Recent Research in Science and Technology 2013, 5(5): 07-11
ISSN: 2076-5061
Available Online: http://recent-science.com/

Water quality surrounding to MSW dumps of Raipur city-A case study

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Abstract

In India, urbanization and rapid population growth have led to degradation of environment, by increased rate of exploitation of natural resources and generation of municipal solid wastes (MSW). Municipal Solid Waste (MSW) disposal is a big problem for most of the towns in developing countries. In India dumping of MSW on low laying area is the common practice in most of the towns. The dumping of waste in uncontrolled manner creates many kinds of problems for the surrounding environment. Ground water pollution is one of the serious effects of the MSW dumping. The assessment of impacts on ground water sources near to MSW dumps is of considerable importance in management and disposal of solid waste. The leachate may greatly affect the ground water sources near to the dumpsites. In the present study an attempt has been made to investigate the extent of impact on ground water sources namely open wells, shallow tube wells (depth less than 30 m) and deep tube wells (depth more than 50 m). The pollution status is also monitored at varying distances from the solid waste dumping sites to investigate the trend of leachate movement in the subsoil. Water samples from different sources at different locations are assessed for physical, chemical and biological properties.

Keywords: Assessment of impact, Ground water pollution, Municipal solid waste (MSW) dumps, Water sources.

INTRODUCTION

Urbanization have led to degradation of environment, particularly in developing countries by increased rate of exploitation of natural resources and generation of municipal solid wastes (MSW). The solid waste disposed in open dumps by small community did not create serious environmental problems, as the small amount of wastes could be assimilated by nature. With increased population, urbanization, and industrialization the quantum of MSW generated increased many fold and it is beyond the assimilation capacity of nature. The solid waste dumps if not managed properly, may cause many types of socio-environmental problems (Zurbrugg, 2002), like ground water pollution, air pollution, soil contamination, odour nuisance, fly nuisance etc. Increasing awareness for health and environmental effects of MSW dumping has the requirement for proper assessment of harmful effects of it.

The most serious problem is groundwater contamination. The U.S. Environmental Protection Agency (EPA) estimates that between 0.1% and 0.4% of usable surface aquifers are contaminated by industrial impoundments and landfills. As water filters through any material, chemicals in the material may dissolve in the water, a process called leaching. The resulting mixture is called leachate. As water percolates through MSW, it makes a leachate that consists of decomposing organic matter combined with iron, mercury, lead, zinc, and other metals from rusting cans, discarded batteries and appliances. It may also contain paints, pesticides, cleaning fluids, newspaper inks, and other chemicals as well as bacteria and viruses. Leachate is produced when the waste becomes saturated with water (Marian and Benson, 1999). Contaminated water can have a serious impact on all living creatures, including humans, in an ecosystem.

About 0.15 million tonnes of municipal solid waste is generated in India every day. That is approximately 50 million tonnes annually. Out of the total municipal waste collected, on an average 94% is dumped on land and 5% is composted. The average rate of MSW generation (0.25 to 0.6 kg/ person/day) is very low as compared to developed countries, but due to rapid growth of population and increased urbanization solid waste generated is of very large amount. In most of the cities and towns the MSW is dumped on low-lying area without following the guidelines for safe disposal of solid waste (Akolkar, 2002). It is generally seen that slums and other low-income group of people surround the locations of solid waste dumps and thus, in the countries like India it has become a vital problem to go for sanitary landfills with their limited financial resources.

The assessment of impacts on ground water sources near to MSW dumps is of considerable importance in management and disposal of solid waste. The leachate may greatly affect the ground water sources near to the dump sites. The study of leachate movement and its potential to pollute ground water sources merits the investigation. In the present study an attempt has been made to investigate the extent of impact on ground water sources namely open wells, shallow tube wells (depth less than 20 m) and deep tube wells (depth more than 50 m). The pollution status is also monitored at varying distances from the solid waste dumping sites to investigate the trend of leachate movement in the subsoil. Water samples from different sources at different locations are assessed for physical, chemical and biological properties.

