Limit of BIS 105000 Standard. In case of Iron, out of 100 samples, 26 samples have exceeded the Permissible Limit. For Turbidity, 25 out of 100 samples have exceeded the Permissible Limit of BIS 105000 Standard. High turbidity of sample may be associated with high concentration of Iron (Fe>1mg/litre).

Conclusion: The study reveals that quality of drinking water in the service area of Rural Health Unit & Training Centre, Singur is good with respect to the chemical parameters under this study, as most of the values within permissible limit of BIS Standard. Current study also shows no major threat of health hazard from the drinking water quality of this service area with reference to the parameters under this study

Background:

Water is the most vital for all living organisms. Water makes up about 70 -90 percent by weight of most form of life.[1] Oceans and seas constitute 97 percent of water of earth surface which are mainly saline water and not suitable for human consumption. Among remaining 3 percent fresh water, only 0.3 percent is usable by human being. Water can be contaminated due to disposal of industrial waste, disposal of pesticide , fertilizer from agriculture land, soil erosion (arising due to deforestation), fast urbanisation and other human activity. There are many water borne diseases like Hepatitis A, Hepatitis B, Diarrhoea, Cholera, Typhoid, Paratyphoid etc. which can be transmitted by drinking contaminated water. Therefore investigation of drinking water quality is essential for human health. In this study we investigated Drinking Water Quality with respect to the chemical parameters like pH, EC, Total Hardness, Total Alkalinity, Iron, Turbidity, Total Chloride of Service Area of Rural Health Unit & Training Centre (under A.I.I.H & PH) and made a comparison with the standard value of BIS Standard and also attempted to rationalise its implication on public health of the villagers of this service area.

Materials and Method:

Study Area: Service area of Rural Health Unit & Training Centre contains six Gram panchayats (ANANDANAGAR, BAINCHIPOTA, BAGDANGA-CHINNAMORE, GOPALNAGAR, BARUIPARA, PALTAGAR, and NASIBPUR) which covers 64 Villages. The Total service area of Rural Health Unit & Training Centre, Singur can be divided into 12 Units. The estimated population of the service area is approximately 1, 06,000 (estimated in 2013). The map of the service area is given in Figure 1.

