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An Assessment of Impact of Baddi Industrialization on Ground Water Quality in Nearby Areas

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Abstract—*Ground water is liable to contamination through anthropogenic and other sources like addition of industrial waste, domestic and agricultural waste to the water bodies. The present research has been carried out to access the impact of industrialization on ground water quality. Ground water samples were collected from different bore well used for drinking purpose The physico-chemical parameters such as pH, Electrical conductivity, TDS, Total hardness, Ca++ ions, Mg++ ions, Chloride, and metals were analyzed (APHA, 1998) to know the present status of the groundwater quality. The results obtained were compared with the Bureau of Indian Standards (BIS: IS: 10500, 2003) guidelines for drinking water suitability in relation to possible health hazards. Ground water salinization, hardness of ground water and metal pollution has been identified as a impacts of human activities in the area. On the basis of TDS, the ground water is slightly saline in character due to the anthropogenic activities. The Ground water samples show high concentration of one or more heavy metals. Iron and lead concentration in ground water samples were found to be as high as 1.8 mg/L and0.3mg/L respectively. This can be dually responsible for the health of people residing there.*

Keywords: *Ground water, physico-chemical analysis, Industrialization, TDS.*

1. INTRODUCTION

Water is essential natural resource for sustaining life and environment which we have always thought to be available in abundance and free gift of nature and that life cannot exist even for a limited period in the absence of water.Due to increasing contamination and scarcity of surface water resources, a major stress has been shifted to ground water resources. More than 90% of the rural population uses ground water for domestic use [2]. Ground water has the properties of dissolving and carrying in solution, a variety of chemical and other materials. The quality and purity of ground water has direct effect on human health [8]. The advent of industrialization and urbanization involves the use of fertilizer in farming [4], seepage from effluent bearing water body [11] and industrial effluent discharge without proper treatment into nearby open pits or pass them through unlined channels, resulting in the contamination of ground water [3]. The hydro-geochemical conditions are also responsible for causing significant variations in ground water quality [9].Rapid Industrialization and urbanization is taking place in last one decade, rising to the special package of incentives granted by the central govt. This has led to the setting up of different manufacturing unit generating variety of effluent and waste product, hence adding loads of pollution to water resources and environment. The objective of the present study is to evaluate the effect of industrialization on nearby ground water quality status. Therefore, this will help in proper management of water resources and further help to curtail deterioration of water quality in the study area.

2. STUDY AREA

Study area comprises of Solan district of Himachal Pradesh state. It ranks 9th among the districts of the state. Its area spread over a total geographical area of 1936 sq/Km.Geographically, the area under study lies between 30^0 55’53” to 31^0 22’01” North latitude and $76^0$36’10” to $77^0$15’14”longitude. The average elevation of the district ranges between 300-3000m above mean sea level .The area comes under the subtropical type of climate lies in the lap of outer Himalayas forming part of Shiwaliks.

2.1 Industrial Development

The local inhabitants mainly depend on agriculture for their subsistence.Large and small scale industrial development however has taken place randomly all over the district; especially rapid industrial development is taking place in areas adjoining Punjab plains viz. at Nalagarh valley within the nagar Panchayats of Barotiwala,Gulurawala, Sandholi, Thana, Bhud areas.

3. MATERIAL AND METHODOLOGY

3.1. Water Sampling

In present investigation, thirty ground water samples from different blocks covering the area of Baddi town, Solan District, Himachal Pradesh during *October, 2014*. The location map of the study area is shown in Figure1. Samples were collected in acid-washed and ethanol-rinsed plastic containers. The water samples were preserved at temperature 4°Cfor the analysis of different parameters. The analysis of water was done using procedure of standard methods.(APHA,1998)

