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**SHORT COMMUNICATION** **OPEN ACCESS**

# Effect of solid waste on hydrochemistry of groundwater near Sipri dumping site, Jhansi, India.

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**ABSTRACT**

*Lack of technology and poor management system of solid waste disposal causes serious environmental problems (air, water and soil pollution) in developing countries like India, Nepal, Bhutan, and Pakistan. The leaching of solid waste is one of the serious environmental problem in the urban and sub-urban areas of the country which causes ground water pollution and health hazards. The present investigation was conducted to assess the groundwater pollution due to the open dumping of solid waste from the dumping site of Sipri area in Jhansi city. The degree of pollution is assessed by studying the physico-chemical characteristics of groundwater available in the aquifer. The study was conducted during January 2017 to December 2017 to evaluate the physico-chemical parameters such as pH, Total Dissolve Sold (TDS), Electrical Conductivity (EC), Total Hardness (TH), Turbidity (Tu) Nitrate ($NO_3$) and Sulphate ($SO_4$) of groundwater in and around the Sipri dumping sites, Jhansi . The results showed that water samples of several hand pumps were contaminated. Therefore, this dumping site is a threat to the environment as well as to the local people and the local authority should pay its attention to prevent further pollution of groundwater in this area.*

**Keywords:** Solid Waste, Groundwater, Sipri Dumping Sites, Jhansi.

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## INTRODUCTION

Water is a highly valuable source for the existence of all living beings. The water quality is a major concern for the entire human race and is directly proportional to human welfare. In India, majority of populations are directly dependent on groundwater as their major drinking water supply. most of population is depend on groundwater as the only source of drinking water supply. The groundwater is assumed to be comparatively much cleaner than surface water and is nearly free from all polluted stuff . But continued disposal of pollutants from the industrial sector, domestic sewage and solid wastes dump causes the groundwater to become polluted and caused serious health hazards [12].

Municipal solid waste (MSW) is one of the greatest risks to the environment especially in remote cities of India because of their improper management systems. [10]. Municipal solid waste is generally a blended mixture of wastes from both the domestic and commercial sources which is generated by the living community [13].

Municipal solid waste generally consists of degradable (paper, textiles, food waste, straw and yard waste), partially degradable (wood, disposable napkins and sludge) and non-degradable materials (leather, plastics, rubbers, metals, glass, ash from fuel burning like coal, briquettes or woods, dust and electronic waste) [6, 7, 15, 12, 10].

Expedious industrialization and population expansion in India has led to the mass movement from villages to cities, which generate thousands of tons of MSW on daily basis. Poor collection and inadequate transportation are responsible for the aggregation / chunk of MSW at every nook and corner [5, 14].

Nearby areas of landfills are highly prone to ground water contamination because of the availability of potential pollution source of leachate extending from the nearby site. Such contamination at ground water levels opens up a serious threat to local residents and to the whole environment as well. During the rainy season, water gets mixed up into the waste easily and majority of of the chemicals and decomposed material gets dissolved in water and start leaching therein. This leachate begins the problem of groundwater contamination [4].

## MATERIAL AND METHODS

### Study Area

Jhansi is well known district of Bundelkhand region of Uttar Pradesh with a geographical area of 502.75 thousand hectare. The district is located in the South West corner of the region at $24^{0}11'N$ - $25^{0}57'$ N latitudes and $78^{0}10'E$ - $79^{0}23'$ E longitudes. Population of Jhansi is nearly 4, 79,612. The western area of the district is covered with hillocks. Jhansi is located in the plateau of central Indian area dominated by rocky reliefs and minerals underneath the soil. The city has a natural slope in the north as it lies on the south western border of the vast *Tarai* plains of Uttar Pradesh.

Present study has been carried out to assess the impact of leachate percolation on groundwater quality from an unlined landfill site Sipri Maila Kitoriya Masihaganj, Jhansi (fig-1). Around the solid waste disposal sites is a slum area and there are a large number of rag pickers who are the local residents in this area. These locals consume untreated groundwater drawn from Hand pumps. The depth of these hand pumps varies from 50-70 meters. These hand pumps were situated within a distance of 200 to approximately 2000 meters from dumpsite areas. To the best of our knowledge no report is still available on the analysis of groundwater from this unlined dumpsite area.

### Analytical design

In the present study Solid waste dumpsite situated in Sipri Maila Kitoriya Masihaganj has been chosen for monitoring of groundwater quality. 15 different sampling sites were randomly selected in and around dumping sites. Sampling was done in the morning time and the water samples were collected in 1L polythene bottles and 1 ml of $HgCl_2$ solution (preservative) was added to each sample. All sample were properly labeled with details of the source, date of sampling, time of sampling and address. All samples were tested in the laboratory within 24 hours from the time of collection. The physico-chemical parameters selected were pH, Turbidity (Tu), Total Dissolve Solid (TDS), Electrical conductivity (EC), Total Hardness (TH), Sulphate ($SO_4$) and Nitrate ($NO_3^-$ ). Physical and chemical properties of groundwater have been done according to standard methods [2].

