Impact of Municipal Solid Waste Landfill on Surrounding Environment: A Case Study

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Abstract Municipal solid waste in India is largely managed by disposal in landfill site due to its favourable economics. In this paper the impact of municipal solid waste management and its disposal at Ghazipur landfill site which is approximately 72 acres is presented. The site on an average receives about 2000 tonne per day of MSW from North and South Shahdara, Delhi. The Ghazipur site is already matured and receives MSW over its full capability. The impact of Ghazipur landfill site on the surrounding environment was studied and analysis of noise, air, soil and groundwater pollution was conducted including a socio-economic impact survey. A comparative analysis of the above factors was done with the Boragaon waste dumping site in Guwahati. It was observed that the impact of this MSW on these sites to be negative on the surrounding environment which influences the nearby area greater than 10km in diameter. Both the sites adversely affect the residents of the surrounding area and in near future with the increase of quantity of MSW, it would further result to a serious environmental hazard.

Keywords: Municipal Solid Waste, Landfill, Pollution.

1 Introduction

Solid waste includes all the discarded solid materials from commercial, municipal, industrial, and agricultural activities. According to UNEP data, the rate of waste generation generally increases in direct proportion to that of a nation's development [1]. In Delhi, the present MSW generation is nearly 8000 tonnes per day and is increasing by 3-4 % per annum which is likely to increase to 18000 tonne per day by the year 2021. Land filling is the preferred method of municipal solid waste (MSW) disposal due to its favourable economics [2] According to various studies, researchers concluded that poorly designed landfills can create contamination of groundwater, soil, and air [3] [4] [5]. The most frequently reported hazard to the human health from these landfills is from the use of groundwater that has been polluted by leachate [8]. As water percolates through the landfill, contaminants are leached from the solid waste. Leachate is produced when moisture enters to refuse in a landfill, extracts contaminants into the liquid phase, and produces moisture content sufficiently high to initiate liquid flow. Leachate may contain dissolved or suspended material associated with wastes disposed of in the landfill, as well as many by-products of chemical and biological reactions [9]. Strength of leachate from MSW landfills varies with the progress of biological activity occurring in landfill. The study was carried on the Ghazipur landfill site that is nearly 72 acres. The site receives MSW from North and South Sahadara. The landfill site on an average receives about 2000 TPD of MSW. The Ghazipur site is accessible from National Highway -24 via Kondli road running parallel to Ghazipur drain. It is already matured and remains receiving MSW over its full capability. The effect of the existing landfill on the surrounding environment was studied which included the various environment attributes. The effects of landfill on the surrounding air, noise, soil and ground water environment were analyzed. Further the survey was conducted to study the impacts of landfill on the people residing in the nearby area. A comparative analysis of the above factors was done with the West Boragaon waste dumping site in Guwahati where dumping of garbage is nearly 500 metric tonne per day. The dumpsite is the only waste disposal ground of Guwahati city. The site is within the Brahmaputra flood plain having area of about 108 bigha which is located at a distance of about 15km from the city and 2 km from NH-37.

2 Methodology Adopted

The impact of Ghazipur landfill site and Boragaon dumping site on the surrounding environment includes noise pollution, soil pollution, water pollution, air pollution and socio-Economic impact. The following methodologies were adopted for the study viz.

Figure 1 Ghazipur landfill site

Figure 2 Boragaon dumping site

2.1 Noise Pollution An area of 5 acre was taken and analyzed for noise at three locations in and around Ghazipur. There were 9 stations taken at each 3 locations i.e. at Ghazipur, main road and apartments near Ghazipur landfill site. The noise monitoring was conducted during the peak hours as per National Monitoring system. The noise levels at Boragaon, Guwahati were checked mainly in the following stations: Basistha Chariali, N.H-37, Lokhra Chariali, N.H-37, Pachim Boragaon Chowk, N.H-37. The methodology adopted has been taken from IS Code 4954 (1968) and the manual provided by Central Pollution Control Board (Ministry of Environment & Forests, Govt. of India) which provides the guidelines for Noise Pollution Regulations in India [12].

