Study of pollution in ground water in Bhagwanpur industrial area

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Abstract

Rapid urban population growth and industrialization has introduces many important implications on the environment like exploitation of natural resources to meet the over increasing demand. Ground water contamination is also a major problem in India as it is cost effective, assured and easily exploitable. It is one of the major sources of drinking water and it provides water for domestic use for a large part of Indian population. It is progressively getting contaminated by discrimination interference from humankind. If all the physical, chemical and biological parameters in optimum and balanced state then it is called as normal condition. If balance is disturbed or anyone components are in excess then it causes contamination in water. The present study deals with analysis of some important water quality parameters in ground water samples as per APHA [1].

Keywords: Pollution, Ground water, Bhagwanpur Industrial Area, Physico-chemical

1. Introduction

Water plays a vital role in human life. Due to the inadequate quantity of surface water available and to fulfill the needs of the people, the search and exploitation of ground water is necessary and it is the main source for agricultural, industrial, drinking and domestic purposes. Ground water is used for domestic and industrial water supply and irrigation all over the world because it is believed to be comparatively much clean and free from pollution than surface water. In the last few decades, it has been seen that there is a tremendous increase in the demand for fresh water due to rapid growth of population and accelerated pace of industrialization [2]. As a consequence of urbanization and industrialization ground water is getting polluted day by day. The main reason of resource contamination or depletion in several places is either contamination from natural source or anthropogenic activities. Variation of groundwater quality in any area is a function of physicochemical quality parameters which are greatly influenced by geological formations and anthropogenic activities of the area [3]. Various major sources of pollution in groundwater include municipal waste, industrial discharge, domestic waste, agricultural waste etc. All these activities affect ground water quality. These sources generate pollutants ranging from heavy metals, chlorinated hydrocarbon, phenols, cyanides, pesticides, major inorganic species and bacteria [4]. Various researchers have observed that human health is threatened by most of the industrial activities particularly in relation to excessive discharge of untreated effluent and unsanitary conditions. This study is associated with ground water quality assessment and physico-chemical data are utilized to analyze the groundwater quality.