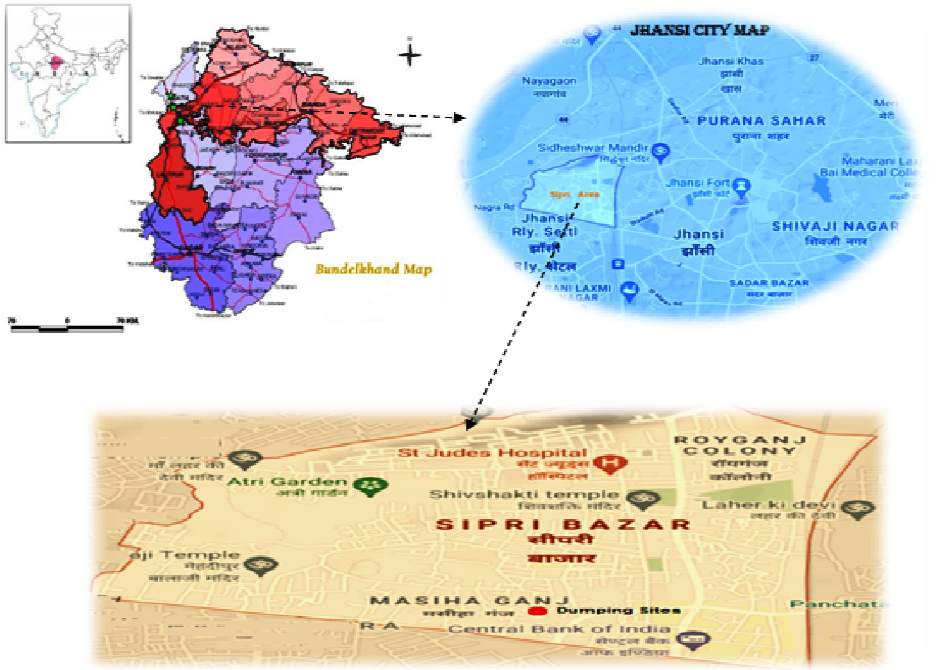


Fig-1: Location of Study area

## RESULTS AND DISCUSSION

Average results of the Physico-chemical parameters for groundwater samples are presented in Table-1. Status of water quality is obtained by analytical results of various physico-chemical parameters of all the samples.

### pH

The present study indicated that the pH of different areas around dumping sites was ranged 6.5 - 8, which were within the desirable limit of BIS (Table 1). Highest value of pH was found at the sampling site S-8, while the minimum value of pH was found at the sampling site S-5. Abhimanyu *et al* [1] observed pH to

assess the alkaline nature of ground water in Jhansi district U.P. The pH value of sample varied between 6.5 to 8.0 and were found within the prescribed limit by WHO.

**Table 1. Assessment of physico-chemical parameters of groundwater quality of different sites of Sipri area in Jhansi City, Bundelkhand**

| S.No. | Parameters Sites ▼ | pH | TDS (mg/l) | EC (µS/cm) | TH (mg/l) | $NO_3$ (mg/l) | Turbidity (NTU) | $SO_4$ (mg/l) |
|---|---|---|---|---|---|---|---|---|
| **1.** | S-1 | 7.2±.4 | 572±8.3 | 1243±21.1 | 390±2.3 | 1.1 ±.1 | 5±.3 | 43±3.2 |
| **2.** | S-2 | 7.4±.7 | 613±7.9 | 1360±23.4 | 428±2.8 | 1±.2 | 5±.4 | 45±3.3 |
| **3.** | S-3 | 7.1±.5 | 594±5.7 | 1290±26.3 | 538±3.1 | 1.23.2± | 5±.5 | 53±3.7 |
| **4.** | S-4 | 7.5±.3 | 545±6.1 | 1380±22.3 | 486±3.3 | 1.4±.2 | 5±.4 | 54±4.3 |
| **5.** | S-5 | 6.5±.8 | 554±9.4 | 1270±24.3 | 410±3.5 | 1.3±.1 | 6±.4 | 41±4.6 |
| **6.** | S-6 | 7.3±.5 | 691±7.6 | 1530±26.1 | 370±3.6 | 1.1±.1 | 5±.4 | 40±4.5 |
| **7.** | S-7 | 7.4±.3 | 578±5.3 | 1250±25.2 | 378±3.2 | 7.8±.1 | 5±.6 | 33±4.1 |
| **8.** | S-8 | 8.0±.7 | 948±10.5 | 1987±31.2 | 667±3.9 | 11±.1 | 12±.7 | 76±4.3 |
| **9.** | S-9 | 7.1±.2 | 454±6.5 | 860±27.2 | 410±2.8 | 2.2± .1 | 5± .4 | 56±5.6 |
| **10.** | S-10 | 7.2±.5 | 370±5.4 | 798±23.4 | 360±4.3 | 1.1± .2 | 5±.3 | 43±4.9 |
| **11.** | S-11 | 6.8±.4 | 480±4.4 | 879±25.4 | 350±4.1 | 1.8±.1 | 7±.3 | 41±4.2 |
| **12.** | S-12 | 7.5±.3 | 695±8.3 | 1240±22.2 | 420±2.8 | 3.4±.2 | 3±.2 | 38±3.8 |
| **13.** | S-13 | 7.6±.2 | 426±9.1 | 860±21.5 | 310±2.3 | 2.5±.1 | 5±.3 | 46±3.7 |
| **14.** | S-14 | 7.3±.1 | 530±6.4 | 1060±23.2 | 350±2.1 | 1.5±.1 | 3±.3 | 44±3.3 |
| ***Desirable limit** | | **6.5-8.5** | **500** | **----------** | **300** | **45** | **10** | **45** |