2.2 Ground water Pollution Water sampling was done to determine the existing quality of water around both site areas of Ghazipur and Boragaon so as to assess the impact of municipal solid waste on the environment. After collecting samples from tube wells located near the sites sampling and testing were done following standard guidelines for physical and chemical parameters [14].

2.3 Air Pollution For duration of 10days, air monitoring was done on 4 hour basis for PM10, PM2.5, NO, NO2 and on 1 hour basis for CO. The methodology adopted has been taken from the manual provided by Central Pollution Control Board (Ministry of Environment & Forests, Govt. of India) which provides the guidelines for the measurement of Ambient Air Pollutants [11].

2.4 Soil Pollution An area around Ghazipur land fill and Boragaon dumping site were taken. The chemical properties of the soil sample collected at a depth of 0-50cm were then analyzed as per standard procedure [13] and using IS 2720.

2.5 Socio economic impact A survey was conducted in the form of questionnaire to the residents in order to understand the impact on their day to day life. The sample size of 250 persons were taken for both the surveys conducted each at Ghazipur and Boragaon site.

3 Test Results

3.1 Noise Monitoring: The comparison of results for the noise monitoring in and around Ghazipur are shown in fig.3 below

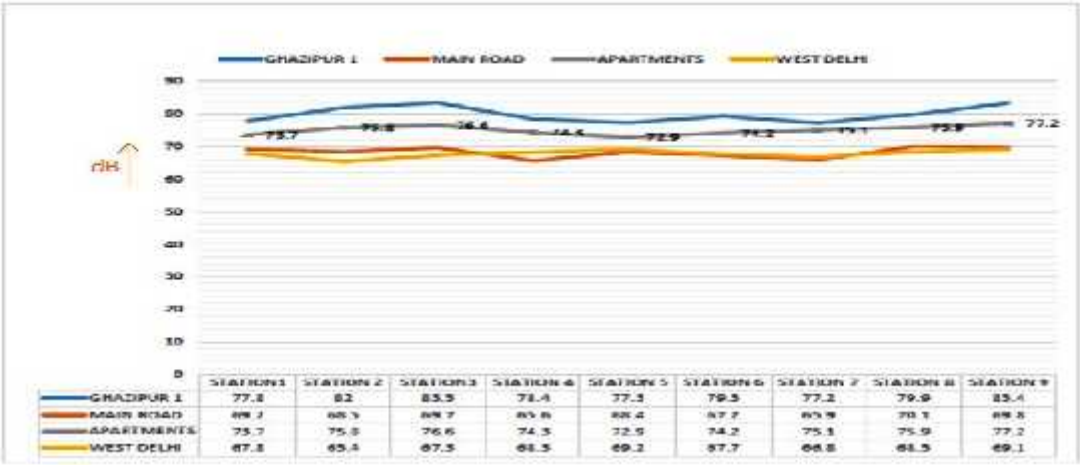

Figure 3 Comparison of sound level in and around the Ghazipur landfill site

Table 1 Report of Noise Level Monitoring carried out Near Boragaon Area in Leq dB(A)
(All the datas are collected during day time -hourly basis at each location between 9:00 AM and 5:00 PM)

Location	Date 6/04/19	Date 11/04/19	Date 18/04/19	Date 30/04/19
Basistha Chari-ali,N.H-37	78.6	75.6	77.4	78.3
Lokhra Chariali, N.H-.37	72.7	78.9	74.4	78.1
Pachim Boragaon Chowk,N.H-37	73.9	73.6	76.3	79.3

As per Noise Pollution Regulations in India by Central Pollution Control Board (Ministry of Environment & Forests; Govt. of India) the permissible noise level in India for industrial areas is 75dB for daytime and 70dB at night,
for commercial areas is 65dB for daytime and 55dB at night and for residential areas it is 55dB for daytime and 45dB at night. The noise monitoring results conducted in daytime for a month in both the respective site is listed in Figure 3 (for Ghazipur landfill) and Table 1 (for Boragaon dumping site). So from the above obtained values in Figure 3 and Table 1 it can be observed that the noise levels have crossed the permissible limits as laid by CPCB in all the selected areas that was monitored both in Ghazipur landfill and Boragaon dumping site.