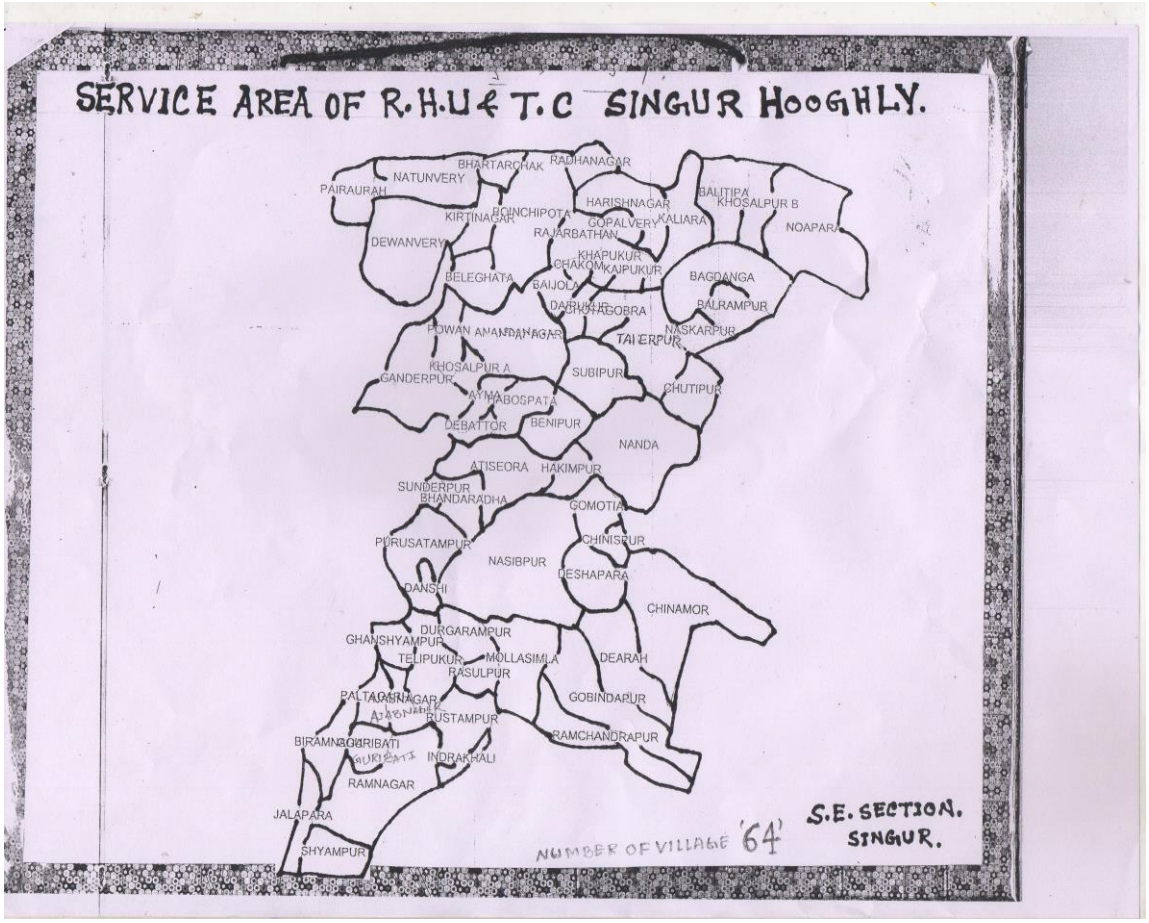


Figure 1: Map of the service area

Sample Collection: Samples were collected in one Litre plastic container (to avoid unpredictable changes in Physico-chemical characteristics) from these 12 Units by the Staff of Sanitary Engineering Section, RHU &TC, Singur. Initially 10 samples from each unit were planned to be tested for chemical analysis within the time period of one year, from December 2014 to December 2015. However it was possible to complete

the chemical analysis for a total of 100 samples only, collecting 8 to 9 samples per Unit within this time period. Tube wells in each unit were selected for water collection on the basis of number of persons using a particular tube well. The tube wells with maximum number of users were selected for collection of water sample. The samples were analysed at Sanitary Engineering Department, of A.I.I.H & P.H, Bidhan Nagar Campus by adopting Standard procedure of APHA (1998).

Method of Analysis: Method of Analysis is described in Table 1.

Table 1: Instruments and Methods of Analysis of the Water Quality Parameters

Name Of Parameter	Instrument Used for Determination	Method Used	Method Reference
pH	pH Meter	_	Manufacturers Operating Instruction
Electrical Conductivity	Conductivity Meter	_	Manufacturers Operating Instruction
Hardness	Burette	Titration	APHA (1998)
Alkalinity	Burette	Titration	APHA (1998)
Iron	Spectrophotometer	Spectrophotometric method	APHA (1998)
Turbidity	Nephelometric Turbidimeter	_	Manufacturers Operating Instruction
Total Chloride	Burette	Titration	APHA (1998)

Results and Discussion

The overall result can be shown in Table 2 and Table 3.

Water Quality of Study Area: For investigation of water quality of drinking water of service area of R.H.U & TC, Singur the following parameters were studied:

pH: The term pH indicates the Hydrogen ion concentration of solution. It is defined as negative log of Hydrogen ions concentration in water. Lower values of pH below 4 will produce sour taste and higher value above 8.5 a bitter taste. Higher Values of pH reduce the efficiency of disinfection process of Chlorine. High pH induces the

formation of trihalomethanes, which will causes cancer to human beings. [2]According to BIS 105000 standard, permissible limit of pH for drinking water should be 6.5-8.5. pH values of the water samples reveal that among 100 water sample except one sample (collected from Nasibpur Durgarampur, Unit -8 having pH value 5.56) all other have value with in the range of 6.5 – 8.5. So there is no likelihood of adverse effect on human health from the pH of drinking water of the study area.

Total Hardness: Hardness of water is a measure of the total concentration of the calcium and magnesium ion expressed as calcium carbonate. Hard water is useful to growth of children due to presence of calcium but absolutely soft waters are corrosive and dissolve the metals. More cases of cardiovascular diseases are reported in soft water areas.[3] According to BIS 105000 standard, permissible limit of Hardness for drinking water should be 600 mg/litre. The study reveals that Hardness value of all the drinking water samples are found to be within the permissible level of BIS and hence there is no likelihood of adverse effect on human health.