STUDY AREA AND METHODOLOGY

Study was conducted for MSW dumps of Raipur town. Raipur is in Chhattisgarh state of India, with a population of 1 million (approx.) having latitude of 21°14' N and longitude of 81°38' E. It is on Bombay-Hawrah main raiway route with average annual rainfall of 1200 mm. In order to assess the impact of MSW dumps on the different ground water sources three kinds of water sources were selected, which are found to be generally used by the surrounding people. Water sources selected are namely- open wells, shallow tube wells (< 20m depth), and Deep tube wells (> 50m depth). MSW is collected and dumped at different locations of the Raipur town. Four locations of the MSW dumps were selected for this study namely- Rawan bhata, Sanjay nagar, Tikara para, and Gudhiyari. From each location the water samples were collected for all three kind of sources at varying distances from MSW dumps in four groups, 0-10m, 11-20m, 21-50m, 51-80m distances according to availability of wells (Khan, 2001).

Sampling was done in the month of July and August (rainy season) to assess the worst possible scenario. More than 500 samples were collected in all at different varying distances from MSW dumps, different locations and different sources of ground water. Water samples were analyzed as per the methodologies mentioned in Standard Methods (APHA-AWWA-WPCF, 1989). Parameters analyzed for assessing water quality were, a) Temperature, b) Total Dissolved Solids (TDS) c)Total alkalinity, d) Total hardness, e) Chloride contents, f) Dissolved Oxygen (DO), g) Turbidity, h) pH, h) Electrical conductivity (EC), and i) Most Probable Number (MPN) (Khan, 2001).

RESULTS AND DISCUSSION

Water quality of different sources

Result of the analysis for water quality parameters (average values) for the sample collected from open wells (total 135 samples) are shown in Table 1. In general the values of all the parameters are highest near to MSW dumps except the values of DO and pH. As the distance from MSW dumps increases the parameter values are decreasing. The values of turbidity and MPN are found to be critical near to MSW dumps but after a distance of 80m it becomes low.

Table 1. Water qualities of open wells at different distances from MSW dumps

S.No.	**Test**	**Sample Locations from MSW dump- site in m**			
		0-10	**11-20**	**21-50**	**51-80**
1	Temperature (^{0}C)	23	23	23	23
2	TDS (mg/L)	234	201	170	86
3	Total Alkalinity (mg/L) as $CaCO_3$	750	730	693	656
4	Total Hardness (mg/L) as $CaCO_3$	406	374	233	203
5	Chlorides (mg/L)	132	123	110	98
6	Dissolved Oxygen (mg/L)	6.8	6.8	7.0	6.5
7	Turbidity (NTU)	24	17	13	9
8	pH	7.2	7.3	7.3	7.2
9	EC (mho/cm)	403	356	324	198
10	MPN/100ml	13	07	03	03

Result of the analysis for water quality parameters (average values) for the sample collected from shallow tube wells (total 226 samples) are shown in Table 2. Similar trend was observed that, in general the values of all the parameters are highest near to MSW dumps except the values of DO and pH. As the distance from MSW dumps increases the parameter values are decreasing. The values of turbidity and MPN are found to be critical near to MSW dumps but after a distance of 80m it is in acceptable range.

Table 2. Water qualities of shallow tube wells (< 20m depth) at different distances from MSW dumps

S.No.	Test	Sample Locations from MSW dump- site in m			
		0-10	11-20	21-50	51-80
1	Temperature (^{0}C)	24	23	24	24
2	TDS (mg/L)	203	187	156	65
3	Total Alkalinity (mg/L) as $CaCO_3$	653	603	545	456
4	Total Hardness (mg/L) as $CaCO_3$	306	374	204	156
5	Chlorides (mg/L)	105	98	76	78
6	Dissolved Oxygen (mg/L)	5.4	5.7	5.9	5.8
7	Turbidity (NTU)	10	9	6	1
8	pH	6.9	6.8	6.8	6.8
9	EC (mho/cm)	380	345	289	124
10	MPN/100ml	07	05	02	Nil

Result of the analysis for water quality parameters (average values) for the sample collected from deep tube wells (total 208 samples) are shown in Table 3. Similar trend was observed that, in general the values of all the parameters are highest near to MSW dumps except the values of DO and pH. As the distance from MSW dumps increases the parameter values are decreasing. The values of turbidity and MPN are found to be low near to MSW dumps and after 50m distances it is with in acceptable limits.