2. Methodology

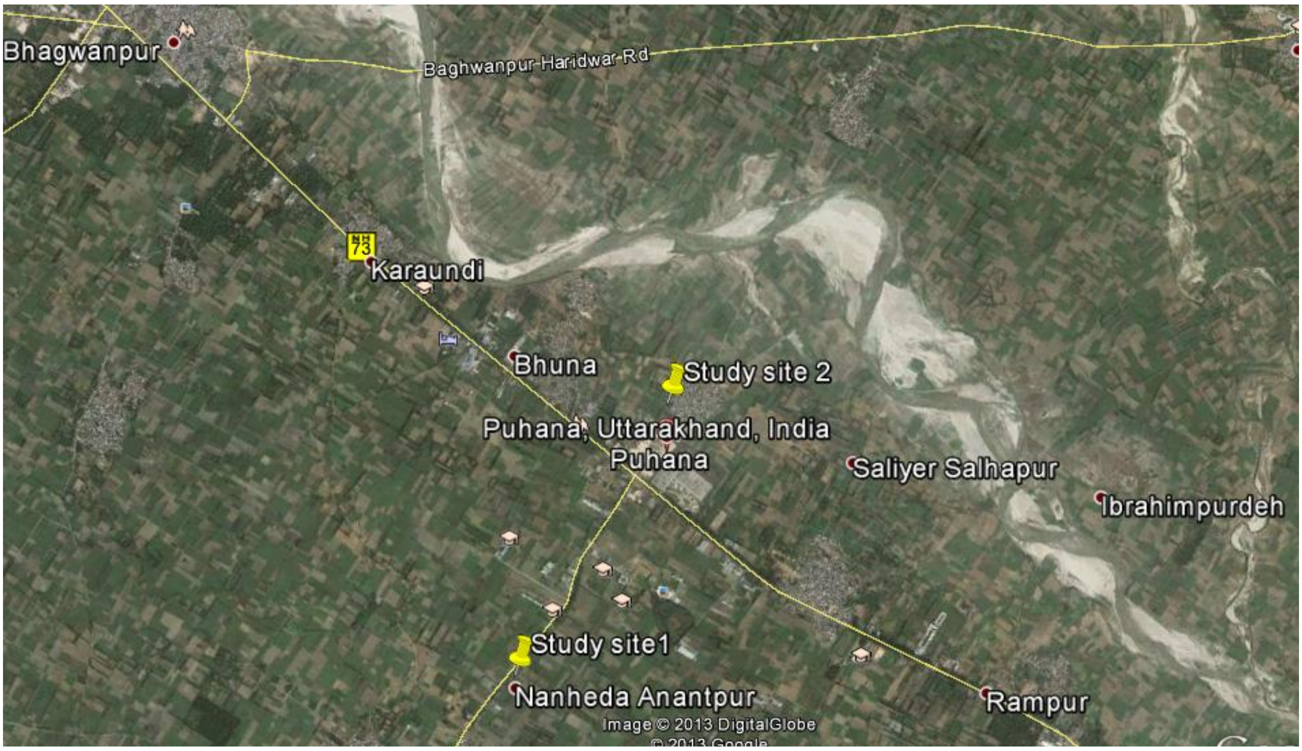
Study Area

Bhagwanpur is a town in Roorkee Tehsil, Haridwar district in the state of Uttarakhand, India. It is 47 km far from Dehradun which is the capital of Uttarakhand. It is located at latitude of 30.06941°N and longitude of 77.83997°E. As of 2001 India census, Bhagwanpur had a population of 4953. Males constitute 52% of the population and females 48%. Bhagwanpur has an average literacy rate of 67.76%, higher than the national average of 59.5%; with male literacy of 76.82% and female literacy of 58.05%. Number of households in Bhagwanpur are 833. Roorkee city is 11 km far away from Bhagwanpur. Besides SIDCUL, another industrial estate is also developed at Bhagwanpur near Roorkee. It had attracted many pharmaceutical and biotech units.

Sample collection

The water samples were taken from handpumps from Puhana and Nanheda Anantpur located in Bhagwanpur in Haridwar district. Puhana is located in South east direction and 4.32 km away from Bhagwanpur and Nanheda Anantpur is 4.99 km in South east direction (Fig 1).

Figure 1. Satellite Image showing Sampling Stations.



Pre washed plastic bottles were used for sample collection. After collection, samples were transported to laboratory and kept at 4°C till the time of analyses.

Analysis of Samples

The water physico-chemical analysis was done using standard analytical methods for water analysis [1]. The water samples were analyzed for various physicochemical parameters like pH, electrical conductivity, turbidity, total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), alkalinity, calcium, magnesium, chlorides, nitrates, fluorides, hardness etc. The pH of the sample was measured with a pH meter that has been previously calibrated with buffer solutions and electrical conductivity was measured with a conductivity meter calibrated with potassium chloride solution. Turbidity was measured with the help of turbiditymeter. Total solids (TS) were determined gravimetrically by evaporating a known volume of water sample to dryness in a pre- weighed crucible on a steam bath at 105°C. Total dissolved solids (TDS) were determined gravimetrically by adding a known volume of sample after filtration to a pre- weighed empty petriplate and putting it to water bath and then weighed after drying. Total dissolved solids (TSS) were determined by filtering known volume of sample through a pre-weighed filter paper and weighed after drying at 103 to 105°C in oven. Alkalinity was determined by titrating a known volume of water sample with 0.10 M HCl. Total amount of Calcium and magnesium in water samples were determined by titration with EDTA (ethylenediaminetetraacetic acid). Chloride (Cl^-) was analyzed by titration of a known volume of water sample with standardized silver nitrate ($AgNO_3$) solution. NO_3^- was determined by colorimetric method by adding sulfite urea, antimony, chromotropic acid and sulfuric acid to known volume of sample and then after 45 min OD was taken at 410 nm. Fluoride was estimated by SPADNS (4,5-Dihydroxy-3-(p-sulfophenylazo)-2,7-naphthalene disulfonic acid, trisodium salt) method. Total hardness is estimated as Ca + Mg by titration of known volume of sample against 0.01 M EDTA by adding buffer solution and

Erichrom black-T as indicator. Each sample was analyzed in duplicate, so as to ascertain the validity of the method and the average of the results reported. General laboratory quality assurance measures were observed to prevent sample contamination and instrumental errors.

