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Assessment of Ground Water Quality in Vicinity of Industries in Bijnor, U.P, India

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ABSTRACT: due to increase in industrial activity, there is increasing pollution of groundwater which is major source of drinking and irrigation in rural and urban areas. Waste water from small scale industries in most cases are disposed off without proper sewer lines leading to heavy deterioration of groundwater and causing problem to people living in nearby areas. Thus main focus of this study is to assess the suitability of ground water near three industries (sugar mill, paper industry, distillery) in bijnor city of uttar pradesh for drinking purpose. A total of eighteen samples were collected from six locations (two near each industry) for three months from oct' 2016 to dec' 2016. All the samples were analyzed for various physico-chemical parameters. When results were compared with is 10500 : 2012 drinking water- specifications, it was observed that some parameters were in desirable limit, some were in between desirable and permissible limit and some were outside permissible limit, making it unhealthy for human consumption without proper treatment.

Keywords: Bijnor, Ground water, Physico-chemical and Correlation Matrix.

I. INTRODUCTION

Water is essential requirement to all forms of life. Water is important for agriculture, manufacturing, transportation, domestic and many other human activities (Phiri O. *et al.,* 2005). Despite being a priceless natural resource, water is very poorly managed (Fakayode *et al.,* 2005). About 1.5 billion people have no safe drinking water globally and about 5 million deaths per year are due to waterborne diseases (Abdul Latif Qureshi *et al.,* 2015). There are many human activities which are responsible for deterioration of water at such an alarming rate. Urbanisation and industrialization have contributed to a large extent in polluting ground water as growing industries has reduced space for waste disposal and introduce a large number of organic and inorganic substances in the environment. Industrial waste which is in most cases disposed off without treatment pollutes ground water due to seepage. This industrial waste water may contain heavy metals like sodium, potassium, calcium, magnesium which are life threatening as most people in rural areas still rely on ground water for drinking purpose and domestic use (Phiri O. *et al.,* 2005). This demands need for proper assessment of quality of wastewater discharged from industries as people consuming groundwater near industries are resulting in continuous outbreak of many water-borne diseases like diarrhoea, cholera and other. India is coming up as fast growing industrial sector putting a lot of pressure on environmental cleanliness and exploitation of valuable resources. Although government has laid specific norms for quality of effluent to be discharged from different industries but it seems like industries are busy in making profits without considering need to preserve nature from harmful effluents. As a result people and nature are worst affected from the consequences.

Studies have been carried out in various regions in India to examine sources of groundwater pollution and its characteristics. Matta Gangan *et al.,* 2016 have studied impact of industrial effluent on ground water and surface water quality in Dhampur region of Bijnor District and founded catchments area of study to be severely polluted. People depended on the polluted water are prone to health hazards of polluted drinking water and water quality management is needed. A study was conducted by Shaik Rameeza *et al.,* 2012 for ground water quality in industrial zone of Vishakhapatnam and some parameters were found exceeding the permissible limit and unsafe for drinking purpose.

Madan Murari Vaishnav *et al.,* 2012 studied paper mill pollution hazards on ground and surface water of adjoining areas of Hasdeo River Champa and results were beyond desirable and upper limit for EC (1258µS/cm), TSS (245mg/l), DO(3.38mg/l), Sodium(612 mg/l).

Present study is to assess ground water quality in vicinity of industries in Bijnor of Uttar Pradesh due to industrial waste water. Bijnor gains importance due to its western boundary being covered by the stream of the river Ganges.

According to CPCB, Bijnor discharges 24 MLD of wastewater. In Bijnor, 04 point sources were identified namely Hemraj Drain, Bijnor Sewage Drain, Chhoiya River and Malan River. Chhoiya River carries wastewater of Wave Sugar mill, Mohit Paper mills and Jain Distillery. River Chhoiya finally gets merged into River Ganga at Punjabi Dera (Jalilpur). Groundwater also gets contaminated due to seepage of water from River Chhoiya. The specific objectives of this study is thus to examine ground water quality in vicinity of three industries (Sugar mill, paper industry, Distillery)

II. MATERIALS AND METHODS

A. Profile of study area

Bijnor is a district in Uttar Pradesh with the extreme parallels of north latitude as 29° 2' and 29° 58' and east longitude as 78° 0' and 78° 57' and elevation of 237 metre (777feet). According to statistical data of 2003, area covers by district is 4561 sq km. District has five subdivisions- Najibabad, Bijnor, Nagina, Dhampur and Chandpur. Three industries located in stretch of Bijnor-Nagina is area of study. These are located at around 13km from bijnor city and discharge their waste water in river chhoiya which terminates in River Ganga. Location of study area is shown in Fig. 1.

