

Evaluation of Ground Water Contamination by Inorganic pollutants in Tea Garden Area of Biswanath Chariali, Biswanath, Assam, India

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ABSTRACT

Water stored underground is the nature's blessing to the mankind. It is one of the Earth's most precious resources and its development plays a vital role in the Country's economy. The present investigation is a modest attempt to understand the potability of drinking water provided by different sources in the tea belt area of Biswanath Chariali, Biswanath, Assam. It has been observed that from the early point of the tea gardens a lot of pesticides and various types of chemical fertilizers have been used continuously. It is very likely that it may contaminate the ground water quality of the area by percolation, runoff and leaching process. More or less the people in the tea garden areas are ignorant and illiterate and most of them are still physically unconscious. Therefore there is a need of elaborate scientific study especially in the ground water which is called the life blood of living creature. Moreover due to lack of appropriate maintenance practice some source are observed in very worst condition and proper scientific study in this area is very scanty. Therefore there is a need to evaluate the potable quality of water and draw a proper scientific plan for their management. A total of 10 numbers of water samples were collected from different water sources like ring wells, deep-tube wells and main supply plants of the gardens to study the different water quality parameters like p^H, EC, TDS, TH, TA, Ca, Mg, free CO₂, F⁻, Cl⁻, SO₄²⁻. Data were subjected to normal distribution pattern of the water quality parameters and correlation analysis was carried out to study the interrelationships between different parameters.

Keywords: Ground water quality, Tea gardens, Contamination, Biswanath Chariali, Biswanath

INTRODUCTION

Tea garden areas, like those found in India, are significant contributors to the country's economy and cultural heritage. The tea industry is a major source of employment and revenue, with India's tea production accounting for a substantial share of global production. However, the water resources in these areas are facing increasing threats from inorganic pollutants, posing risks to human health, agriculture, and ecosystems. Inorganic pollutants, such as heavy metals, nitrates, and fluorides, can contaminate water sources through agricultural activities, industrial operations, and domestic waste. The use of fertilizers, pesticides, and other chemicals

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Published: 24/04/2024

DOI: <https://doi.org/10.70558/IJST.2024.v1.i2.241021>

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in tea cultivation can lead to the leaching of these pollutants into nearby water bodies, while industrial processes and domestic waste can also contribute to water pollution. This evaluation aims to assess the levels and sources of inorganic pollutants in water sources within tea garden areas, highlighting the need for effective water management strategies to mitigate these risks.

Water of sufficient quantity and quality is an essential resource for Agricultural, Industries and Tourism but also for everyday life in cities and villages. But water resources are depleted and degrade due to the use of huge number of fertilizers, pesticides and agrochemicals in tea garden belts for better production which contaminates ground water through percolation and rivers and other water bodies through surface run off. Unwanted elements and other excess elements easily leach out through high permeable and porosity soil, which are easily contaminated with ground water.

The loss of quality is causing health hazards and death of human which disturbed the whole ecology system of the region. The identification of environmental hazards of tea garden belts is directly or indirectly caused by the water quality, geomorphology, geological, hydrological condition and other land use and also socio-economic pattern.

Water borne diseases are the major problem of tea garden area. Waste tea garden management is one of the causes of health hazard. The diarrhoea, malaria and other water born disease are “Acute problem” of the tea garden belts in the monsoon period. Therefore a study was carried out to find out the potable quality of water samples from five tea garden areas were analyzed from March to May and draw a proper scientific plan for their management. A total of 10 numbers of water samples were collected from different water sources like ring wells, deep tube wells and main supply plants of the gardens to study the different water quality parameters like p^H , EC, TDS, TH, TA, Ca, Mg, free CO_2 , F^- , Cl^- and SO_4^{2-} . The findings of this evaluation will provide valuable insights into the current state of water quality in tea garden areas and inform strategies for sustainable water resource management.

