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CHEMICALS USE IN TEA GARDENS AND ITS EFFECT ON POTABLE WATER SOURCES IN GOHPUR SUBDIVISION, SONITPUR DISTRICT, ASSAM, INDIA

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Abstract

The paper highlights the effect of water pollution in Tea Garden areas of Gohpur Sub-division, Sonitpur district, Assam. . Different types of chemical fertilizers, pesticides, fungicides, weedicides are used in Tea Garden areas. These chemicals are deteriorating the drinking water sources for human consumption. Chemicals are vital resource for healthy production of crops. The state of Assam is the World's largest Tea growing region by production. Huge amount of chemicals are used for high yield in Tea Gardens, but its contamination with water resources are often ignored. In this study, we collected 12 different drinking water samples from 6 Tea Gardens in different spots of Gohpur Sub-division, Sonitpur district, Assam. From analysis, it is observed that potable water quality is not as good as WHO limit.

Key Words: Tea Garden, Potable water, agro chemicals, Gohpur.

Introduction

India is one of the huge tea producing country in the earth. Assam alone contributes to around 55% of the total tea production in India. Assam now produces nearly 700 million kg of tea annually and accounts for around half of India's overall tea production. The state also generates annual foreign exchange earnings estimate at an equivalent to Rs3000 crore. There are two distinct production styles in Assam. The whole leaf orthodox style and the CTC style. For increase production a large number of chemicals are used in these gardens (1). As a result soil and water pollution becomes conspicuous. In these gardens legally or illegally contaminated fertilizers like

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zinc-oxy sulphate and sub-standard pesticides are used which are banned in the developed countries. The residues of some pesticides can persist in the environment for more than 20 years (2). It is evident in many studies that this problem will be more severe in the future in Assam. This study has been made to determine the present contamination level of chemicals in soil & water in tea gardens in the Gohpur sub-division, Assam, India.

Study Area

Gohpur subdivision which is taken as study area is located at Longitude 26.88°N and Latitude 93.63°E. It has an average elevation of 883 feet from sea level. The total area of Gohpur sub-division is 316 sq. km (304.84 sq. km rural area and 10.70 sq. km urban area). It connects to Majuli and Jorhat by small ships through the river Brahmaputra. The temperature ranges from 9°C in January to as high as 34°C in May. Summers are hot and humid with an average temperature of 30°C. The annual rainfall is 13.4 inches. It is worth considered stating that, Monabari tea estate, the biggest tea garden in Asia is situated just 49km from Gohpur town.

Sampling Methodology

For chemical analysis, total 24 nos. of samples were collected from different drinking water sources of the six big tea gardens of Gohpur sub-division. The sources of the water samples were shallow hand tube wells, septic tanks, open wells, ponds and drains. Tube wells were operated at least 10 minutes to get fresh ground water. The water samples were collected in clean 1L poly propylene bottles.

Material & Method

pH of the drinking water samples were measured by pH meter. The content of chloride and phosphorus concentration was determined by the method of Richard (3). Heavy metals concentration in water samples were determined by Atomic absorption Spectro-Photometer. SO_4^{2-} content present in the water samples were analyzed by turbid metrically at 450nm using UV-spectrophotometer.

Name of the Agro-chemicals used in the study area

A survey by questionnaire from Sep 2022 to Feb 2023 was done by the investigator to know about the agro-chemicals mainly artificial fertilizers, pesticides, fungicides and weedicides which were used in tea gardens.

Table 1: Name of major fertilizers used in the tea gardens of Gohpur sub-division.

FERTILIZER	FORMULA	NUTRIENTS	% OF NUTRIENTS	IMPURITIES
Urea	$CO(NH_2)_2$	Nitrogen (N)	N-45	……
Super phosphate (Normal)	$Ca(H_2PO_4)_2xH_2O$ + CaSO4	P_2O_5, Ca, S	P-20, Ca-21, S-11	Cd, fluoride, Cr, Mn, Ni and Zn
Diammonium	$(NH_4)_2H_2PO_4$	N, P_2O_5	N-18, P-46	Cd, Cr, Pb, As

phosphate (DAP)				
Dolomitic limestone	$CaCO_3$ + $MgCO_3$	Ca, Mg	Ca-24 to 30,Mg-6 to L2	Heavy metals
Ammonium nitrate	NH_4NO_3	Nitrogen(N)	N-34	……
Gypsum	$CaSO_4.2H_20$	Ca, S	Ca-22,S-18	……
Micronutrients and others	$CuSO_4xH_20$,$NaB_4O_710H_2O$ $ZnSO_4H_2O$,$(NH_4)_6Mo_7O_{24}.2H_2O$ $Mn(NH_4)PO_4.H_2O$	Cu, B, Zn, Mo, Mn etc.	Cu-25 to 35, B-11, Zn-61, Mo-54, Mn-28	Trace as impurities

