

## **Impact of improper disposal of solid waste on ground water quality- A case study**

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### **Abstract**

The present study has been made to evaluate the ground water quality of Samba town of Jammu division of J&K state. The solid waste generated in urban areas is increasing day-by-day. Many municipalities and corporations are facing the problem of managing large volumes of solid waste generated in their area. One of the alternatives for disposal of solid waste is filling the depressions, drains, nallah, open spaces etc. In the present study, a big nallah flowing through Samba town carries huge load of pollutants in the form of refuse and waste water opens at many places into self-created garbage pits. Ground water monitoring was carried out at two stations around garbage pit to assess the ground water quality of hand pumps used by the residents of the area for domestic and other uses. The study revealed that the quality of ground water, however, conform to the drinking water quality standards but there is need for periodic evaluation of various water quality parameters as well as adoption of proper water quality management practices as natural quality of groundwater is being degraded near the garbage pit.

**Keywords:** *Solid waste, Ground water quality, Depressions, Drains, Nallahs, Open spaces*

### **Introduction**

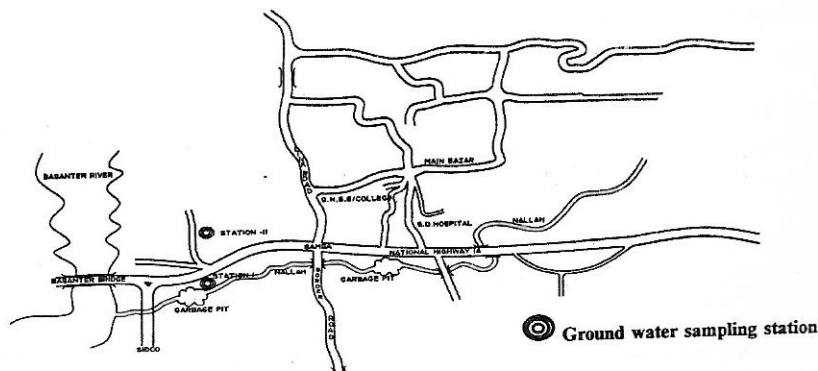
Due to rapid growth of population, urbanization and industrialization, there is several fold increase in generation of waste and waste water. Due to improper disposal of solid waste, there is a great threat to the quality of ground water.

In the present study, a nallah flowing through Samba town, carries huge load of pollutants in the form of waste and waste water was studied. This nallah opens at many places into self-created garbage pits before draining into the river Basantar. In garbage pits, solid waste stays on the top but water percolates deep inside into the surface. Therefore, it is important to monitor the surface and ground water quality parameters. The monitoring programme was planned to measure ground water quality with the objectives to evaluate, analyze and summarize existing ground water quality, and to correlate the results of the data with permissible standards for drinking water quality.

### **Materials and Method**

#### **Study Area**

The present study has been aimed to assess the quality of ground water of Samba town of Jammu division of J&K state. The solid waste generated in Samba town is mostly dumped in open land fills in low lying areas, drains, nallah etc. Since there is no sewage treatment plant and recycling facilities in the area, the sewage and the solid waste is directed in the nallah which flows in the town. For this purpose, two different stations or study sites have been selected Station-I (hand pump located near the garbage pit) and Station-II (hand pump located at a distance of 300 meters from the garbage pit).



**Fig. 1: Location map of ground water sampling stations**

Since the town has developed in an unplanned manner, there is no underground drainage system in the area. Moreover, the nallah opens up at many places into self-created garbage pits. In these pits the solid waste stays at the top and the stored water seeps into soil cover. Once the soil cover is saturated, the infiltrated water moves to subsurface water through fissures and joints.

### Methodology

A total of 6 representative samples were collected fortnightly from the study area during November 2005 to January 2006. The samples were collected from both hand pumps, which were being extensively used for drinking and other domestic purposes. The location of ground water sampling stations (Hand pumps) is shown in Fig. 1. Both physical and chemical analysis were carried out according to standard methods (APHA, 1998). The various analyzed parameters include pH, DO, COD, chloride, nitrate, calcium, magnesium and total hardness.