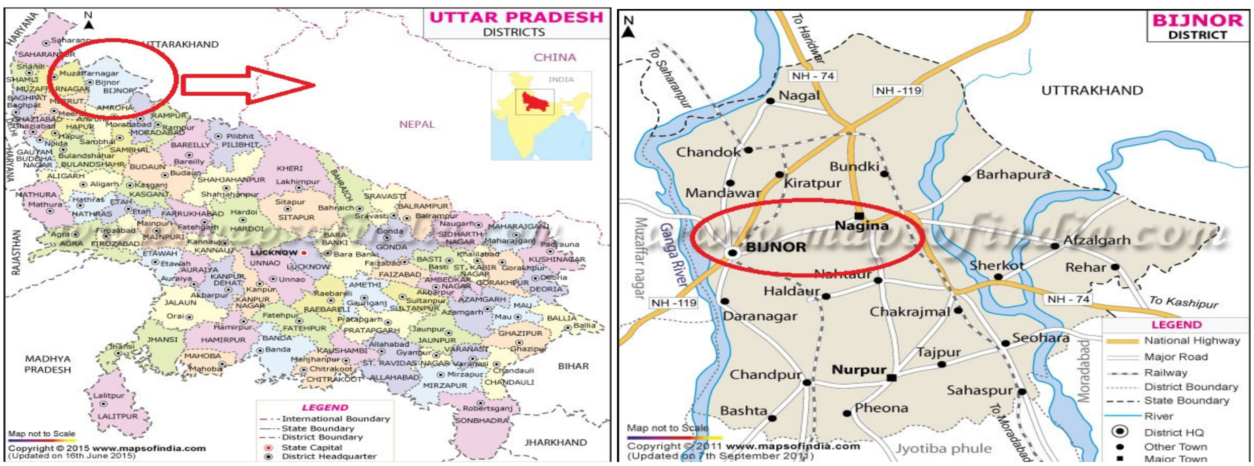

Fig. 1. Location Map of Study Area.

B. Sampling points

For study of ground water quality, water samples were collected from two different sampling sites near three industries (sugar industry, paper industry, Distillery). Two samples each near to three industrial sites were collected for three months from Oct' 2016 to Dec'2016 i.e., a total of 6 samples were collected in polyethylene bottles at one time and a total of 18 samples were collected in three months. Sampling points were marked as:

Table 1: Description of sampling points.

S. No.	Type of Industry	Station Name	Location	Type Of Source
1.	Sugar Mill	S1	Rashidpur Garhi	Open well
2.		S2	Gyan Vihar	Hand pump
3.	Paper Mill	P1	Bahera Village	Bore well
4.		P2	Infront of Paper Mill	Hand pump
5.	Distillery	D1	Hardaspur Village	Bore well
6.		D2	Near Distillery	Han pump

C. Sampling

Bottles were properly labelled with sample number and well rinsed with the sample water to be collected. Hand pumps and tube wells were permitted to flow continuously for around 10min before sample collection. pH, conductivity, odour, taste, colour were noted at the place and then sample were immediately maintained at 4°C and brought to environmental laboratory of NIT Kurukshetra for further physicochemical analysis. All analysis were performed strictly according to APHA (1998).

III. RESULTS AND DISCUSSION

The average values for physico-chemical parameters analyzed by APHA (1998) protocol for 3 months of 6 different sites are depicted in Table 2.

Table 2: Average values of Physico-chemical parameters.

