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Drinking water is still harmful of reopened Chamurchi tea garden; West Bengal, India

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ABSTRACT

India is the second largest producer of tea (camelia sinensis), the largest consumer and the fourth largest exporter (after Sri Lanka, Kenya and China) in the world. The major tea growing areas of India are Darjeeling, Terai and Dooars (West Bengal). The use of pesticides for effective pests control and artificial agrochemicals used for the growth and rate of production has generated a lot of concern relating to public health and environmental pollution like water etc. Polluted water is the cause for the spread of epidemics and chronic diseases in human beings. So assessment and monitoring of the drinking water sources located in the small tea garden areas are utmost necessities. A total 10 numbers of water samples were collected from different water sources like ring wells, ponds, drains and tube wells of Chamurchi to study the different water quality parameters like pH, Hardness, iron and coliform.

Key Words: Water quality, Small tea gardens, Contamination, reopened tea garden.

INTRODUCTION

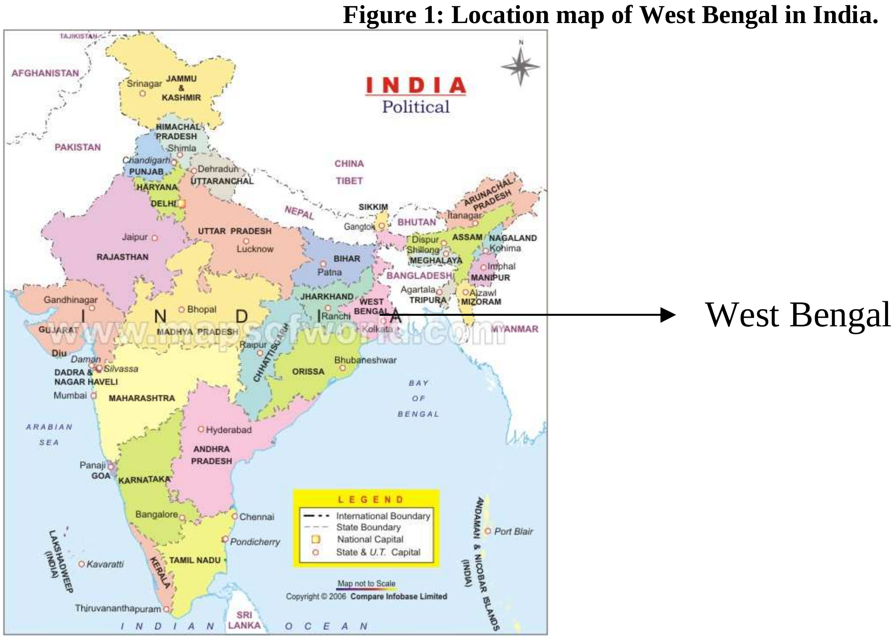
Tea is the major industrial sector in North Bengal. Tea alone generates an annual turnover of 8 million USD. There are around 350 tea gardens in the North Bengal region that provides employment to about 3.5 lakh people working in the tea gardens. It produces around 200 million kg of tea of the total 830 million kg of tea produced in the country per annum. The climate of the North Bengal region provides an ideal condition for growing different types of teas [1].The district Jalpaiguri specially known as Dooars. It lies in the valley formed by the lower Teesta and its tributaries in the Himalayan foothills. Tea plantation was started at Jalpaiguri in 1874 [2]. In

1876 there were 13 plantations. Today the region has 168 estates with an area under tea of 69,175 hectares of land producing about 154m.kg.

Chamurchi tea garden (our interest) is one of the tea producing belts of dooars, West Bengal [3]. It is situated near Dhupguri in Jalpaiguri district of West Bengal. The tea garden has a special significance because it was closed in 2002 and reopened in 2009 after a 7 years period due to some serious problems like management, economy, increasing amount of taxes, environmental pollution etc [4]. There was an acute drinking water problem in all the gardens after they were shut down and the electricity and water supply was disconnected. People used river water for drinking [5]. This water was highly contaminated with dolomite from the cement manufacturing factories. Even the ground water was unfit for drinking due to large-scale application of fertilizers, pesticides and agrochemicals in the tea gardens [5]. As a result the soil and water of the tea garden areas are contaminated by pollutants and the quality of soil and water become degraded [6].