Table 3. Water qualities of deep tube wells (> 50m depth) at different distances from MSW dumps

S.No.	Test	Sample Locations from MSW dump- site in m			
		0-10	11-20	21-50	51-80
1	Temperature (^{0}C)	25	25	24	25
2	TDS (mg/L)	176	156	155	146
3	Total Alkalinity (mg/L) as $CaCO_3$	432	303	245	256

4	Total Hardness (mg/L) as $CaCO_3$	268	217	234	189
5	Chlorides (mg/L)	57	48	46	38
6	Dissolved Oxygen (mg/L)	5.1	5.3	5.4	5.4
7	Turbidity (NTU)	6	5	3	1
8	pH	6.2	6.3	6.3	6.4
9	EC (mho/cm)	320	290	298	267
10	MPN/100ml	02	01	Nil	Nil

Comparison of water quality from different sources near to MSW dumps

Fig1. Temperature of water samples from different sources

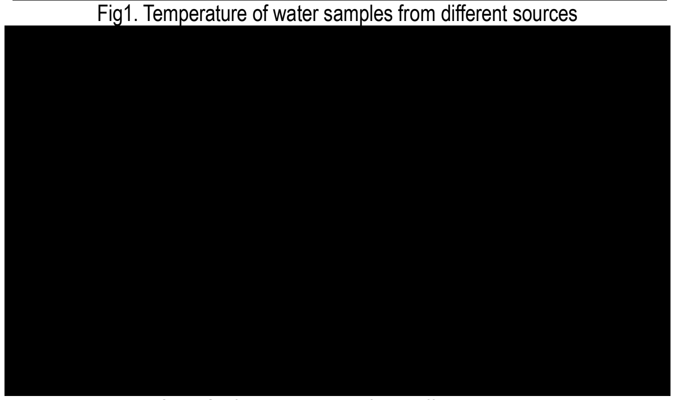

Fig 2. TDS of water samples from different sources

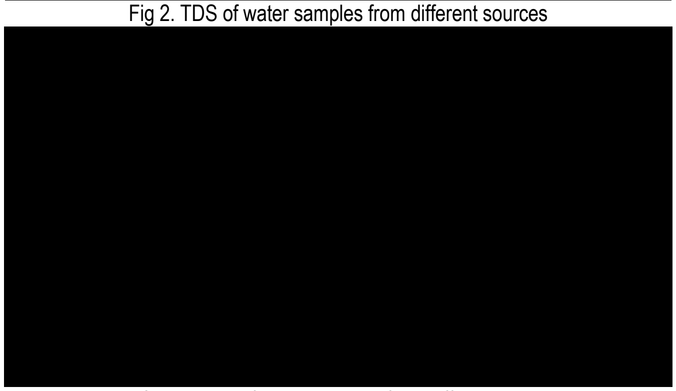

Fig 3. Alkalinity of water samples from different sources

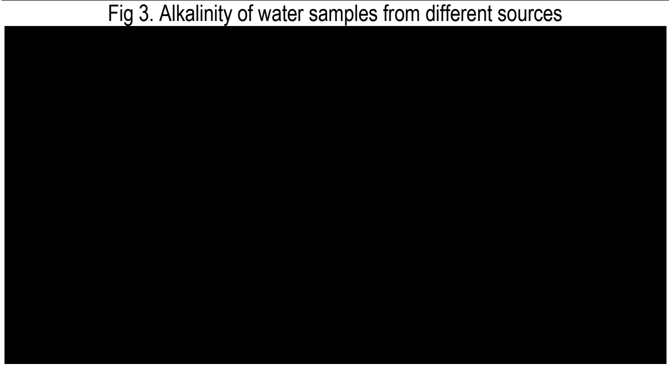

Fig 4. Hardness of water samples from different sources

Fig. 5 Chloride content of water samples from different sources

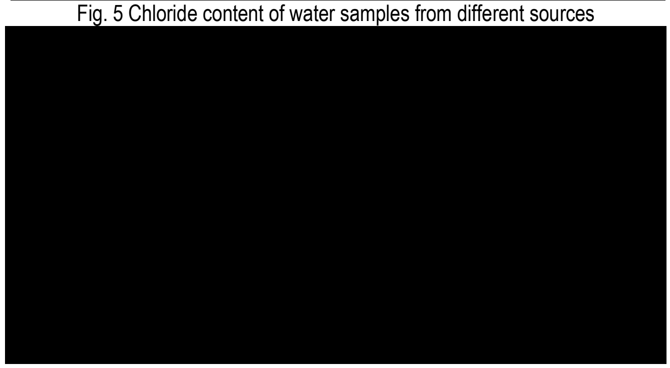

Fig 6. DO of water samples from different sources

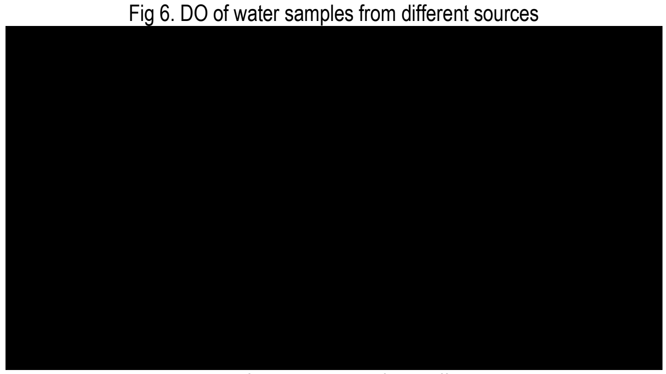

Fig 7. Turbidity of water samples from different sources

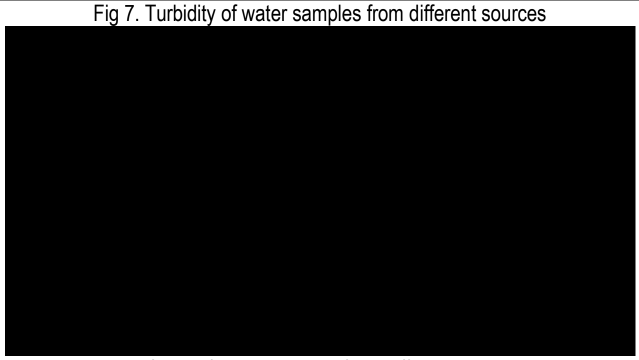

Fig 8. pH of water samples from different sources

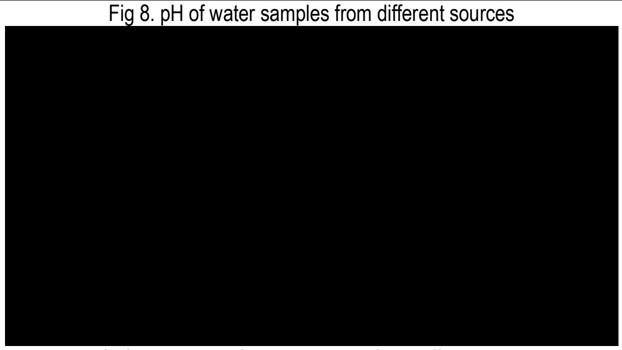

Fig 9. Conductivity of water samples from different sources

Fig 10. MPN of water samples from different sources

The comparison of water quality from different sources shown in Fig. 1 through Fig. 10 shows that the MSW dumps affect the waters of open wells most. Waters of shallow tube wells are also affected considerably, but waters from deep tube wells are affected least. It shows that MSW dumps affect the top aquifer considerably. Since deep tube wells draw water from lower aquifer so it shows least contamination.

CONCLUSIONS

Values of water quality parameters examined for the water samples from wells in proximity of the MSW dumping sites are found to be higher as compared to the parameter values of samples collected away from the dumping sites. Similar effect is noticed for all MSW dumping sites. The effect on ground water found to be depending on the distance of well from the dumping site. The extent of ground water pollution decreases with increase in the distance of well from the dumping site. During percolation of leachate through soil, its characteristics changes due to physical, chemical and biological forces before it contaminates the ground water hence the distance is important. In comparison to open wells and shallow tube wells the quality of water from deep tube wells are found to be better. It is recommended that no human settlement should be allowed up to a minimum distance of 100m from MSW dumping sites.

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