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Geospatial Variation of Groundwater Quality in Raipur Industrial Area, Chhattisgarh

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Abstract : *The extraction of natural resources has been rapidly increased due to industrialization and urbanization in and around Raipur, the capital city of Chhattisgarh, India. In present work, the Urla and Siltara Industrial growth centers are selected to assess and evaluate the groundwater quality and water table status of this region. A number of Hazardous waste generating units result the surface and groundwater pollution in concern region. Water used in the manufacturing industry picks up high TDS, acidity or alkalinity and heavy metals. The physical and chemical characteristics of 24 groundwater samples collected from different locations in period of post monsoon, December 2014 are presented in the paper. The trace elements i.e., Na, K, Mg, Ca, Sr, Cr, Mo, Mn, Fe, Zn and Tl in ground water were analyzed by ICP OES technique. The total dissolved solids (TDS), total hardness (TH), Ca, Mg, Na, Sr, and Zn in groundwater was ranged from 350-820, 80-812, 6.62-180, 2.08-80, 55.37-390, 1.12-5.93 and 0.001-1.96 mg l^{-1}, respectively. The sources and impacts of various water toxicants are discussed.*

Keywords: *groundwater, heavy metals, Raipur, pollution*

1. INTRODUCTION

The growth of industrialization, urbanization and advanced agricultural activity plays a key role for the development of state and the nation's economy. The water consumption for all purposes is steadily on the rise and as a result, stress on ground water is also increasing at an alarming rate. The exploitation of groundwater has increased remarkably in and around Raipur city due to industrialization, urbanization and growth of population change in land use pattern [1-2]. The ground water quality is important as the quantity. The untreated effluents from industrial units percolate into soil near the source or travel through unlined channels to shallow pits where seepage into soil and vadose zone takes place which eventually contaminates ground water [3].It is evident from the literature that infiltration of the effluents has led to the contamination of aquifers in deferent parts of India [4].The contamination of ground water adversely affects the plant growth and human health [5]. The atmospheric deposition, solid waste disposal and various industrial waste discharges in the environment originate the runoff, surface and ground water pollution [6].Due to the spatial and temporal variations in water chemistry a monitoring campaign that will provides a representative and reliable estimation is necessary[7]. In present investigation, groundwater samples from different locations of industrial area were collected to understand the geospatial variation and chemical composition of water in the context of anthropogenic activities and natural phenomena.

2. MATERIALS AND METHODS

2.1 Study area

There are four numbers of industrial growth centres and 25 Industrial Areas in the state, which hosts thousands of industrial units. Most of the 240 medium and large scale industries are in the iron, steel, cement and food grain sector. In urla and Siltara industrial growth centres include 424 and 47 numbers of industries near by the capital region. The location map of Sampling sites and their geological information are shown in Figure 1 and Table 1. The capital city of Raipur falls under top sheet no 64G11-12 (survey of India) and in Mahanadi basin. Raipur is situated in the bank of Kharun river, that is one of the tributary of Shivnath river. Geographically area displays a gently undulating topography with general slop toward north. The climate is subtropical and the southwest monsoon is the principal source of rainfall. The annual average of rainfall is around 1300 mm. The wind direction is predominantly southwest and is calm.

The sampling area is situated on the proterozoic chandi formation belonging to Raipur group of Chhattisgarh supergroup and comprises of limestone, shale and sandstone at places dolerite instruction. Precipitation is the main source of groundwater recharge along with minor recharge from canal in canal command area. Out flow through drainage system and withdrawal for different purpose are the principal sources of ground water discharge.

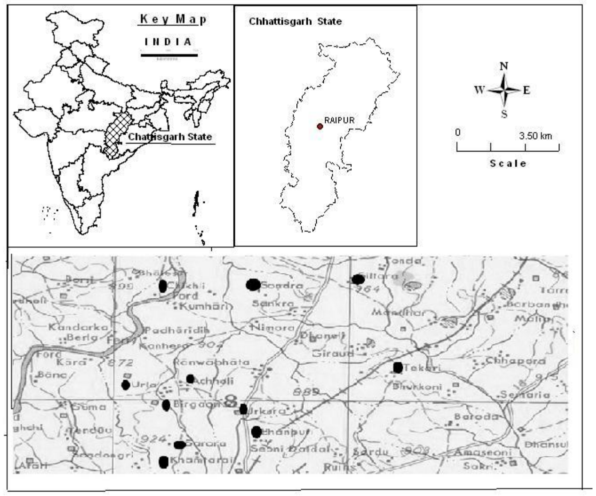

Figure 1: The map of Chhattisgarh with sampling sites of Raipur Industrial area.

2.2 Sampling

Twenty four groundwater samples collected in duplicates from different locations of Urla and Siltara industrial area in the period of post monsoon, December 2014. The sampling locations are shown in the figure 1. The water samples were collected in 1l double cap polythene bottle. One of the portions of the sample was used for the measurement of physical parameter while another was acidified with few drops of ultra pure nitric acid for metal analysis.

2.3 Analysis

The Hana water analyzer kit was used for the pH, temperature, Electrical conductivity (EC) and total dissolved solids (TDS) in groundwater samples. The ICP-OES was applied for the metal analysis in the groundwater samples.

3. RESULTS AND DISCUSSIONS

The depth and age of tube wells was ranged from 25.0-100 m and 1.5- 55 yr respectively. The variation of temperature was recorded with the range of 23.4- 24.7 with mean value of 24˚C. The pH of ground water was

Table 1: The geological position of Sampling sites in Raipur Industrial Area.