According to our literature review, there has been no published report concerning the contaminants in drinking water sources in Chamurchi tea garden. The objective of the present detailed survey based study was to determine the contamination of pH, total hardness (with calcium and magnesium hardness) (TH), iron (Fe), fecal and total coliform in the different drinking water sources at Chamurchi Tea Garden of Jalpaiguri district in West Bengal. Thus the current article would help to fling light on the water quality especially relating to the above mentioned parameters of the tea garden community because they faced lots of health problems caused by drinking water during the crisis period (2002 to 2009).

Figure 1: Location map of West Bengal in India.



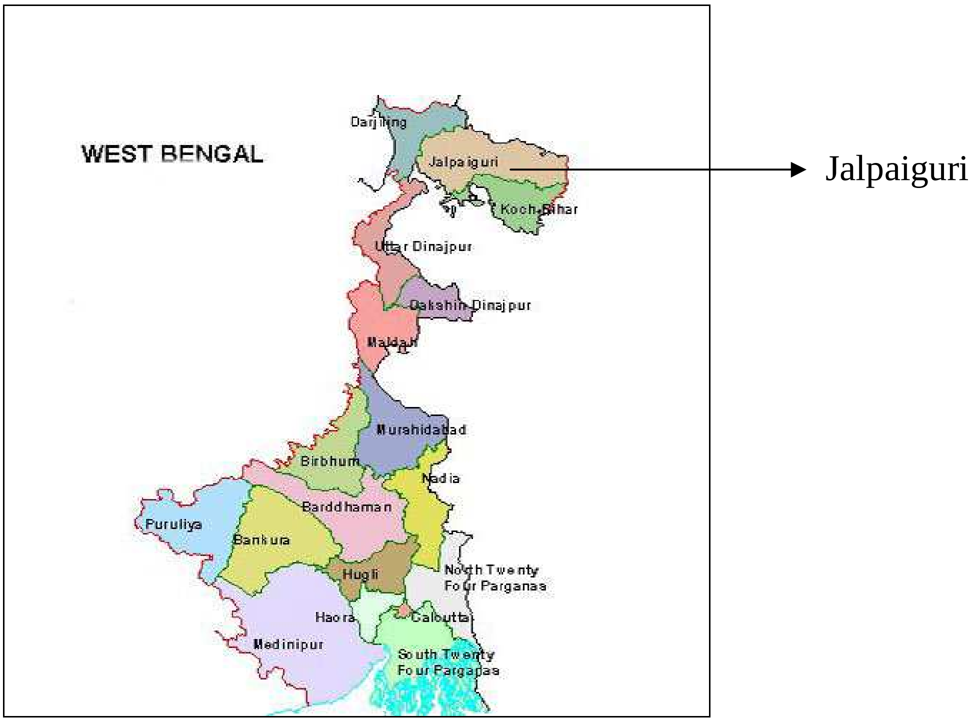


Figure 2: Location map of Jalpaiguri district in West Bengal.

MATERIALS AND METHODS

Sampling methodology

The sources of the water samples were shallow tube wells, ring well, ponds etc. of the tea garden areas. The 10 water samples were collected following the standards methods of collection. Tube wells were operated at least 10 minutes before collection to flash out the stagnant water inside the tube and to get fresh ground water. The water samples were collected in clean 1L Poly propylene bottles and stored in an ice box.