Table 2: Fungicide & weedicide

Trade Name	**Chemical concentration**	**Active ingredient**	**Reemdn**	**Against**
Folicur	Tebucontazole	S	25.9% m/m	2.5ml/l
Contaf	Hexaconozole	S	5%	0.5-1ml/l
2,4-D	2,4-dichloro-phenoxy acetic acid	_	1120g/ha	…
Isoprotunon	1,1-dimethylurea	N	800g/ha	…

Result and discussion

The potable water samples are collected from surface, sub-surface and tube well. The pH and concentration of different ions and elements like F^-, Cl^-, SO_4^{2-},PO_4^{2-}, As, Fe, Mn, Hg, Cd concentration are shown in (Table 3&4).

Table3: Concentration of different water quality parameters in ppm. except pH in tea gardens.

Gardens Name	**pH (Min-Max)**	**Cl^- (Min-Max)**	**F^- (Min-Max)**	**PO_4^{2-} (Min-Max)**	**SO_4^{2-} (Min-Max)**
Ghogra T.E.	6.2-6.7	11.4-32.7	0.15-0.25	0.040-1.31	5.5-25.2
Gohpur T.E.	6.6-7.6	55.1-99.6	0.72-0.91	0.126-0.155	54.1-57.9
Purupbari T.E.	7.1-8.6	77.9-100.8	0.63-1.04	0.223-1.287	23.4-74.7
Helem T.E.	7.0-7.4	24.8-99.7	0.82-1.01	0.02-0.131	18.9-54.4
Dafflagarh T.E.	7.5-7.7	101.1-175.2	0.75-0.89	0.180-1.250	45.57-94.57
Brahmajan T.E	6.4-7.1	56.6-97.2	0.71-0.83	0.082-0.265	68.1-70.3
WHO ppm	7-8.5	250	1.5	……..	200

Table 4: Concentration of heavy metals (in ppm) in tea gardens

Gardens Name	**Mn (Min-Max)**	**As (Min-Max)**	**Fe (Min-Max)**	**Cd (Min-Max)**	**Hg (Min-Max)**
Ghogra T.E.	0.17-1.53	0.001-0.031	0.28-0.57	0.002-0.011	Trace-0.010
Gohpur T.E.	0.02-1.17	0.001-0.003	1.70-9.86	0.124-0.145	Trace-0.013
Purupbari T.E.	0.34-1.68	0.02-0.05	0.21-5.02	0.194-1.26	Trace-0.06
Helem T.E.	0.74-2.68	0.004-0.052	1.46-3.86	0.02-0.121	0.002-0.096
Dafflagarh T.E.	0.41-4.13	0.02-0.03	1.62-12.80	0.14-1.03	Trace-0.001
Brahmajan T.E	0.20-4.43	0.014-0.017	21.64-24.57	0.080-0.214	Trace-0.003
WHO ppm	0.3	0.01	……..	0.05	0.006

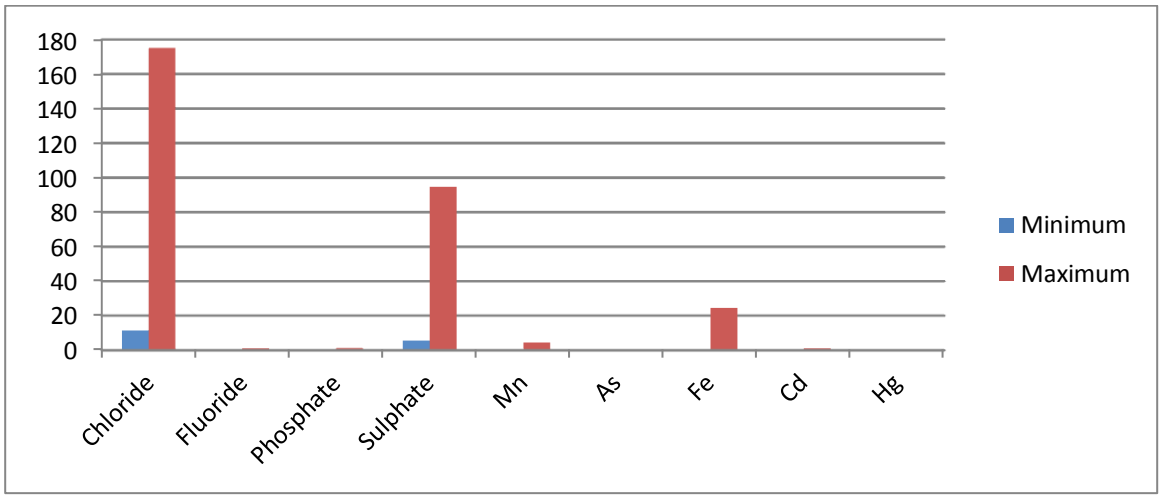

Fig: Minimum and maximum concentration of parameters in Tea Garden areas of Gohpur Sub-division