S.No.	PARAMETERS	SAMPLING STATIONS					
		S1	S2	P1	P2	D1	D2
1.	Colour	Transparent	Pale yellow	Pale yellow	Pale yellow	Transparent	Transparent
2.	Taste	Unobjection able	Unobjection able	Unobjection able	Unobjection able	Unobjection able	Unobjection able
3.	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4.	pH	7.09	7.06	6.84	5.95	7.81	7.76
5.	Conductivity	438.00	331.2	1570.33	1180.00	502.67	914.00
6.	Total Hardness (as $CaCO_3$)	834	848.2	775	811	688	726
7.	Alkalinity	348	370	618	470	232	310
8.	Sulphate	90.26	61.82	105	213.6	88.7	96.1
9.	Chloride	66.82	94.68	154	190	60.02	77.6
10.	TDS	1000	1282	2230	2950	1370	1497
11.	Dissolved Oxygen	8.9	7.11	4.32	1.47	6.16	7.09

*All parameters in mg/L except Conductivity (µmhocm^{-1}) and pH.

(i) **pH:** Acidic pH results in release of H_2S to air while alkaline pH results in decline of plant growth (Rakhi Chaudhary *et al.,* 2011). In this study, pH of samples ranges from 5.95 to 7.81 which is slightly alkaline which may be due to discharge of alkaline effluent from industries.

(ii) **Electrical Conductivity:** Electrical conductivity is measure of concentration of ionized substances in water (Manju Sharma *et al.,* 2013). Electrical conductivity values were found high in samples near paper mill and in desirable limit near sugar mill.

(iii) **Total Hardness:** Hardness is due to presence of divalent cations of Ca^{2+} and Mg. In all samples that were analyzed hardness was found quite high, with maximum near sugar mill (848.2 mg/L).

(iv) **Alkalinity:** It is the ability to neutralize acid or can say ability to react with hydrogen ions. Desirable limit of alkalinity is 200 mg/L and permissible is 600mg/L in absence of alternate water source according to BIS 2012. Alkalinity was higher than desirable in all samples but higher than permissible (618mg/L) near Paper Mill.

(v) **Sulphate:** High concentrations of sulphur can cause dehydration in humans according to WHO (2004). Sulphate was found within prescribed limits in all cases.

(vi) **Chloride:** Chloride is one common anionic constituent of water whose high concentration imparts salty taste to water making it unacceptable for drinking. According to BIS 2012, permissible limit is 250mg/L and permissible limit in absence of alternate source is 1000mg/L. In this study, value ranges from 60.02 to 190 mg/L. No value crossed the desirable limit.

(vii) **Total dissolved solids (TDS):** It is the amount of solids which is well dissolved in water and obtained only after evaporating water sample. Results for TDS ranges from 1000 to 2950mg/L. Value higher than permissible limit of 1500 mg/L was observed near Paper Mill.

Dissolved Oxygen: DO is important for aquatic life. Low DO cause undesirable odour, taste and retards natural biological processes. DO of all samples were found above 5mg/L which is minimum acceptable limit except for samples near paper mill.

A. Graphical representation

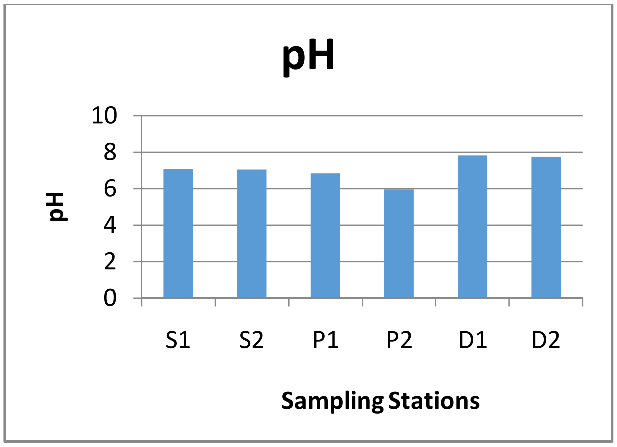

Fig. 2. pH Variations.