MATERIALS AND METHODS

Study area:

Biswanath Chariali ‘26.37 N and 93.10 E’ is a sub-division under Biswanath district of Assam, India has been chosen as study area for present observation. The Biswanath district with an area of 1415 sq km is situated on the north bank of the Brahmaputra River ‘92.20 E to 93.45 E longitude and 26.2 N to 27.05 N latitude ‘and bound by Arunachal Pradesh to the north, Bramhaputra river to the south, North Lakhimpur and Darrang district to the east and west respectively. The climate of the district is warm, sub tropical, the summer and the winter temperature vary from 7 to 36⁰c. the average annual rainfall ranges 170 to 220 cm. hot and humid climatic condition, paddy fields, annual perennials low flowing streams, channels, irrigation drains, ponds etc. provide favourable breeding habitats for vector mosquitoes in this district. The study site containing 5 number of major tea gardens namely Pabhoi, Majulighur, Pretabghur and Asia’s biggest tea garden Monabari.

Sampling Methodology:

A total of ten water samples, two from each garden were collected from deep tube well, Ring

well and main supply plant in pre-cleaned 1 liter polyvinyl container. Water samples were collected following the standard methods.

Sample Analysis:

The parameters temperature, odour, colour and test were measured at the site of collection. P^H water samples measured with digital p^H meter [Elico L1-127]. EC of the samples were also measured with the help of digital conductometer. TS, TDS and TSS were measured by using standard method [2]. Fluorides were estimated by SPANDS method using uv-spectrometer at 570 nm. Calcium and magnesium were estimated by EDA method. Phosphates were measured by using spectrophotometer [Elico SL-159] at 690 nm.

RESULTS AND DISCUSSION:

In the present study the potability of water for drinking purpose with respect to p^H, EC, TH, TA, TDS, Ca²⁺, Ma²⁺, Cl⁻, SO₄²⁻ and fluoride was compared with the standards set by WHO for different water quality parameters. Table 1 shows various sampling locations of the study area.

TABLE 1: SAMPLING LOCATION AND SOURCES

| S/N | Sampling location | Source | sample code |
|-----|-------------------|-------------------|-------------|
| 1 | Pabhoi | Main supply plant | Dw 1 |
| 2 | „ | Deep tube well | Dw 2 |
| 3 | Majulighur | Ring well | Dw 3 |
| 4 | „ | Deep tube well | Dw 4 |
| 5 | Pertabghur | Deep tube well | Dw 5 |
| 6 | „ | Main supply plant | Dw 6 |
| 7 | Baghmari | Ring well | Dw 7 |
| 8 | „ | Hand pump | Dw 8 |
| 9 | Monabari | Ring well | Dw 9 |
| 10 | „ | Main supply plant | Dw 10 |

The results of various physico-chemical parameters are presented in the table 2 and all the values are averages of three times measurements.

TABLE 2: Various physico-chemical characteristics of drinking water samples

| S/N | PARAMETERS | DW1 | DW2 | DW3 | DW4 | DW5 | DW6 | DW7 | DW8 | DW9 | DW10 |
|-----|----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 1 | Odour | NC |
| 2 | Colour | NC | LY | LY | NC |
| 3 | Taste | NO |
| 4 | Temperature oc | 27 | 24 | 24 | 23 | 22 | 24 | 23 | 24 | 23 | 25 |