pH

Measurement of pH is one of the most important and frequently used tests in water chemistry. pH is used in alkalinity and carbon dioxide measurement and many other acid-base equilibrium. The permissible limit of pH in drinking water is within 6.5 to 8.5 according to Bureau of Indian Standards (BIS). High levels of pH may impart a bitter taste to the water. In the present study the variation of pH is 6.2 to 8.6 which is narrow and in general the pH is towards alkaline side.

Chloride (Cl^-)

Chloride (Cl^-) is one of the major inorganic anions in water and waste water. In potable water, the salty taste produced by chloride concentration is variable and dependent on the chemical composition of water. The recommended maximum contaminant level is 250 ppm and in the present study the range of chloride ion is 11.4 to 175.2 ppm

Fluoride (F^-)

The fluoride concentration in the study area is found from 0.15 to 1.04 ppm which is safe limit provided by WHO (4).

Phosphate (PO_4^{2-})

Phosphorous occurs in natural water almost solely as phosphates. Phosphorous is essential to the growth of organisms and can be the nutrient that limits the primary productivity of a body of water. In the present study area the concentration of phosphate is 0.02 to 1.31 ppm, which is above the permissible limit due to excessive use of phosphate fertilizer in soil.

Sulphate (SO_4^{2-})

The maximum permissible and allowable concentration of sulphate in drinking water is 200 mg/L and 400 mg /L respectively, according to BIS. If it is above standard limit then it reduces lung function and causing asthmatic symptoms. In The study area the range of sulphate is within limit of 5.5 to 94.57 ppm.

Manganese (Mn)

Manganese is the fifth most abundant metal in the earth's crust. The study revealed that maximum samples had Mn concentration above the permissible limit (0.3 ppm) of WHO standards. The range of Mn in the study area is 0.02 to 4.53 ppm. Manganese toxicity can cause hearing problems, insomnia, depression, loss of appetite, headaches, weakness etc (5).

Arsenic (As)

The range of arsenic in the study area is 0·001 to 0.052 ppm which is above the WHO limit of 0.01 ppm. Arsenic poisoning is a severe concern for the people all over the globe and other life forms. It is highly toxic and can cause weight loss, hair loss, nausea, cancer and other fatal illness. The main source of As is DAP.

Iron (Fe)

The range of iron in the study area is from 0.21 to 24.57 ppm. It is very high to WHO limit because of high amount of micronutrients use in the nearby soil. Iron is a secondary drinking water standard and primarily regulated because of the aesthetic problems associated with elevated iron concentrations.

Cadmium (Cd)

The range of cadmium in the present study is from 0.002 to 1.03 ppm. Cadmium is very dangerous for human health and the WHO limit for cadmium in drinking water is 0.003 ppm. Cadmium poisoning causes destruction of testicular tissue, RBCs, disorder of bone narrow, kidney diseases etc (7).

Mercury (Hg)

Mercury is a heavy metal of known toxicity, noted for inducing public health disasters in Minamata Bay, Japan(8). It is a toxic heavy metal which is widely dispersed in nature. The range of mercury in the study area is from trace to 0.096 ppm, which is slightly high to WHO limit. Hg may come to drinking water sources from pesticides. It can cause harmful effect on nervous, digestive and immune system (9).

CONCLUSION

From the above discussion on the chemical quality data, it is observed that the potable water pollution in the tea garden areas of Gohpur Sub-division, Sonitpur, Assam is significant. The widespread use of fertilizers and pesticides leads to contamination of potable water, which harms environment and threatens life. From the above study it is observed that some of the parameters are above the permissible limit by WHO. It is because of uncontrolled use of chemicals in the tea garden areas of Gohpur Sub-division. The long term use of these chemicals may cause weakness, kidney disease, asthma, disorder of bone marrow, cancer etc. To avoid these scenarios, we can work together to keep the environment clean by following these measures –

1. The use of fertilizers, pesticides and other chemicals should be reduced.
2. Do not dispose the chemicals into the sanitary sewer.

3. A continuous and systematic monitoring of relevant parameters are required for an effective management of potable water sources in the tea garden areas.
4. The organic fertilizers may increase the rate of tea production and reduce the pollution rate of the environment.
5. Awareness among the people for a proper planning and management can solve the problems.

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