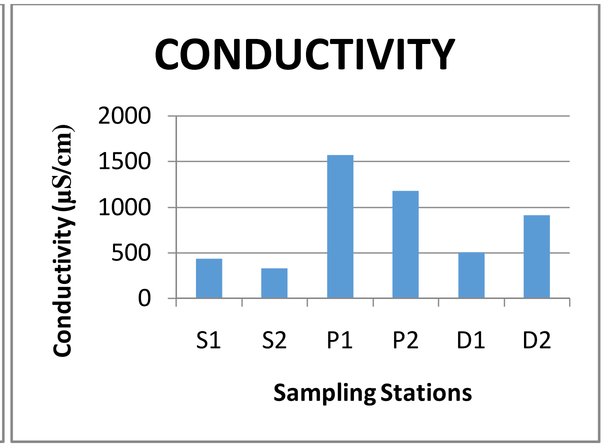

Fig. 3. Conductivity Variations.

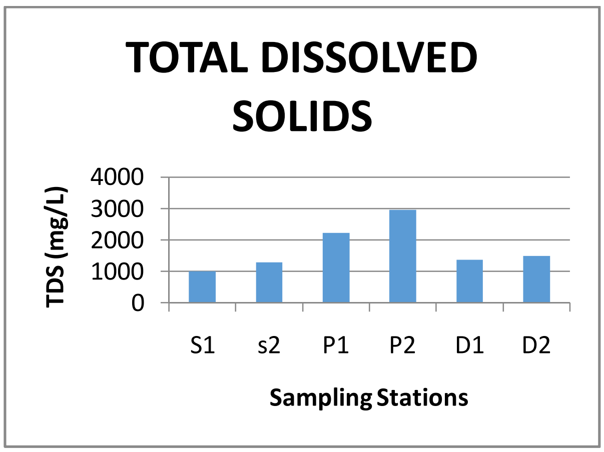

Fig. 4. TDS Variations.

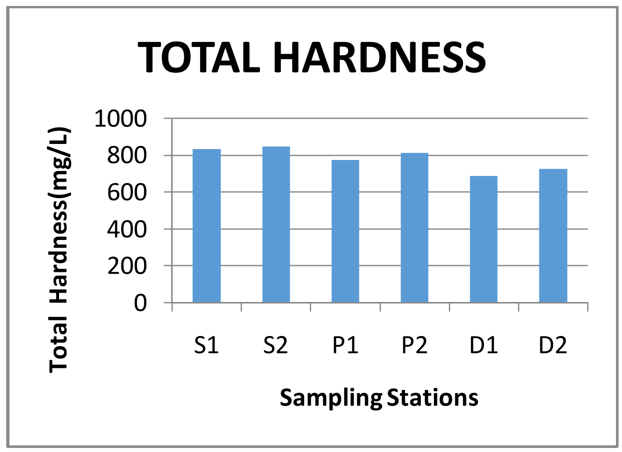

Fig. 5. Total Hardness Variations.

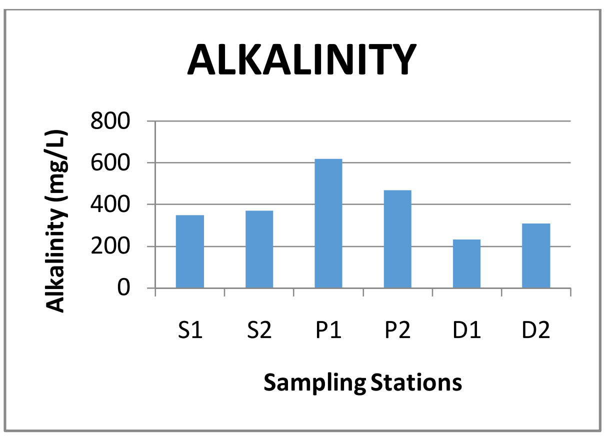

Fig. 6. Alkalinity Variations.

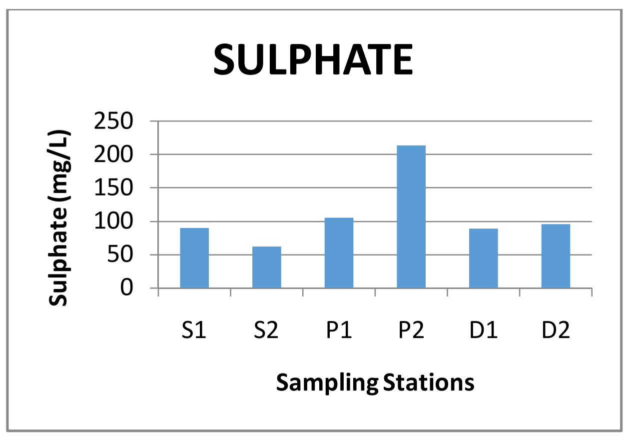

Fig. 7. Sulphate Variations.