### Results and Discussion

For studying the impact of refuse and waste water of the garbage pit on ground water quality, the water quality parameters were analyzed and are presented in Table I. A comparison of ground water quality of the study area with drinking water standards per guidelines laid down by WHO (1971) and BIS (1990) is presented in Table II. A critical examination of the tables reveals that quality of water considerably vary from location to location. pH is a measure of intensity of acidity or alkalinity and the concentration of hydrogen ions in water. The pH of the water samples collected around the garbage pit ranged from 6.92–8.21, whereas the samples collected from the hand pump located at a distance of 300 meters away from the garbage pit showed a range of 7.42–8.61. The pH values of both samples are normally acceptable as per guidelines suggested by WHO (1971) and BIS (1990). These findings are in conformity with Murugesan *et al.* (2005), i.e. 6.62–8.07; Mor *et al.* (2003), i.e. 7.2–8.6 and Aurangabadkar *et al.* (2000), i.e. 6.5–8.7 who have worked on the levels of ground water pollution in the urban environment.

Dissolved oxygen (DO) measured for all samples ranged between 1.48–4.00 ppm and 1.65–5.30 ppm at Stations I and II, respectively. These values of DO are below 5.00 ppm which clearly indicate pollution which may be due to the contents of decomposable matter in the samples which is more in the water



samples collected from Station-I as compared to those collected from Station-II. These findings are comparable with the findings of Ravinder *et al.* (2005) who recorded high DO values from wells situated away from the dumping site and low DO values in the nearby wells of Warangal town while studying the impact of dumping municipal solid waste (MSW) on ground water quality of Warangal. The COD values of Stations I and II are between 16.00- 36.00 ppm and 13.00- 24.00 ppm, respectively. These COD values illustrate that there is large amount of organic matter present in both the samples. However, it is clear from the study of Table-I that the COD value decreases with the increase in distance from the garbage pit. These findings are in conformity with Ravinder *et al.* (2005) who has recorded similar observation while assessing the ground water quality of Warangal town. The increase in COD value of water sample collected near the Station-I is due to high level of discharge of domestic sewage from nallahs.

Chloride concentration in the water samples collected from the Station-I ranged from 58.03 to 138.00 ppm whereas it ranged from 14.40 to 45.00 ppm at Station-II. Both these concentrations or levels of chloride are well within the permissible limits of WHO (1971) and BIS (1990). But chloride content from the Station-I showed higher content as compared to the Station-II. Therefore, it can be explained that there is regular addition of large quantities of sewage from nearby localities to the garbage pit, it is absorbed by the soil or it leached into the soil and move with the groundwater. Moreover, food waste also contributes to the chloride content in water.

Sulphate content in the water samples of present study ranged from 17.50 to 42.00 ppm from the Station-I and 1.50 to 18.00 ppm from the Station-II. The higher concentration of sulphate in water samples of Station-I is due to the seepage of pollutants from the waste water which is being regularly added to the garbage pit by the nallah. But both the values of the sulphate are found to be within the prescribed limits of WHO (1971) and BIS (1990). The present values of sulphate content are in agreement with the values recorded by Mor *et al.* (2003) who have tried to work out the pollution status of ground water of Jind city.

Nitrate content in both the samples collected from Stations I and II ranged from 0.70 to 16.80 ppm and 0.25 to 9.00 ppm respectively. Table-II shows that although both the values are within the permissible limits of 45-100 ppm as prescribed by BIS (1990), the Station-I values are higher as compared to the Station-II values which may be due to large addition of decayed vegetable and animal matter, sewage sludge, domestic effluents disposal to land, leachates from refuse dumps and atmospheric washout. Similar findings were recorded by Ravinder *et al.* (2005).

**Table I: Physico-chemical analysis of ground water sample**

| Parameter                     | Station-I<br>Hand pump located 5 m away from<br>the garbage pit |        |       |       |       |       | Station-II<br>Hand pump located 300 m away from the<br>garbage pit |        |       |       |       |       |
|-------------------------------|---|--------|-------|-------|-------|-------|--|--------|-------|-------|-------|-------|
|                               | I   | II     | III   | IV    | V     | VI    | I  | II     | III   | IV    | V     | VI    |
| pH                            | 6.92  | 8.21   | 7.7   | 8.2   | 7.6   | 7.4   | 7.42   | 8.61   | 8.0   | 8.4   | 8.0   | 7.8   |
| DO                            | 1.48  | 3.2    | 3.2   | 4.0   | 4.0   | 4.0   | 1.65   | 3.5    | 4.0   | 5.3   | 5.3   | 4.2   |
| COD                           | 28.8  | 36.0   | 26.0  | 16.0  | 17.0  | 17.0  | 14.4   | 24.0   | 16.0  | 13.0  | 13.0  | 15.0  |
| Cl <sup>-</sup>               | 58.03   | 109.9  | 83.8  | 113.6 | 120.4 | 138.0 | 24.87  | 14.4   | 20.40 | 30.55 | 45.0  | 24.0  |
| SO <sub>4</sub> <sup>2-</sup> | 33.0  | 17.5   | 28.0  | 26.0  | 42.0  | 26.0  | 1.5  | 6.0    | 18.   | 16.0  | 14.0  | 16.0  |
| NO <sub>3</sub> <sup>-</sup>  | 9.5   | 3.5    | 0.7   | 6.6   | 3.8   | 16.8  | 0.25   | 1.1    | 2.2   | 9.0   | 2.8   | 1.2   |
| Ca <sup>2+</sup>              | 117.02  | 135.82 | 88.9  | 113.0 | 75.0  | 92.3  | 87.37  | 82.46  | 40.1  | 42.5  | 72.1  | 74.5  |
| Mg <sup>2+</sup>              | 23.16   | 29.39  | 35.1  | 38.5  | 25.0  | 31.7  | 17.96  | 13.71  | 7.3   | 18.0  | 21.9  | 25.3  |
| TH                            | 387.15  | 459.67 | 366.0 | 440.0 | 292.0 | 360.0 | 291.82   | 262.09 | 130.0 | 180.0 | 270.0 | 290.0 |