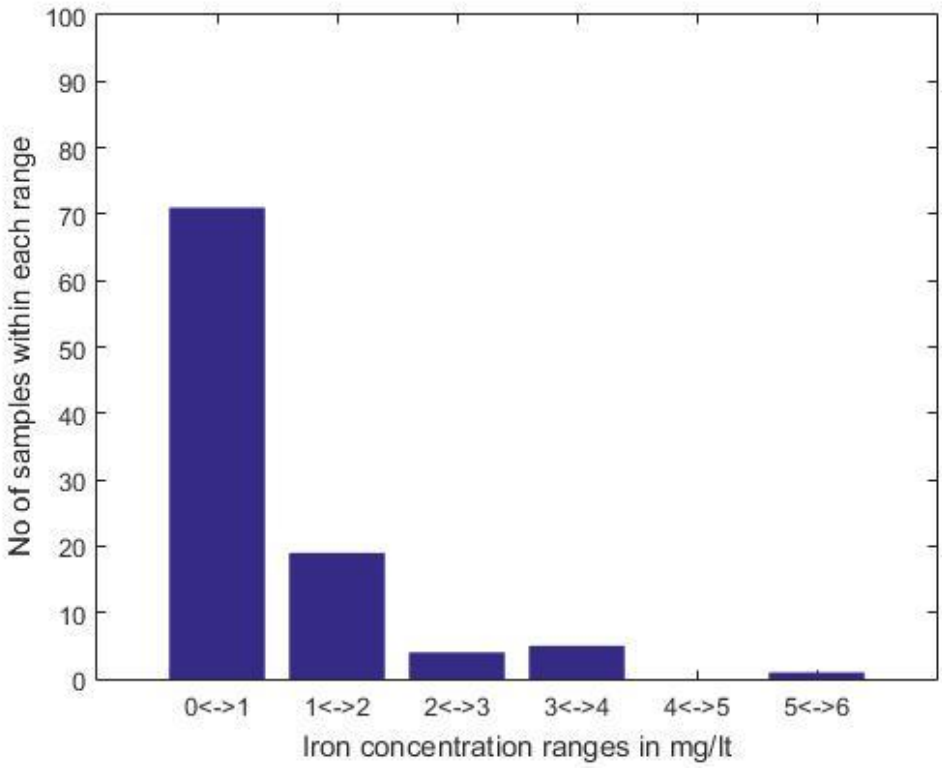
Total Alkalinity: The total content of substance in water that cause an increased concentration of hydroxide ions either upon dissociation or as a result of hydrolysis is called alkalinity. Excess alkalinity in water is harmful for irrigation which leads to soil damage and reduce crop yields[4] but alkalinity has no specific health hazards. According to BIS 105000 standard, permissible limit of alkalinity for drinking water should be 600 mg/Litre. The values of present study lie within Permissible limit of BIS Standard.

Total Chloride: Chlorides are widely distributed as salt of sodium, calcium, and potassium in the water. Although chlorides are not harmful as such, their concentration over 250 mg/Litre imparts a peculiar taste to the water, thus rendering the water unacceptable for drinking purposes from aesthetic point of view. According to BIS 105000 standard, permissible limit of Chloride for drinking water should be 1000 mg/litre. The values of present study lie within the permissible limit of BIS standards.

Iron: Iron has got little concern as a health hazard but is still considered as a nuisance in excessive quantities. Long time consumption of drinking water with high concentration of iron can lead to liver diseases (hemosiderosis).[5] According to BIS 105000 standard, permissible limit of iron for drinking water should be 1 mg/litre.

Present study reveals that out of 100 samples 74 samples are in range of permissible limit but 26 samples are above the permissible limit. The total result is briefly presented in Figure 2.

Figure 2: Iron concentration of water samples



As 74 percent of the drinking water are in permissible limit of BIS, with respect to iron, so probability of any adverse effect on public health due to presence of iron is less in this service area. Installation of iron removal plant is needed to get more and more iron free water.