3. Results and Discussions

Physico-Chemical Parameters

The values of physico-chemical parameters in ground water samples collected from Puhana and village Nanheda Anantpur are summarized in Table 1.

Table 1. Physico-chemical characteristics of ground water samples collected from Puhana and Village Nanheda Anantpur

S. No.	Parameters	Puhana	Nanheda Anantpur
1	pH	7.98	8.14
2	Turbidity (NTU)	0.0	0.0
3	Electrical conductivity (µmho/cm)	533	554
4	Total Solids	653.15	674.64
5	Total Dissolved Solids	342.15	357.45
6	Total Suspended Solids	310.24	320.10
7	Alkalinity	384.14	398.02
8	Calcium	14.30	25.04
9	Magnesium	4.15	8.64
10	Chlorides	583.64	594.61
11	Bicarbonates	465.21	477.43
12	Nitrate	8.54	9.08
13	Fluoride	0.60	0.72
14	Total Hardness	70.25	74.13

pH

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. pH was found 7.98 in sample of Puhana and 8.14 in sample of Nanheda Anantpur. It lies within BIS and WHO standard limits for drinking water quality and are suitable for drinking purpose. The normal recommended pH range for irrigation water is from 6.5 to 8.4 [5].

Turbidity

Suspension of particles in water interfering with passage of light is called turbidity. Turbidity of water is responsible for the light to be scattered. Turbidity in natural water restricts light penetration thus limiting photosynthesis, which consequently leads to depletion of oxygen content. Turbidity was not found in any of the ground water sample.

Electrical Conductivity

A high value of EC generally means high degree of salinity. Therefore, EC is considered as an important water quality parameter in assessing drinking water as well as irrigation water. EC is a widely used as indicator for salinity and this has also been used to classify the water under medium saline, low and high saline water. EC was found 533 and 554 µmho/cm in Puhana and Nanheda Anantpur. These values are within standard limits as prescribed by Bureau of Indian Standards (BIS) [6]. It was observed by some workers that when EC value exists at 3000 µmho/cm, the generation of almost all the crops would be affected and it may result in much reduced yield [7]. They also opined that the higher value of EC in groundwater is due to the high dissolved solids which may subscribe to the conductivity and has a direct bearing on the percentage of total solids.

Total Solids

Total solids are dissolved solids plus suspended and settleable solids in water. A high concentration of total solids will make drinking water unpalatable. Levels of total solids that are too high or too low also affect water clarity. Higher solids decrease the passage of light through water, thereby slowing photosynthesis by aquatic plants. Water will heat up more rapidly and hold more heat; this, in turn, might adversely affect aquatic life that has adapted to a lower temperature regime. Total solids were recorded 653.15 mg/l and 674.64 mg/l in Puhana and Nanheda Anantpur.

Total dissolved solids

The level of TDS is one of the characteristics, which decides the quality of drinking water. Total dissolved solids were recorded 342.15 mg/l and 357.45 mg/l in Puhana and Nanheda Anantpur, which are under standard limits prescribed by World Health Organization (WHO) [8] and BIS [9]. Water with fewer residues is less palatable and suits for drinking purpose. On the other hand, high level of TDS may aesthetically be unsatisfactory for bathing and washing [10].

Total Suspended Solids

Total suspended solids (TSS) include all particles suspended in water which will not pass through a filter. As levels of TSS increase, a water body begins to lose its ability to support a diversity of aquatic life. Suspended solids absorb heat from sunlight, which increases water temperature and subsequently decreases levels of dissolved oxygen (warmer water holds less oxygen than cooler water). TSS was recorded as 310.24 mg/l in Puhana and 320.10 mg/l in Nanheda Anantpur.

Alkalinity

Alkalinity of water is its capacity to neutralize a strong acid and it characterized by the presence of all hydroxyl ion capable of combining with the hydrogen ion. The various ionic species that contribute to alkalinity include bicarbonate, hydroxide, phosphate, borate and organic acids [11]. The bicarbonate alkalinity is expressed as a total alkalinity, which was recorded as 384.14 mg/l in Puhana and 398.02 mg/l in Nanheda Anantpur. The standard desirable limit of alkalinity in potable water is 120 mg/l [12]. The alkalinity values of all the samples are exceeding the permissible limit. However, little abnormal value of alkalinity is not harmful to human beings [13].