\*All parameters are in ppm except pH

Table II: Physico-chemical analysis of ground water sample

| Parameter                     | Station-I<br>(handpump<br>located at 5 m<br>away from garbage<br>pit) | Station-II<br>(handpump<br>located at 300 m<br>away from<br>garbage pit) | Indian Standard |          | WHO<br>Standard |
|-------------------------------|---|--|-----------------|----------|-----------------|
|                               |   |  | Acceptable      | Maximum  |                 |
| pH                            | 6.92- 8.21  | 7.42- 8.61   | 7.0- 8.5        | 6.5- 9.2 | 6.5- 9.2        |
| DO                            | 1.48- 4.0   | 1.65- 5.3  | -               | -        | -               |
| COD                           | 16.0- 36.0  | 13.0- 24.0   | -               | -        | 10              |
| Cl <sup>-</sup>               | 58.03- 138  | 14.4- 45.0   | 200.0           | 1000.0   | 500.0           |
| SO <sub>4</sub> <sup>2-</sup> | 17.50- 42.0   | 1.5- 18.0  | 200.0           | 400.0    | -               |
| NO <sub>3</sub> <sup>-</sup>  | 0.7- 16.8   | 0.25- 9.0  | 45.0            | 100.0    | -               |
| Ca <sup>2+</sup>              | 75.0- 135.82  | 40.1- 87.37  | 75.0            | 200.0    | 75.0            |
| Mg <sup>2+</sup>              | 23.16- 38.50  | 7.30- 25.30  | 30.0            | -        | 150.0           |
| TH                            | 292.0- 459.67   | 130.0- 291.82  | 200.0           | 600.0    | 500.0           |

\*All parameters are in ppm except pH

Calcium concentrations from Station I and II ranged 75.00 to 135.82 ppm and 40.10 to 87.37 ppm, respectively and this level/ concentration of Ca<sup>++</sup> content is found to be within the maximum limit prescribed (75-200 ppm) by the Indian Standards (1990) by above (75 ppm) WHO (1971) standards. Again Ca<sup>++</sup> content is high in the water sample collected from the Station-I which is due to fact that domestic waste water contributes ions to the ground water. Magnesium concentration in the ground water samples collected from Stations I and II ranged from 23.16 to 38.50 ppm and 7.30 to 25.30 ppm, respectively and is well within the prescribed limits of WHO (1971) and BIS (1990). Hardness values ranged from 292.00 to 459.67 ppm and 130.00 to 291.82 ppm in water samples collected from Stations I and II, respectively.

These values of Ca<sup>++</sup>, Mg<sup>++</sup> and total hardness are in agreement with the values recorded by Mor *et al.* (2003), while assessing the pollution status of ground water due to landfills and septic tanks in Jind city of Haryana. Ca<sup>++</sup> and Mg<sup>++</sup> ions in greater quantities may be present in ground water either by leaching of soil deposits or through seepage of ions from domestic waste water. The hard water causes ill-effects on digestive system and moreover, the possibilities of forming Ca<sup>++</sup> oxalate crystals (leading to stone formations) in the urinary tracts.

## Summary and Conclusion

From the above results, it is concluded that the ground water of Samba town is not highly contaminated but there is an indication of increasing pollution due to discharge of sewage and solid waste into rivers and nallah along with other land sites which ultimately percolates into the ground and is thus responsible for ground water pollution. Hence, there is an urgent need to take immediate necessary steps for the protection of this valuable natural resource in Samba town.

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