3.2. Methodology

The collected groundwater samples were analyzed for pH using pH meter. Total alkalinity (TA) as $CaCO_3$ and bicarbonate HCO_3 were estimated by titrating with HCl.Total hardness (TH) as $CaCO_3$ and Calcium ($Ca^{2+)}$ were analyzed titrimetrically, using standard EDTA,Magnesium (Mg^{2+}) was calculated on the basis of the difference in the concentration between TH and Ca^{2+}. Fluoride content in water was measured by ELICO-52 Spectrophotometer. Sodium (Na^{+}) and Potassium (K^{+}) were measured by flame photometry. Sulphate ($SO4^{2-}$) and nitrate (NO^{3-}) were analyzed by spectrophotometer; The Physico-chemical analysis was carried out according to standard methods as given by APHA 1992 and the results were compared with the Indian Standards (IS: 10500) for potable water. All the parameters concentrations are in mg/l.

4. RESULTS AND DISCUSSION

The water quality analysis of different ground water samples have been carried out for pH, Electrical conductivity, TDS, Total hardness, Ca hardness, Mg hardness, Ca ion, Mg ion, Chloride, and metals. The status of water quality of these ground water samples by their physico-chemical analysis along with their permissible limits (BIS:IS:10500,2003) are presented in table 1.

The water from the study area of has no color, odour. Taste of the water of the water sample in most of the locations pleasant in taste.

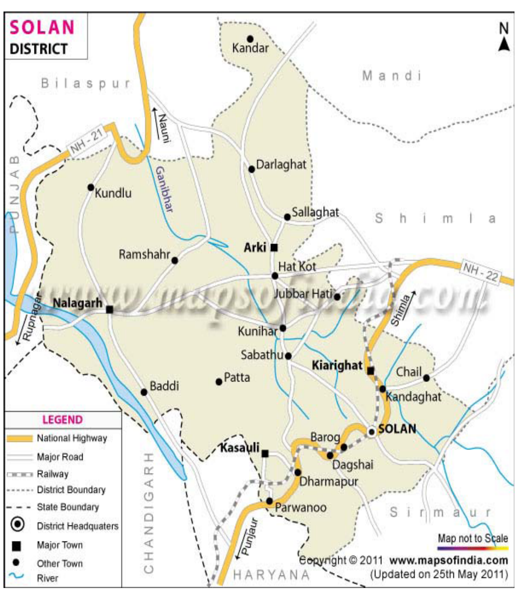

Fig. 1: Location Map of the Area

pH:- The pH value in the samples ranging from 7.3 to 8.8 indicating slightly alkaline nature. Some bore well water having higher concentration of pH due to weathering of plagioclase feldspars by dissolved atmospheric carbon dioxide that will release sodium andcalcium which progressively increase the pH and alkalinity this kind of result observed by Njitchoua et al, 1997.

Alkalinity: - The presence of carbonates, bicarbonates, and hydroxides is themain cause of alkalinity in natural waters (Rajankar*et al.*, 2009).Bicarbonates represent the major form since they are formed inconsiderable amount from the action of carbonates upon the basic materials in the soil[14].Alkalinity of water samples ranged between 130 to 190 mg/L. The alkalinity at four locations has crossed the permissible limits. It can impart unpleasant taste to water and can be deleterious to humans in presence of high pH,hardness and TDS.

Hardness:-Hardness is the important parameter for determining the usability of groundwater [12]. It is a measure of the capacity of water to the concentration of calcium and magnesium in water and is usually expressed as the equivalent of CaCO3 (APHA, 2005). Total hardness is one of the most important properties of drinking water. Hardness may cause urolithiasis[15]. Total hardness in the present study varied from 155 to 288 mg/L. Total Hardness values of all samples exceed the highest desirable limits. Hardness of water is primarily due to the result of interaction between water and the geological formations [23].The limit of total hardness for drinking water is specified as 300 mg/l. The high degree of hardness in the area may be attributed to the untreated/treated sewage and industrial waste into the Sirsa River and its tributaries.