| | | | | | | | | | | | |
|----|-----------------|------|------|------|------|------|------|------|------|------|------|
| 5 | Turbidity | 21 | 19 | 18 | 23 | 16 | 21 | 19 | 18 | 23 | 16 |
| 6 | TDS mg/l | 288 | 166 | 210 | 188 | 148 | 334 | 92 | 382 | 98 | 82 |
| 7 | TSS mg/l | 46 | 50 | 34 | 52 | 12 | 12 | 14 | 40 | 20 | 44 |
| 8 | pH | 6.8 | 6.4 | 6.1 | 6.9 | 6.1 | 6.8 | 6.6 | 6.3 | 6.4 | 7.2 |
| 9 | Conductance | 0.11 | 0.12 | 0.29 | 0.13 | 0.17 | 0.18 | 0.08 | 0.35 | 0.12 | 0.13 |
| 10 | Alkalinity mg/l | 190 | 170 | 160 | 210 | 150 | 220 | 140 | 170 | 140 | 150 |
| 11 | CO2 | 17.6 | 26.4 | 30.8 | 22.0 | 39.6 | 22 | 13.2 | 13.2 | 13.2 | 8.80 |
| 12 | Hardness mg/l | 28 | 30 | 42 | 34 | 60 | 70 | 36 | 112 | 38 | 48 |
| 13 | Fluoride mg/l | BDL | BDL | BDL | 0.23 | 0.20 | 2.1 | 0.19 | 0.23 | 0.15 | 0.19 |
| 14 | Chloride mg/l | 8.5 | 7.1 | 21.3 | 7.1 | 18.5 | 8.5 | 8.5 | 35.5 | 21.3 | 11.4 |
| 15 | Sulphate mg/l | 12.1 | 12.4 | 10.5 | 13.7 | 13.7 | 12.9 | 10.3 | 11.6 | 8.8 | 12.6 |
| 16 | Calcium mg/l | 6.4 | 4.8 | 10.4 | 9.6 | 12 | 13.6 | 9.6 | 5.6 | 8.8 | 9.6 |
| 17 | Magnesium mg/l | 2.9 | 4.4 | 3.8 | 2.4 | 7.3 | 8.8 | 2.9 | 23.8 | 3.8 | 5.8 |

NC- No characteristic, NO- Not observable, LY- Light yellow, BDL- Below detection level.

GRAPHICAL PRESENTATION OF VARIOUS PARAMETERS:

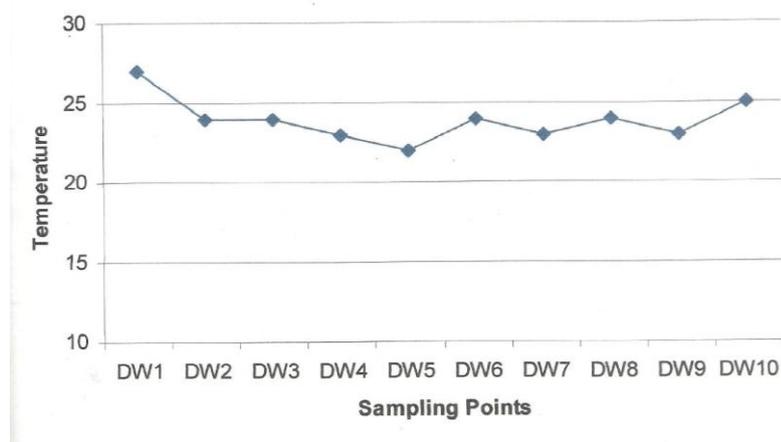


Fig.1: Variation of temperature of drinking water samples

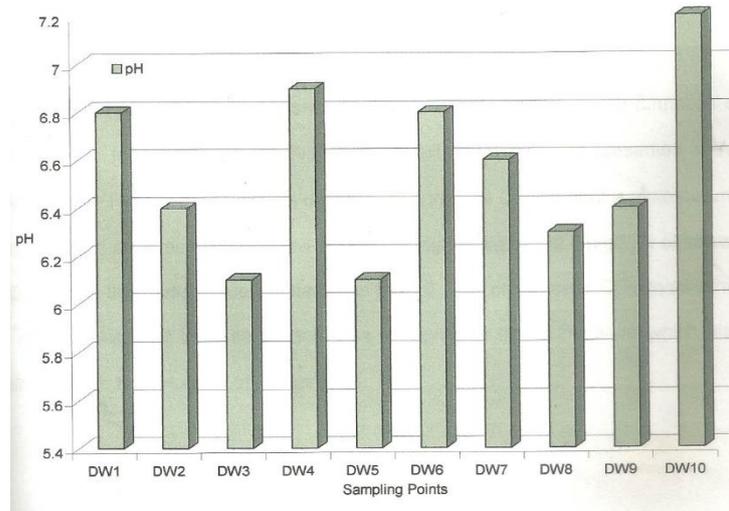


Fig.2: Variation of pH of drinking water samples

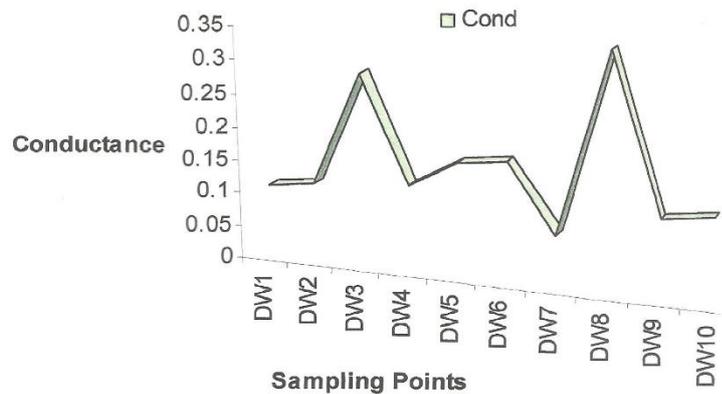


Fig.3: Variation of conductance of drinking water samples

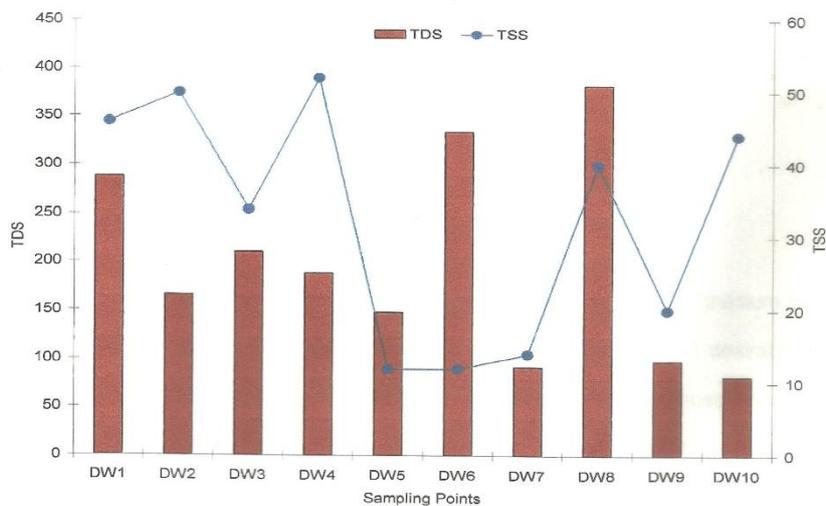


Fig.4: Variation of TSS and TDS of drinking water samples

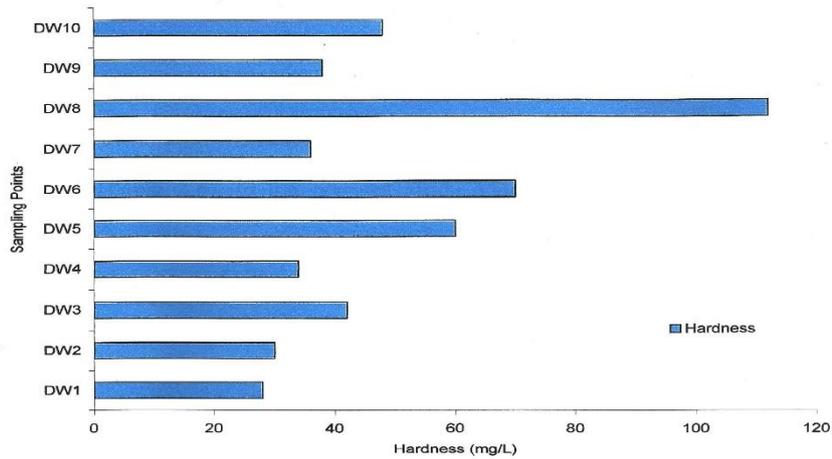


Fig.4: Variation of Hardness among drinking water samples

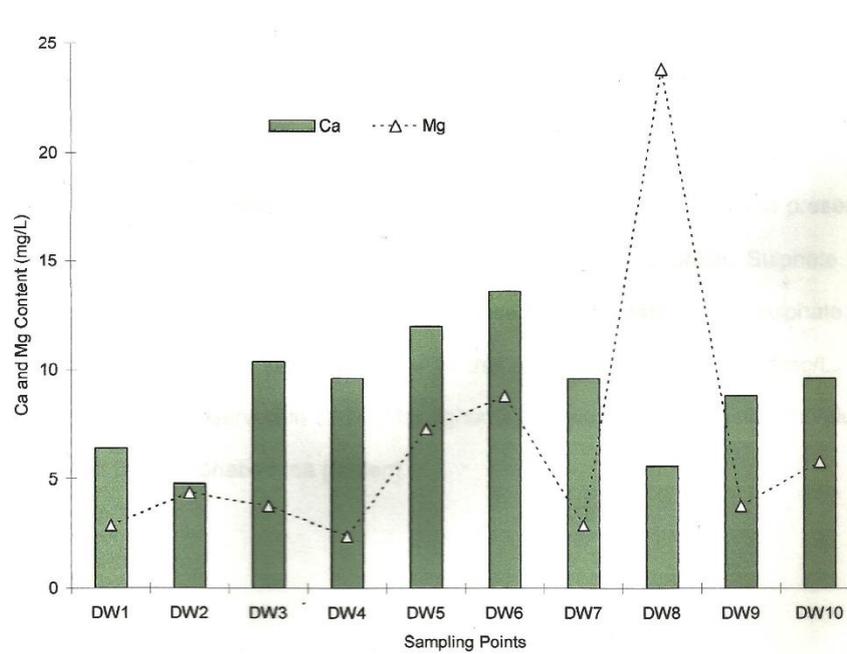


Fig.4: Variation of Ca and Mg content drinking water samples

CONCLUSION:

In the present investigation it has been observed that most of the inorganic constituents are within the specified level. The Temperature, Turbidity, Colour and Odour are quite normal for most of the samples excepting few ones. The pH of the samples has been observed from slightly acidic to almost normal. The TDS of the samples has been observed much lower in comparison to the permissible level. Alkalinity, free CO₂, hardness, calcium, magnesium content of the drinking water samples has been observed within the specified limit. The alkalinity content is little bit in higher side for few samples. The fluoride content is significantly high in pertabghur tea garden. The sulphate is moderately present in all samples. The current study has been done only for one season. Thus it is difficult to make a clear cut conclusion with this one season

data. The present investigation is primarily for data generation and it could provide useful information for water quality assessment in future study in the area.

Reference:

1. Adekunle, I. M., Adetunji, M. T., Gbadebo, A. M., & Banjoko, O. B. (2007). Assessment of Groundwater Quality in a Typical Rural Settlement in Southwest Nigeria. *International Journal of Environmental Research and Public Health*, 4(4), 307-318.
2. Gajbhiye, S., Awasthi, M. K., & Sharma, S. K. (2014). *Assessment of ground water quality*. LAP LAMBERT Academic Publishing.
3. Shekhar, S. (2017). Assessment of groundwater quality. *Hydrogeology and Engineering Geology*.
4. Liu, C. W., Lin, K. H., & Kuo, Y. M. (2003). Application of factor analysis in the assessment of groundwater quality in a blackfoot disease area in Taiwan. *Science of the total environment*, 313(1-3), 77-89.
5. Ishaku, J. M. (2011). Assessment of groundwater quality index for Jimeta-Yola area, Northeastern Nigeria. *Journal of geology and mining research*, 3(9), 219-231.
6. Rajesh, R., Elango, L., & Brindha, K. (2019). Methods for assessing the groundwater quality. *GIS and geostatistical techniques for groundwater science*, 57-78.
7. Vijay, R., Khobragade, P., & Mohapatra, P. K. (2011). Assessment of groundwater quality in Puri City, India: an impact of anthropogenic activities. *Environmental monitoring and assessment*, 177(1), 409-418.
8. Chakraborty, M., Tejankar, A., Coppola, G., & Chakraborty, S. (2022). Assessment of groundwater quality using statistical methods: a case study. *Arabian Journal of Geosciences*, 15(12), 1136.
9. Rao, N. S., Rao, P. S., Reddy, G. V., Nagamani, M., Vidyasagar, G., & Satyanarayana, N. L. V. V. (2012). Chemical characteristics of groundwater and assessment of groundwater quality in Varaha River Basin, Visakhapatnam District, Andhra Pradesh, India. *Environmental monitoring and assessment*, 184(8), 5189-5214.
10. Jain, C. K., & Vaid, U. (2018). Assessment of groundwater quality for drinking and irrigation purposes using hydrochemical studies in Nalbari district of Assam, India. *Environmental earth sciences*, 77(6), 254.
11. Chetia, M., Chatterjee, S., Banerjee, S., Nath, M. J., Singh, L., Srivastava, R. B., & Sarma, H. P. (2011). Groundwater arsenic contamination in Brahmaputra river basin: a water quality assessment in Golaghat (Assam), India. *Environmental monitoring and assessment*, 173(1), 371-385.
12. Dutta, B., & Sarma, B. (2018). Correlation study and regression analysis of ground water quality assessment of Nagaon Town of Assam, India. *Geomorphology*, 2826006(1541), 03.
13. Smedley, P. L., Nicolli, H. B., Macdonald, D. M. J., Barros, A. J., & Tullio, J. O. (2002). Hydrogeochemistry of arsenic and other inorganic constituents in groundwaters from La Pampa, Argentina. *Applied geochemistry*, 17(3), 259-284.
14. Kurwadkar, S. (2019). Occurrence and distribution of organic and inorganic pollutants in groundwater. *Water Environment Research*, 91(10), 1001-1008.

15. Verma, P., & Ratan, J. K. (2020). Assessment of the negative effects of various inorganic water pollutants on the biosphere—an overview. *Inorganic Pollutants in Water*, 73-96.
16. Kowalkowski, T., Gadzała-Kopciuch, M., Kosobucki, P., Krupczyńska, K., Ligor, T., & Buszewski, B. (2007). Organic and inorganic pollution of the Vistula River basin. *Journal of Environmental Science and Health, Part A*, 42(4), 421-426.
17. Shah, A. B., & Singh, R. P. (2016). Monitoring of hazardous inorganic pollutants and heavy metals in potable water at the source of supply and consumers end of a tropical urban municipality. *International Journal of Environmental Research*, 10(1), 149-158.
18. Prasse, C., & Ternes, T. (2010). Removal of organic and inorganic pollutants and pathogens from wastewater and drinking water using nanoparticles—a review. *Nanoparticles in the water cycle: Properties, analysis and environmental relevance*, 55-79.
19. Tepavitcharova, S., Todorov, T., Rabadjieva, D., Dassenakis, M., & Paraskevopoulou, V. (2009). Chemical speciation of inorganic pollutants in river–estuary–sea water systems. *Environmental monitoring and assessment*, 149(1), 251-260.
20. Haq, I., & Kalamdhad, A. S. (2021). Phytotoxicity and cyto-genotoxicity evaluation of organic and inorganic pollutants containing petroleum refinery wastewater using plant bioassay. *Environmental Technology & Innovation*, 23, 101651.