Sample analysis

The pH is measured by pH/Ion 510 Bench pH/Ion/mV Meter (Eutech Instrument) by hydrogen selective electrodes. The instruments were calibrated and standardized before carrying out the analysis. Hardness was done by EDTA titration using ammonia buffer and Eriochrome Black -T as indicator. Iron is estimated by spectrophotometer [Aqamate (VIS) Thermo Scientific spectrometer]. Total coliforms, and faecal coliform analysis were performed MPN Count (Multiple Tube Technique) [7].

RESULTS AND DISCUSSION

pH

pH is a term used universally to express the acidic and basic nature of a solution. An important overall measure of water quality, pH can alter corrosiveness and solubility of contaminants. In general the pH of natural water is within the range 6.5 to 8.5. Beyond this range the water will affect the mucous membrane of cell and water supply system [7]. Low pH will cause pitting of pipes and fixtures or a metallic taste. This may indicate that metals are being dissolved. At high pH, the water will have a slippery feel or a soda taste [8]. In our study the minimum pH found 5.8 and maximum 7.5 in different spot sources (Table-1). The most of the water samples in the study area were found to be acidic in nature. This may be due to use of fertilizers like ammonium sulphate and super phosphate in agriculture [9].

Hardness of water

Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water. Hard water has high concentrations of Ca2+ and Mg2+ ions. General guidelines for classification of waters are: 0 to 60 mg/L (milligrams per liter) as calcium carbonate is classified as soft; 61 to 120 mg/L as moderately hard; 121 to 180 mg/L as hard; and more than 180 mg/L as very hard [10].In the study samples the minimum hardness is 48 mg/L (soft) and maximum 284 mg/L (hard) (Table-1). Although hard water does not pose a health risk, but can cause aesthetic problems and cardiovascular health problem. It can pose serious problems in industrial settings, where water hardness is monitored to avoid costly breakdowns in boilers, cooling towers, and other equipment that handles water. Domestic hard water usage can cause eczema in children. Hard water may cause dry, itchy skin. Hard water can also clog hair follicles causing unnecessary hair loss. The presence of dissolved salts and minerals in the soil of the tea gardens may enhance the concentration of TH in the tea ground water of the study sites. At the same time the agrochemicals applied in the tea gardens directly or indirectly might affect the concentrations of a large numbers of inorganic chemicals in ground water which effect the concentration of TH in water [11]

Iron

Iron is the fourth most abundant element, by weight, in the earth's crust. Natural waters contain variable amounts of iron despite its universal distribution and abundance depending upon the geological area and other chemical components of the waterway. Iron in groundwater is normally present in the ferrous or bivalent form [Fe^{++}] which is a soluble state. It is easily oxidized to ferric iron [Fe^{+++}] or insoluble iron upon exposure to air. Other forms may be in either organic or inorganic wastewater streams. Taste thresholds of iron in water are 0.1 mg/l for ferrous iron and 0.2 mg/l ferric iron, giving a bitter or an astringent taste. Water used in industrial processes usually contains less than 0.2 mg/l iron. The current aquatic life standard is 1.0 mg/l based on toxic effects. [12].According to Bureau of Indian Standard specification for drinking water the permissible range is 0.3mg/L. Beyond this limit the taste or appearance are affected, it has adverse effects on domestic uses and water supply structures and promotes iron bacteria. In our result the minimum iron content 0.0123 mg/L and maximum 0.7112mg/L at kathalguri tea estate (Table-1). The results show that the water is more or less iron free except kathalguri. The high value of iron at that spot because the use of fertilizer and different iron containing pesticides in the tea garden at kathalguri.