S. No.	Place	Latitude	Longitude
1.	Bajrang Nagar Urla	21°19'1.17"N	81°36'27.11"E
2.	Rajendra Nagar Urla	21°19'1.35"N	81°36'28.30"E
3.	Acholi Chowk	21°19'23.33"N	81°37'32.85"E
4.	Bhanpuri Bazar	21°17'47.60"N	81°38'45.95"E
5.	Naya Bendri Urla	21°18'1.32"N	81°39'53.19"E
6.	Durga Mandir acholi	21°19'19.04"N	81°37'52.78"E
7.	Ward No. 08 acholi	21°19'19.21"N	81°37'52.62"E
8.	Krishna Chowk Urkura	21°17'28.89"N	81°38'22.95"E
9.	Akash Nagar Birgaon	21°17'37.20"N	81°38'24.77"E
10.	Naya Bendri-02	21°19'40.16"N	81°35'42.07"E
11.	RavaBhata Birgaon	21°18'04.53"N	81°37'45.94"E
12.	Naya Bendri Handpump	21°19'07.41"N	81°35'25.77"E
13.	Bajrang Nagar urkura	21°19'1.17"N	81°36'27.11"E
14.	Krishna Chowk urkura	21°17'28.89"N	81°38'22.95"E
15.	Jawahar nagar urkura	21°17'26.86"N	81°39'19.35"E
16.	Shaktipara chowk	*21°18'23.76"N*	*81°37'29.35"E*
17.	Krishna Chowk school	21°17'28.89"N	81°38'22.95"E
18.	Bajrang Nagar urkura 2	21°19'1.17"N	81°36'27.11"E
19.	Jagriti Nagar urkura	21°18'1.18"N	81°36'27.12"E
20.	Shaktipara bazar chowk	21°22'4.28"N	81°32'29.12"E
21.	Shakti para bazar birgaon	21°17'37.20"N	81°38'24.77"E
22.	Birgaon bazar	21°18'42.28"N	81°38'25.97"E
23.	Jagiriti nagar	21°18'18.42"N	81°39'32.49"E
24.	Urkura school	21°17'26.92"N	81°37'02.98"E

ranged from 6.65 – 9.63 with the mean of 7.22 was found to be neutral to alkaline nature. The TDS in ground water was ranged from 260-1370 with mean value of 641 mg l^{-1}. The EC was ranged from 0.53- 2.78 with mean value of 1.29 mS.

The good correlation of TDS with EC were observed, Figure 2. The total hardness, acidity and alkalinity of groundwater were ranged from 80-790, 22.7- 58.7 and 69.6-209 with the mean value of 542, 58.7 and 124.8 mg l^{-1}, respectively. The geospatial variation of TDS, EC and TH are shown in Figure 3. The concentration of Ca, Mg, Na, Sr, and Zn in groundwater was ranged 6.62-180, 2.08-80, 55.37-390, 1.12-5.93 and 0.001-1.96 mg l^{-1}, respectively.

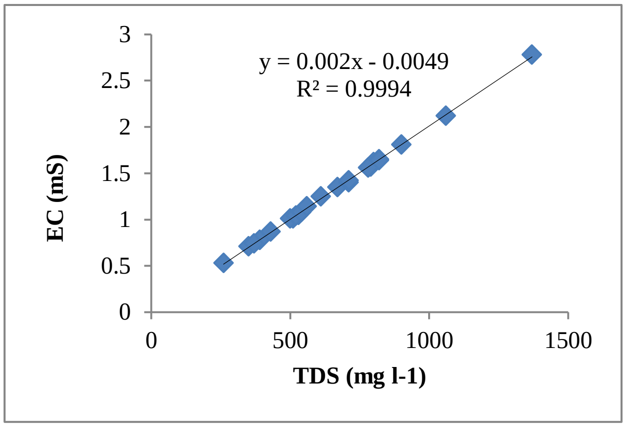

Figure 2: The correlation between TDS and EC.

4. WATER QUALITY ASSESSMENT

The knowledge of water quality and its contents is very essential for judging its suitability for different purposes such as drinking, irrigation, industry, public health and environmental safety. The national agencies like ICMR, BIS and CPCB and the health unit for United Nations i.e., WHO have categorized the standards for water for drinking and other uses. Some of the elements in groundwater have found to be higher than the permissible limits. The piper diagram, cluster and factor analysis of water is a very important tool to understand the hydro -geochemistry and sources of contamination in the aquifers.

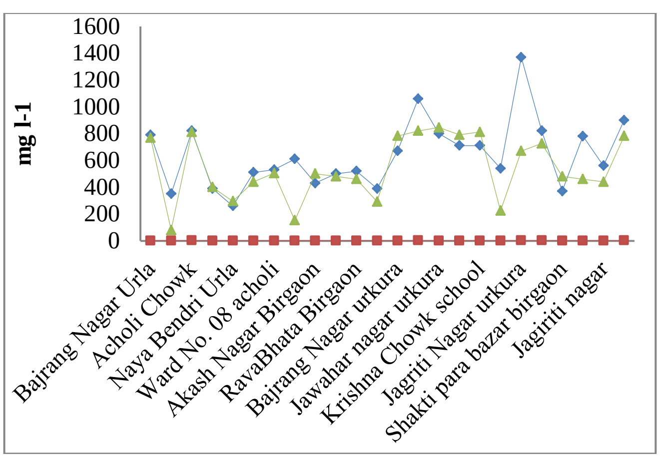

Figure 3: The geospatial variation of TDS, TH and EC in groundwater.

5. CONCLUSION

The total dissolved solid, total hardness and some of crustal metals concentrations are found to be remarkable in the groundwater. The status of lower water table in these areas is being serious due to rapid industrialization and atmospheric pollutions.

6. ACKNOWLEDGEMENTS

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