S1-Prem Ganj, S2-Sipri Bajar, S3-Tandon Garden, S4- Government Colony, S5-German Hospital, S6- Rai Ganj, S7- Prem Ganj, S8- Massiha Ganj, S9-Church,, S10- Sabji Mandi, S11- Nayak Ganj, S12-chamam Ganj, S13- Railway Kachha Pul, S14-Arya K. I. College.

*Drinking Water Specification First Revision -IS: 10500:1991, Edition 2.2(2003 09) (Reaffirmed1993),

**Turbidity (Tu)**

The turbidity of the water samples during the study period three water samples (S-8, 12 NTU; S-5, 6NTU and S-11, 7 NTU) exceeded the desirable limit. The increase in turbidity in post-monsoon season exhibits the pollution of the groundwater which might be due to the leachate percolation. Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water.

**Total Hardness (TH)**

In the present study, the total hardness was found in range of 310 mg/l - 667 mg/l. Highest value of hardness (667 mg/l) was recorded at the sampling site S-8, while the minimum value (310 mg/l) was recorded at the sampling site S-13 (Table 1). Mor *et al.* [11] carried out a study on leachate characterization and assessment of groundwater pollution near municipal solid waste landfill site and observed that total hardness present in ground water in the vicinity of landfill site was in the range of 296 mg/l to 1388 mg/l.

**Nitrate ($NO_3$)**

High concentration of nitrate causes Methemoglobinia (blue baby syndrome) in infants. Nitrate was recorded in the range of 1 mg/l - 11 mg/l and it was found within the desirable limit (45 mg/l) of BIS at all the sampling sites (Table 1). Highest value of nitrate (11 mg/l) was found at the sampling site S-8 while, the minimum value of nitrate (1 mg/l) was found at the sampling site S-2. The concentration of nitrate was found up to 76 mg/l in ground water sample of Moth Block of Jhansi district [3].

**Total Dissolve Solid (TDS)**

Total dissolve solids (TDS) refers to matter suspended or dissolved in water or waste water with high content is inferior and may be polluted. In the present study, TDS of Sipri area ranged from 370 mg/l to 948 mg/l. Highest value of TDS (948 mg/l) was found at the sampling site S-8, while the minimum value of TDS (370 mg/l) was found at the sampling site S-10 and were above the desirable limit (500 mg/l) of BIS, which may be due to higher concentration of dissolved solids in water that causes adverse effect in taste. The very high EC and TDS observed in the groundwater suggest a downward transfer of leachate into groundwater as reported earlier by Mor *et al.,* [11] and Longe and Enekwechi [9] Kamboj and Choudhary [8].

**Electrical Conductivity (EC)**

The conductivity around the study site of Sipri was found to be in range between of 798 µS/cm – 1987 µS/cm. Highest value of conductivity (1987) was found at the sampling site S-8 while the minimum value (798) was recorded at the site S-10.

## Sulphate ($SO_4$)

Sulphate concentration of samples ranged from 33 mg/l - 76 mg/l and it was found within the desirable limit (200 mg/l) of BIS at all the sampling sites (Table -1). Highest value of sulphate (76 mg/l) was found at the sampling site S-8, while the minimum value of sulphate (33 mg/l) was found at the sampling site S-7.

## CONCLUSION

Groundwater hydrochemistry of Sipri area reveals that the quality of water falls somewhat under the desirable limits which can be utilized for atleast some purposes.. Sample 8 depicts higher concentration of TDS ,EC and Nitrate as compared to other samples. Highly concentrated TDS in water can cause the loss of its portability which further lowers down the solubility of oxygen in such waters.. Water of approximately all study samples show increased hardness and contaminated in nature. Residents of Sipri area are prone to the immediate health problems such as stomach disease, gastric troubles etc. Continuous water quality monitoring in the study area is encouraged, by increasing the frequency of sampling and also analysis on the study area is needed to effectively monitor the impact on Sipri area, particularly on environment and human health. Therefore there is an urgent need of proper scientific management methods to be taken on the Sipri dumping site to prevent ground water contamination and the regular monitoring of the ground water quality in and adjoining areas of landfill dumping site is also required.

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