Coliform

Coliform bacteria are organisms that are present in the environment and in the faces of all warm-blooded animals and humans. Coliform bacteria will not likely cause illness. However, their presence in drinking water indicates that disease-causing organisms (pathogens) could be in the water system. Most pathogens that can contaminate water supplies come from the faeces of humans or animals. Total coliform bacteria are commonly found in the environment (e.g., soil or vegetation) and are generally harmless. If only total coliform bacteria are detected in drinking water, the source is probably environmental. Faecal coliform bacteria are a sub-group of total coliform bacteria. They appear in great quantities in the intestines and faeces of people and animals. The presence of faecal coliform in a drinking water sample often indicates recent faecal contamination meaning that there is a greater risk that pathogens are present than if only total coliform bacteria is detected. While most of the Coliform bacteria are harmless to humans, a small percentage of Faecal Coliform bacteria may cause intestinal distress and in more severe cases nausea, vomiting and even death [13]. According to WHO and Testing characteristics for drinking water (BIS 10500: 1991), drinking water should not contain more than 10 total coliform bacteria per 100 ml of water. The maximum acceptable concentration of Faecal coliform "0" per 100 ml of water. Faecal coliform bacteria can enter rivers through direct discharge of waste from mammals and birds, from agricultural and storm runoff, and from human sewage. However, their presence may also be the result of plant material, and pulp or paper mill effluent. Pets, especially dogs, can contribute to fecal contamination of surface waters. Runoff from roads, parking lots, and yards can carry animal wastes to streams through storm sewers. Birds can be a significant source of faecal coliform bacteria. Some waterborne pathogenic diseases that may coincide with fecal coliform contamination include ear infections, dysentery, typhoid fever, viral and bacterial gastroenteritis, and hepatitis A. The presence of fecal coliform tends to affect humans more than it does aquatic creatures, though not exclusively. Untreated organic matter that contains fecal coliform can be harmful to the environment. Aerobic decomposition of this material can reduce dissolved oxygen levels if discharged into rivers or waterways. This may reduce the oxygen level enough to kill fish and other aquatic life [14]. In our study the 10 samples of Chamurchi Tea Garden show the presence of facial and total coliform, the minimum faecal coliform found 4 MPN /100 ml and maximum 22 MPN /100 ml of water. The total coliform has highest value 50 MPN /100 ml and minimum 11 MPN /100 ml (Table-1). So the values indicate there is a chance of health risk of the area.

Table-1: concentration of water quality parameters at 10 different spots

Serial No.	Spot source	pH value (by hydrogen selective electrodes or pH meter)	Total Hardness (with calcium and magnesium hardness) mg / L	Iron mg / L	Faecal Coliform (MPN /100 ml)	Total Coliform (MPN /100 ml)
1	Chamurchi Bazar	7	156	0.0123	22	50
2	Near maya house	7.5	284	0.026	4	17
3	Dooars Upper Line Tube Water	6.2	108	0.0185	4	26
4	Lower Forest busty Tea Estate	6	120	0.0204	7	21
5	Kathalguri Godamcim Tube Water	5.8	112	0.7112	6	21
6	Tube Water Tea Estate	6	48	0.0439	9	17
7	Near Station Tube Well	6	136	0.0243	4	11
8	River Water	6.6	112	0.0568	8	40
9	River Water 2	6	136	0.1743	8	23
10	S. S. B. Quarter	6.5	148	0.1949	17	50

CONCLUSION

The water analysis data shows that the drinking water quality of Chamurchi tea garden is not so good. The presence of colifom indicates the health risk and the other parameters also not in permissible rage of drinking water. The history of this tea garden says that the drinking water quality was very poor when it was closed. There were several deaths in this area due to blood dysentery, liver cirrhosis, anaemia and cardio respiratory failure which has a direct relation with the poor drinking water quality. The present situation of drinking water sources are also not so safe for use in the tea garden community but not alarming as past. The continuous and uncontrolled use of different chemicals in the tea garden areas of this region may increase the pollution rate which may lead to cause an adverse health effects to the tea garden community also the low literacy, poverty and lack of awareness are indirectly caused of the poor condition of health of tea garden belts.

The only way to get rid of such health problems may be use of organic agrochemicals in place of synthetic agrochemicals in the tea gardens for better productivity and growth rate. For the same awareness and training programs should be conducted for the NGO's and the local people for the sustainable management of drinking water sources.

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