Turbidity: Turbidity is an expression of certain light scattering and light absorbing properties of the water sample. It arises due to presence of suspended matter such as clay, silt, colloidal organic particle and other macroscopic organism. Water samples with high turbidity presents colloidal materials which provides adsorption sites for chemicals that may be harmful or cause undesirable tastes and odours. The suspended solids interfere during water disinfection with chlorine because the particles act as shields for the virus and bacteria.[6]Similarly, suspended solids can protect

bacteria from ultraviolet (UV) sterilization of water. Turbidity may indicate the presence of disease causing organisms. These organisms include bacteria, viruses, and parasites that can cause symptoms such as nausea, cramps, diarrhoea, and associated headaches. In drinking water, the higher the turbidity level, the higher the risk that people may develop gastrointestinal diseases. [7]The turbidity of the water samples within Permissible limit is therefore suitable for drinking purpose. According to BIS 105000 standard, permissible limit of turbidity for drinking water should be 10 NTU. The present study reveals that among 100 samples, turbidity value of 75 samples is within permissible limit but in case of 25 samples the value exceeds the permissible limit. An important observation comes to us that in all the 25 samples where turbidity value exceed permissible limit, the concentration of Iron value also cross the permissible limit. From this observation we can conclude that the high turbidity may be due to presence of high concentration of iron (greater than 1mg/litre). Iron rich water exposed to the air, become turbid due to oxidation of soluble iron to insoluble ferric oxide which settles out as rust coloured salt. [5]As 75 percent of the samples are in permissible limit of BIS, so probability of any public health hazard from turbidity of water is low. Necessary steps should be taken for removal of iron to get less turbid drinking water.

Electrical Conductivity (EC): Electrical Conductivity is a numerical expression of ability of a solution to carry electric current. Since the charge on ions in solution facilities the conductance of electrical current, the conductivity of a solution is proportional to ion concentration. The results of the present study indicate that the Maximum value of EC is 855 µS/cm and Minimum is 258 µS/cm. The electrical conductivity of water estimates the total amount of solids dissolved in water -TDS, which stands for Total Dissolved Solids[8]. TDS is measured in ppm (parts per million) or in mg/litre. High concentrations of total dissolved solids (TDS) may

Cause adverse taste effects. In early studies, inverse relationships were reported between TDS concentrations in drinking water and the incidence of cancer, coronary heart disease, arteriosclerotic heart-disease and cardiovascular disease.[9] Water with high TDS value often has a laxative sometimes the reverse effect upon people whose bodies are not adjusted to them. [2] EC can be converted to TDS using the calculation, TDS (ppm) = 0.64 X EC (µS/cm) .[8] In the present study the maximum value of EC is

855 µS/cm. So TDS value never exceeds the permissible limit of BIS 105000 standard i.e. 1500 mg/litre. So there is no likelihood of adverse effect on health of local villagers with respect to EC and TDS of the drinking water.

Table 2: Minimum, maximum and mean values of the water quality parameters of the water samples tested

Name of the Parameter	Smallest Value	Maximum Value	Mean value
Total Iron (mg/litre)	Below Detection limit	5.75	0.79
Turbidity (NTU)	Nil	68.5	8.17
pH	5.56	8.19	6.99
EC(µs/cm)	258	855	612
Total Hardness (mg/litre)	140	430	312.52
Total Alkalinity (mg/litre)	120	420	314.86
Total Chloride (mg/litre)	10	106	26.80

Table 3: Number of drinking water samples within permissible limits and exceeding permissible limits of BIS Standards.

Parameter	**Range**	**Number of Samples**	**Permissible limit of BIS Standard.**	**No of Samples within permissible limit**	**No of Samples exceeding permissible Limit**
Total Iron (mg/litre)	**Below detection limit to 0.5**	54	**1 (**mg/litre)	74	26
	0.51 to 1	20			
	1.1 to 6	26			
Turbidity (NTU)	**0 to 5**	62	**10 (NTU)**	75	25
	5.1 to 10	13			
	Above 10	25			
pH	**Below 6.5**	01	**6.5-8.5**	99	01
	6.5-8.5	99			
	Above 8.5	00			
EC(µs/cm)	**0-500**	01		_	_

