International Journal of Scientific Engineering and Research (IJSER)
ISSN (Online): 2347-3878
Index Copernicus Value (2015): 56.67 | Impact Factor (2017): 5.156

Potable Water Quality Analysis of Various Sources Available at Nilachal Hills (Kamakhya Hill), Guwahati, Assam, India

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Abstract: ***Kamakhya temple situated atop Nilachal Hills in Guwahati, Assam is a famous pilgrimage and one of the shakti peeths in India. Several festivals are celebrated in the temple of which Amubachi mela is the prominent one. Lakhs of devotees throng the temple to have a glimpse to the deity during the mela. Devotees, saints, priests, tourists etc. who visit the temple, during the mela and round the year, and the inhabitants of the hills, use different sources of water available in the hill for drinking. Water is nature's elixir and even more than a nutrient, a cleanser in human body. Thus, pure drinking water is an essential commodity for healthy living. This paper attempts to bring the significant quality of potable water at various sources in Nilachal Hill before the mela. Physico-chemical parameter of any water body plays an important role in maintaining fragile ecosystem that maintains various life forms. Present research deals with various parameters such as temperature, pH, electrical conductivity, total hardness, dissolved oxygen, iron, chloride, fluoride, sulphate, and phosphate. The results were compared with World Health Organization (WHO) and Bureau of Indian Standards (BIS) for drinking water.***

Keywords: Potable water quality, Nilachal Hills, WHO, BIS, ecosystem

1. Introduction

Water is the elixir of life and one of the most indispensable resources. It is vital to the existence of living organisms but the valued resource is increasingly being threatened with the growing human population which demands water for domestic purposes and economic activities [1]. Increased population and associated pressure on resources has led to over-exploitation of water resources and water scarcity, which have become a nightmare to a huge section of population all over the globe, more specially in the developing countries[2]. Water quality is considered the main factor controlling health and the state of disease in both man and animals. Surface water quality in a region is largely determined both by natural processes (weathering and soil erosion) and by anthropogenic inputs (municipal and industrial wastewater discharge). The anthropogenic discharges constitute a constant polluting source, whereas surface runoff is a seasonal phenomenon, largely affected by climate within the basin [3] [4]. Human activities are a major factor determining the quality of the surface and groundwater through atmospheric pollution, effluent discharges, use of agricultural chemicals, eroded soils and land use. Environmental pollution, mainly of water sources, has become public interest [5]. As reported by [6], [7] and [8], the all-India scenario of drinking water supply continues to be deficient. World Health Organization (WHO) and UNICEF's Joint Monitoring Programme (JMP) for Water Supply and Sanitation (2011) states that 92 per cent of the total population of India had access to improved source of water (96%-urban/89%-rural). But the water supply systems in most cities of India are poorly operated with weak infrastructure and poor resource management. Due to unreliable nature of public water supply in most cities people have to depend either on their own sources or on some commercial agencies or on water vendors. In this regard Guwahati city is no exception. Thus a humble task has been carried out to study the quality of potable water at various available sources in the Nilachal Hills situated in Guwahati city.

2. Study Area

Nilachal Hills located between 91.689^{o} E & 26.167^{o} N to 91.718^{o} E & 26.167^{o} N and 293 meters above mean sea level in metropolis Guwahati, the gateway of Northeast India, is famous for the temple of Goddess Kamakhya. The temple is a springboard and centerpiece of *Shakti* worship in India. The temple is closely related to the history of Assam and has also found mention in *Devi Bhagavata. Devi Purana*, *Kalika Purana*, *Yogini Tantra*, *Hevajra Tantra*, *Chudamoni Tantra* etc. The *Ambubachi mela* is the most important and prominent festival of the temple. It is celebrated annually during the monsoon season, which happens to fall around the middle of the month of June. Several lakhs devotees throng the shrine from across the country including foreigners during the *mela*. The study area experiences mild subtropical climate with average rainfall at of 2272.37 mm, about 90 per cent of it occurs between May and September and maximum and minimum temperature variation between 31^{o}C and 12^{o}C [9]. Geology of the study area consists of gneiss and granite bodies intruded by quartz and quartz-feldsphetic veins, aplite and pegmite [10]. Soils on the hill slope is a product of physical and chemical weathering process on the parent rock viz., granite, gneiss and polymorphic granite [11]. Devotees who visit and stay in the temple complex during the *mela* and round the year and also the inhabitants of the hills use water from various sources such as river water, supply water, water filters installed in the temple complex, *Subhagya kund* (pond), *Kasopukhuri* (pond), well water for drinking and cooking purpose.

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3. Materials and Methods

In the study water samples were collected from 6 different sources of potable water. Water samples were collected in PET bottles of half litre size and closed tightly. The physico-chemical parameters analyzed in the study are temperature, pH, electrical conductivity, total hardness, dissolved oxygen, iron, chloride, fluoride, sulphate, and phosphate Temperature of the water samples was noted on the spot with a mercury thermometer. pH and electrical conductivity was determined in the laboratory immediately after sampling. The samples were analyzed as per standard procedure. Total hardness was determined by EDTA method and dissolved oxygen was measured by Winkler's method. Iron was estimated by using Phenanthroline Method at 510 nm. Chloride was determined by Argentimetric method. Fluoride was measured by the SPADNS method at 570nm. Turbidimetric method was used for Sulphate. Phosphate was determined by Molybdenum blue method. The instruments were used in the limit of précised accuracy and chemicals used were of analytical grade. Double-distilled water was used for all purposes [12].