Calcium

Calcium is commonly present in all water bodies and maximum permissible limit of calcium in drinking water is 100 mg/l as suggested by WHO [12]. The calcium value recorded ranges from 14.30 mg/l and 25.04 mg/l in Puhana and Nanheda Anantpur village, respectively. All values were within standard limits.

Magnesium

Magnesium is also present with calcium in natural water albeit in lower concentration than calcium and has similar source of entry. Magnesium tolerance by human body is lowered than calcium and the high concentrations work as laxative and given unpleasant taste to water; it also add to hardness. The values of magnesium were recorded 4.15 mg/l and 8.64 mg/l in Puhana and Nanheda Anantpur village, respectively. Maximum permissible limit of magnesium in drinking water 50 mg/l as suggested by WHO [12]. In this study, values of magnesium were within standard limits. Some workers have reported [14] that too high magnesium causes nausea, muscular weakness and paralysis in human body when it reaches a level of about 400 mg/l.

Chloride

Chloride in the groundwater samples found to be 583.64 mg/l of Puhana and 594.61 mg/l in Nanheda Anantpur. According to WHO the maximum permissible limit for chloride in drinking water is 200 mg/l. Present study shows the values exceeds standard limits.

Bicarbonates

Bicarbonates are referred to as alkaline salts i.e. they have the ability to neutralize or counteract acids. Bicarbonates were found to be 465.21 mg/l in groundwater of Puhana and 477.43 mg/l in Nanheda Anantpur. As per the guidelines given by WHO, maximum permissible limit of bicarbonates in groundwater is 500 mg/l. Observed values are within the permissible limit.

Nitrate

The value of nitrate recorded as 8.54 mg/l in Puhana and 9.08 mg/l in Nanheda Anantpur. WHO has imposed a limit of 10 mg/l nitrate for drinking water to prevent the disorder of methemoglobinemia [12]. Observed values are higher but still under permissible limits of WHO.

Fluorides

Fluorides were found within the desirable limits sets i.e. 0. 60 mg/l in Puhana and 0.72 mg/l in village Nanheda Anantpur. Fluoride with 0.6 to 1.2 mg/l is regarded as an essential constituent of drinking water mainly because of its role in prevention of dental caries [15].

Total Hardness

The total hardness is an important parameter of water quality whether it is to be used for domestic, industrial or agricultural purposes. It is commonly expressed as Mg and Ca carbonate equivalent per liter. It may be of two type i.e. carbonate (temporary) and non-carbonate (permanent) hardness. The hardness values were recorded 70.25 mg/l in Puhana and 74.13 mg/l in village Nanheda Anantpur. WHO and Indian standards permit any value less than 500 mg/l.

4. Conclusion

Present study recites that Bhagwanpur Industrial Area is facing increased human interventions due to rapid industrialization as well as urbanization. These problems, which cause declines in water quality and quantity, living resources, and overall ecosystem health, are the result of the interplay of many factors over time. Contaminated groundwater can be unsuitable for use and may also adversely affect the quality of surface water and sediments. It may then harm human and ecological health.

The source of ground water contamination in the study area is mainly due to industrial, commercial and household discharge. Among the ground water pollutants associated with urbanization [16], chlorides and nitrates are the chief anthropogenic toxins in which high levels of chlorides were found in the ground water samples of the study area, however, nitrate was within the prescribed limits but still higher. Some workers had attributed high nitrate concentration in groundwater to sewage discharge is peculiar to urbanization [17].

The legacy of groundwater contamination can be a major saddle on the inhabitants because once groundwater is contaminated it is generally complicated and costly to remediate. Therefore, avoiding groundwater contamination is the most practical way of protecting and preserving groundwater quality.

To protect ecological health and human being and to ultimately restore the groundwater to its natural background quality, the following management practices must be considered:

- control short-term threats arising from the contamination
- restricted use of groundwater in contaminated area
- prevent or minimize further migration of contaminants from source materials to groundwater
- clean up groundwater to protect human and ecological health, restore the capacity of the groundwater to support the relevant environmental values and, as far as practicable,
- management responses to groundwater contamination should focus on the greatest threats first, and the benefits of groundwater cleanup must outweigh any incidental negative impacts that could arise.

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