	501-1000	99	**No permissible limit set by BIS for EC.**		
	Above 1000	00			
Total Hardness (mg/litre)	**0-300**	31	**600(**(mg/litre)	100	00
	301-600	69			
	Above 600	00			
Total Alkalinity (mg/litre)	**0-300**	24	**600(**(mg/litre)	100	00
	301-600	76			
	Above 600	00			
Total Chloride (mg/litre)	**0 to 250**	100	**1000(**(mg/litre)	100	00
	251 - 1000	00			
	Above 1000	**00**			

Conclusion:

From the results of this study, the drinking Water Quality of Service Area of Rural Health Unit & Training Centre (under A.I.I.H & PH) with respect to the studied chemical parameters (like pH, EC, Total Hardness, Total Alkalinity, Iron, Turbidity, Total Chloride) can be regarded as good as most of the values are within the permissible limit of BIS standard . Probability of causing any adverse effect on public health of the local villagers is low with reference to the parameters under consideration. However studies with reference to the other chemical and microbiological analysis will have to be done to have a broader view of this water quality.

Acknowledgement:

1. Director, All India Institute of Hygiene and Public Health for giving necessary permission to do free of cost analysis of drinking water sample which are comes from our service area.

2. Dr. Sudarsan Mondal AD, B.N campus , All India Institute of Hygiene and Public Health and Dr, Debasis Dutt , H.O.D (Acting) , Sanitary Engineering Department , B.N campus , All India Institute of Hygiene and Public Health , for allow to do water analysis in Sanitary Engineering Department, B.N campus .

3. Dr. Subhash Chandra Mondal, OC , Rural Health Unit & Training Centre, Singur (under A.I.I.H & PH) , for taking all the necessary action to conduct the water analysis.

4. All the staffs of Sanitary Engineering Section, Rural Health Unit & Training Centre, Singur (under A.I.I.H & PH).

5. Mr. Tapan Rakhshit, Chemist, Sanitary Engineering Department B.N Campus, Salt Lake (A.I.I.H & PH) for his help during analysis.

6. Dr. Pranab Jyoti Bhuyan, Public Health Specialist , Urban Health Unit & Training Centre, Chetla, (A.I.I.H & PH) for giving valuable suggestion during this study.

References:

1. Mukherjee G.N, Das A: Elements of Bioinorganic Chemistry, 3 rd Edition

2. Richard JA, Bose S, Muthukumar A and Muthukumar M. Ground water quality assessment among the selected blocks of Wayanad district, Kerala. Journal of Chemical and Pharmaceutical Research, 2016, 8(3) : 29-36.

3. Calderon RL, Craun GF: Water hardness and Cardiovascular Disease: A Review of the Epidemiological Studies, 1957-78 available from www.who.int/water_sanitation_health/dwq/nutrientschap10.pdf... accesed on 16.08.2016.

4. L Sundar and Saseetharan MK. Ground water Quality in Coimbatore, Tamil Nadu along Noyyal River. J. Environ. Sci. Eng, July 2008, Vol 50, P 187-190.

5. Khadsan RE and Kadu MV. Drinking water quality Analysis of some Bore-wells Water of Chikhli Town, Maharashtra. Journal of Industrial Pollution Control. Available from: http://www.icontrolpollution.com/articles/drinking-water-quality-analysis-of-someborewells-water-ofchikhli-town-maharashtra-. Accessed on 03.08.2016.

6. Turbidity. From Wikipedia the free encyclopaedia available from https://en.wikipedia.org/wiki/Turbidity accessed on 01.08.2016.

7. Mann AG, Tam CC, Higgins CD, and Lodrigues LC. The association between drinking water turbidity and gastrointestinal illness: a systematic review. BMC Public Health, 2007, 7(256): 1 – 7.

8. 8) The Electrical Conductivity of water. Available from http://www.smart-fertilizer.com/articles/electrical-conductivity, accessed on 01.08.2016.

9. 9) Yashoda T, Byragi RT and Ramana CV. Pre- and post-monsoon variation in physico-chemical characteristics in groundwater quality of Mindi industrial area, Visakhapatnam, India. International Journal of Environmental Sciences Volume 4 , No 5 , 2014: p 746-53

10. 10) APHA: Standard Methods for the Examination of Water and Waste water. 20th Edition, 1998, American Public Health Association, Washington, DC; USA.