Table 1: Showing sample location and code

Sampling Location	Sample Code
River water	PW1
Supply water	PW2
Inside temple complex	PW3
Kasopukhuri	PW4
Subhagya Kund	PW5
Well water	PW6

4. Results and Discussion

The results of the physico-chemical analysis of water samples are shown in Table 2 & Table 3

Table 1: Showing physical & biological parameters of potable water

Sample Code	Temp	pH	EC	DO	TH
PW1	25.3	6.76	1.5	23.2	111.33
PW2	24.5	6.98	0.61	22	117.33
PW3	24.5	6.89	0.89	19.2	84
PW4	27.4	6.73	1.73	6.8	123.33
PW5	25.4	6.79	1.86	8.14	186
PW6	24.4	6.95	1.34	20	83.33

Temp – temperature, EC – electrical conductivity, DO – dissolved oxygen, TH – total hardness

The pH value of drinking water is an important index of acidity or alkalinity. A number of minerals and organic matter interact with one another to give the resultant pH value of the sample [13]. In the present study, pH ranges from 6.73-6.95, which lies in the range prescribed by WHO. The Dissolved oxygen in the water samples ranges from 6.8-23.2 mg/L, which is higher than the permissible limit of 8 mg/L for good quality drinking water except PW4 which has a DO value of 6.8mg/L. The aquatic life is held responsible for lowering the value of dissolved oxygen. The ISI suggest that dissolved oxygen should be between 4-6 mg/L. The higher value of dissolved oxygen can impart good aesthetic taste to drinking water [14]. The total hardness ranges between 84 -186 mg/L, while WHO, 2011 and BIS, 2012 permit any value less than 300mg/L and 200 mg/L respectively. In all samples total hardness is within the acceptable limit.

Table 2: Showing chemical parameters of potable water

Sample Code	F^-	Cl^-	SO_4^{2-}	PO_4^{3-}	Fe
PW1	0.16	16.47	24.12	0.25	0.50
PW2	0.33	15.05	22.60	0.14	0.32
PW3	0.37	16.47	19.81	0.15	0.31
PW4	0.50	80.37	20.77	0.30	1.01
PW5	0.07	93.15	28.58	0.20	0.33
PW6	0.20	38.76	84.93	0.20	0.30

Permissible limit of fluoride in drinking water as prescribed by WHO, 2011 is 1.5 mg/L whereas the same has been prescribed by BIS, 2012 at 0.3 mg/L. Fluoride value in the study area ranges from 0.07 – 0.5 mg/L which is within the permissible limit of WHO, 2011 but as per BIS, 2012 fluoride value exceeds the permissible limit in PW2, PW3 and PW4. Fluoride concentration in drinking water produces divergent health effects on the consumer such as bone disease, children may get mottled teeth depending upon their relative proportions [15]. Chloride ranges from 15.05 – 93.15 mg/L which is within the BIS, 2012 guideline value of 250 mg/L. It is the most dominant anion in water [16]. Sulphate ion is estimated to vary from 19.81 - 84.93 mg/L. The maximum tolerance range for sulphate is 200 mg/L (BIS). The excess amount of sulphate causes diarrhea and other gastro intestinal irritation. All samples are free from sulphate problems. Sulphate produces an objectionable taste at 300 - 400 mg/L and bitter taste at 500 mg/L [19]. Phosphates are not toxic to people or animals unless they are present in very high levels. Digestive problem could occur from extremely high level of phosphate. Phosphate will stimulate the growth of plankton and aquatic plants which provide food for fish. When excess of phosphate enters the water way, algal and aquatic plants will grow wildly, choke up water ways and use large amounts of oxygen. This condition is known as eutrophication [20]. In this study phosphate ranges from 0.14 – 0.30 mg/L. Iron in the water samples ranges from 0.30 – 1.01 mg/L which is higher than the permissible limit of 0.3 mg/L as per WHO and BIS, except for PW6. Five out of six sampling locations are contaminated by iron. Piped water supply susceptible to internal corrosion and leaching of iron into water as well as forming iron scales that may produce particulate iron compound in water rendering "red water" that adversely affects the water quality [22]. Iron contamination affects taste and appearance. It has an adverse effect on domestic uses and water supply structures and promotes iron bacteria.

5. Conclusion

People use water for drinking mostly from the six sources mentioned above. As a result, scarcity as well as chemical contamination of water affects a large number of people. Keeping in view the importance of the place and large influx of devotees during the *mela*, it is concluded that regular monitoring of water sources should be ensured by the concerned authorities to prevent the outbreak of water borne diseases in the area. Based on the study, it is concluded that the intrinsic drinking water quality in the area is not encouraging. Thus, suitable protective measure for drinking water sources in the area is recommended.

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Author Profile

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