Conductivity:-Conductivity, a measure of the ability of an aqueous solution to carry an electric current, depends on the presence of ions; on their total concentration, mobility, and valance; and on the temperature of measurement [6],[1].Electrical conductivity is the manifestation of the dissolved salts and is an indicator of water pollution, which has been found pretty high in the present study indicating high degree of water pollution due to effluent discharge. The Electrical Conductivity (EC) and Dissolved Salts (DS) are basic indicators of the total mineralcontents of water and may be related to problems such as excessive hardness, corrosive characteristics or other mineral contamination [8]. The conductivity values of groundwater sample varied from 340 to 604µs/cm

Chloride. Chloride, in the form of (Cl-) ion, is one of the major inorganicanions in water and wastewater. The salty taste produced bychloride concentrations is variable and dependent on the chemical composition of water [10]. Some water containing 250 mg/L may have a detectable saltytaste if the cation is sodium. On the other hand, the typical salty taste may be absent in water containing as much as 1000 mg/L when the predominant cations are calcium and magnesium [11]. A high chloride content may harm metallic pipes and structures, as well as growing plants [1]. The chloride content in groundwater ofbaddi is quite low and varies from 1.77 to 35.5 mg/L. No sample in the study area crosses thedesirable limit of 250 mg/L recommended by BIS and WHO.

Salinisation: Increase in the quantity of dissolved salts such as sulhate, chlorides, bicarbonates of ca, Mg and sodium in the groundwater attributable to both natural as well as human induced factors, leads to the process of salinisation. This is due to mismanagement of irrigation. TDS indicates the general character of water quality of salinity. The groundwater with TDS ranging from 400 to > 3000 mg/L are called saline.

Fluoride content in water is low due to this no dental and Skelton problem arises in the study area**.**

Table 1: Physiochemical analysis of water Quality of Baddi area

Parameters	Minimum Value	MaximumValue	Desirable Limit	Permissible Limit
pH	7.11	8.31	6.5	8.5
CO3	14(mg/L)	98(mg/L)	-	-
HCO3	100(mg/L)	198(mg/L)	-	-
Cl	14(mg/L)	35(mg/L)	250(mg/L)	1000(mg/L)
SO4	10(mg/L)	61(mg/L)	200(mg/L)	400(mg/L)
NO3	0(mg/L)	1.5(mg/L)	45(mg/L)	No relaxation
TDS	210(mg/L)	298(mg/L)		
Alkalinity	130(mg/L)	190(mg/L)		
Total Hardness	150(mg/L)	288(mg/L)	300(mg/L)	600(mg/L)
Na	20(mg/L)	200(mg/L)	-	-
K	2(mg/L)	312(mg/L)	-	-
Fe	0.11(mg/L)	1.8(mg/L)	0.30(mg/L)	1.0(mg/L)
Cr	0(mg/L)	0.14(mg/L)	0.05(mg/L)	1.5(mg/L)
Pb	0.1(mg/L)	0.3(mg/L)	0.05(mg/L)	No relaxation
Zn	0(mg/L)	273(mg/L)	5(mg/L)	15(mg/L)
Hg	0(mg/L)	0(mg/L)		
CN	0(mg/L)	0(mg/L)		
Cu	0(mg/L)	0.07(mg/L)	0.05	1

Iron –Iron content in trace is essential for nutrition. However, while chronically consuming the large amount of Iron can lead to condition known as iron overload, this condition is usually the result of a gene mutation left untreated, iron overload can lead to hemochromatosis, a severe disease that can damage the body organs. Early symptoms include fatigue, weight loss and joint pain. Fe exceed the permissible limit of 0.3 mg/L in 5% samples.

Lead Lead concentration exceeds the permissible limit of 0.05 mg/L in 10% sample. Lead toxicity can cause burning, chronic paralysis, mental confusion and anemia

5. CONCLUSION

The finding from the chemical analysis indicate that the ground water is alarmingly getting contaminated by heavy metals due to industrialization in the study area.The water quality in the investigated area is found to be suitable for drinking only in few locations, while as out prior treatments. It must be noted that a regular chemical analysis must be done to insure that the quality of water in this area is not contaminated, in addition to research for new walls in the area in order to get additional water for the resident people.

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