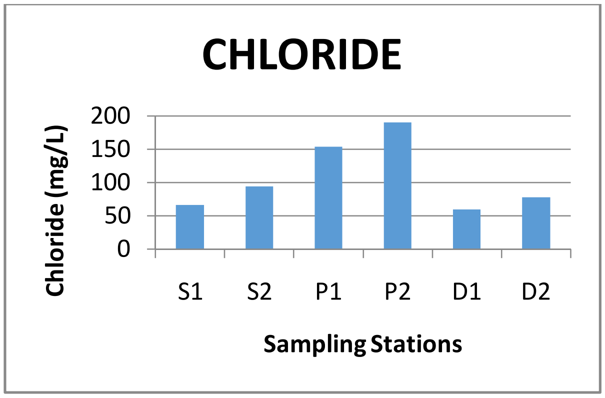

Fig. 8. Chloride Variations.

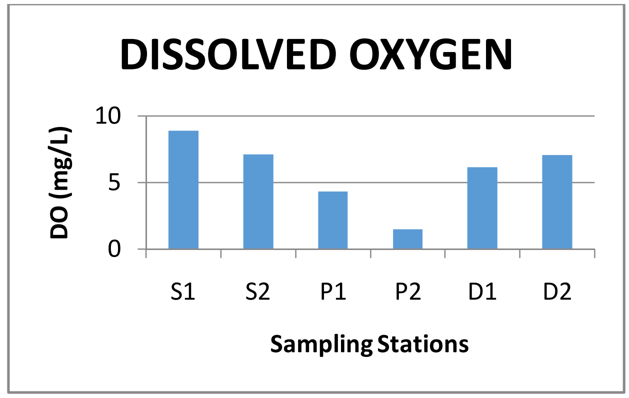

Fig. 9. DO Variations.

B. Correlation Matrix

Table 3: Correlation matrix of average values of samples.

	pH	*conductivity*	*TH*	*Alkalinity*	*Sulphate*	*Chloride*	*TDS*	*DO*
pH	1							
conductivity	-0.45022	1						
TH	-0.64286	-0.14591327	1					
Alkalinity	-0.68053	0.812330888	0.386943	1				
Sulphate	-0.77247	0.54163218	0.095196	0.372755	1			
Chloride	-0.88523	0.767108833	0.31425	0.812125	0.795847	1		
TDS	-0.77103	0.791215255	0.048104	0.661549	0.88207	0.953298	1	
DO	0.717581	-0.70589145	0.032823	-0.56568	-0.85245	-0.90666	-0.97811	1

28 correlation coefficients 'r' were calculated for various water quality parameters (Table 3). Between Chloride and Total Dissolved Solids, highest positive correlation (r = +0.953) was found while lowest positive correlation was found between Total Hardness and dissolved oxygen (r = + 0.0328). Highest negative correlation (r = -0.9066) was found between Chloride and Dissolved oxygen while lowest negative correlation(r = -0.1459) was found between Total Hardness and conductivity. Thus it can be inferred that ground water is extensively polluted due to industries.

IV. CONCLUSION

People living in nearby regions of industries are worst affected in every possible way. They are not getting healthy air to breathe, healthy water to drink, healthy water to irrigate their fields. They are getting pale yellow coloured ground water to drink from sources bored at upper ground level. Hardness of water was found very high in all water samples with maximum near sugar mill making it unacceptable to drink. Conductivity, Alkalinity, TDS of water was found high near paper mill. This indicates need for people living nearby to consume drinking water after proper treatment only and need for authorities to have a proper check on quality of effluent discharged from the industries. Apart from this, industries are also required to cut down a little fraction of their profit for proper treatment of waste before discharge to maintain healthy nature and life of people.

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