3.2 Result of groundwater quality:

Table 2 Comparison of result of different parameters range with Bureau of Indian Standards

Parameter	Unit	Results from Ghazipur land-fill site	Results from Boragaon site	BIS Standards
pH	----	7.5-7.8	6.7-8.2	6.5-8.5
Conductivity	mS/cm	220-274	54.8-76.5	----
TDS	mg/l	771-1440	35-49	500
Total Hardness	mg/l	256-306	140-160	300
Alkalinity	mg/l	215-270	160-200	200
Chloride	mg/l	183-243	10-34	250
Residual Chlo-rine	mg/l	0.26	NIL	0.2

The results obtained above in Table 2, when compared with BIS standard permissible limits gives an idea about the water pollution in both the sites respectively. Except pH and chloride, all other parameters has shown values more than the BIS permissible limit at Ghazipur landfill site whereas parameters are still within BIS permissible range in case of Boragaon dumping site.

3.3 Result of air quality parameters:

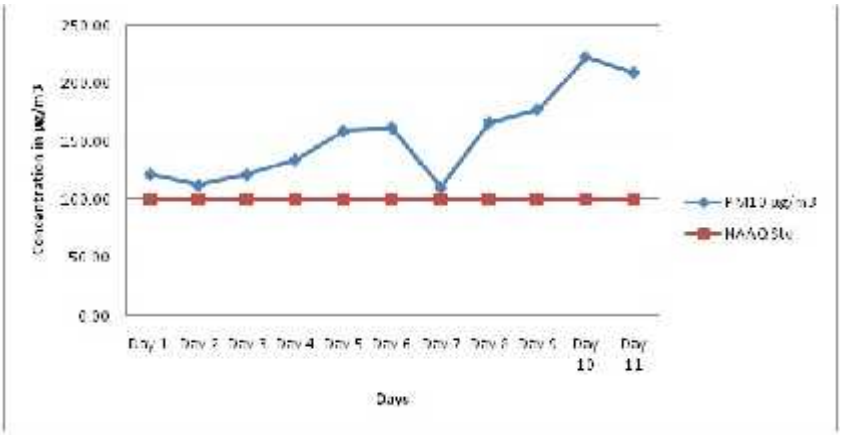

Figure 4. Comparison of PM 10 with NAAQ Std. at Ghazipur landfill site

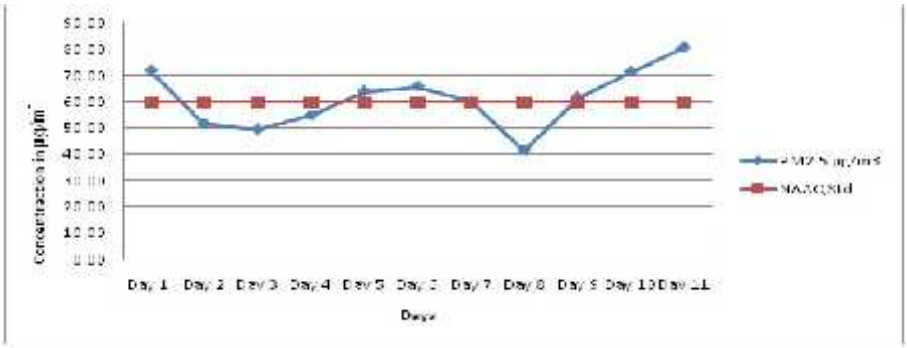

Figure 5. Comparison of PM 2.5 with NAAQ Std**.** at Ghazipur landfill site

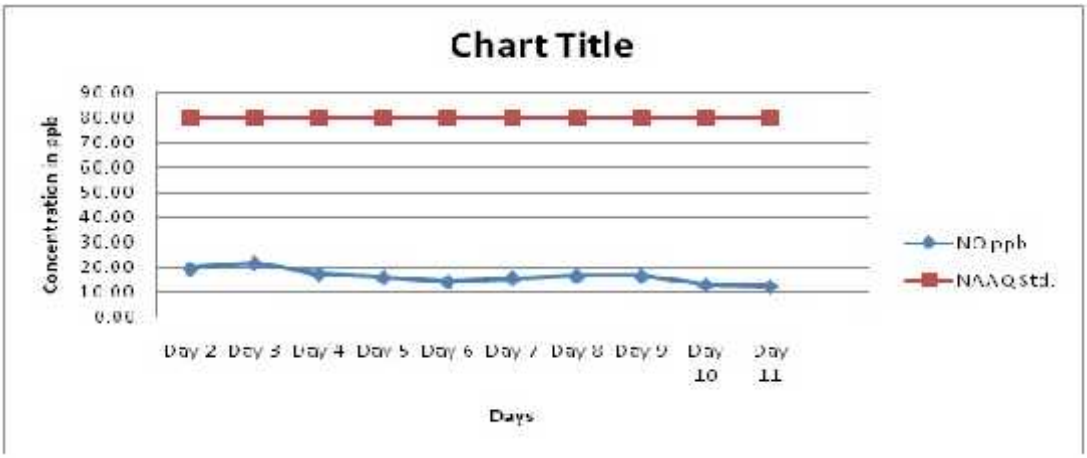

Figure 6. Comparison of NO with NAAQ Std. at Ghazipur landfill site

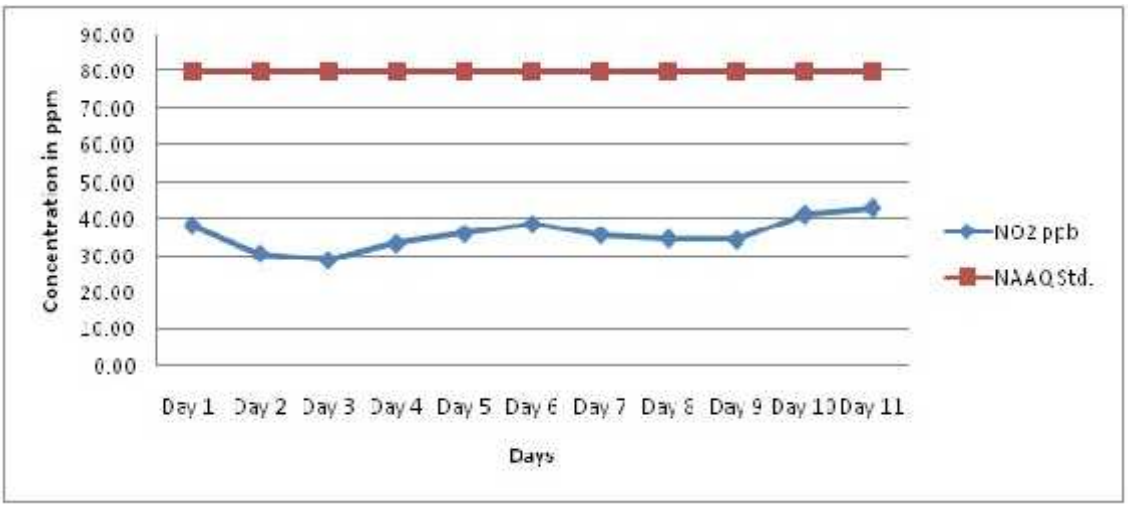

Figure 7. Comparison of NO_2 with NAAQ Std. at Ghazipur landfill site

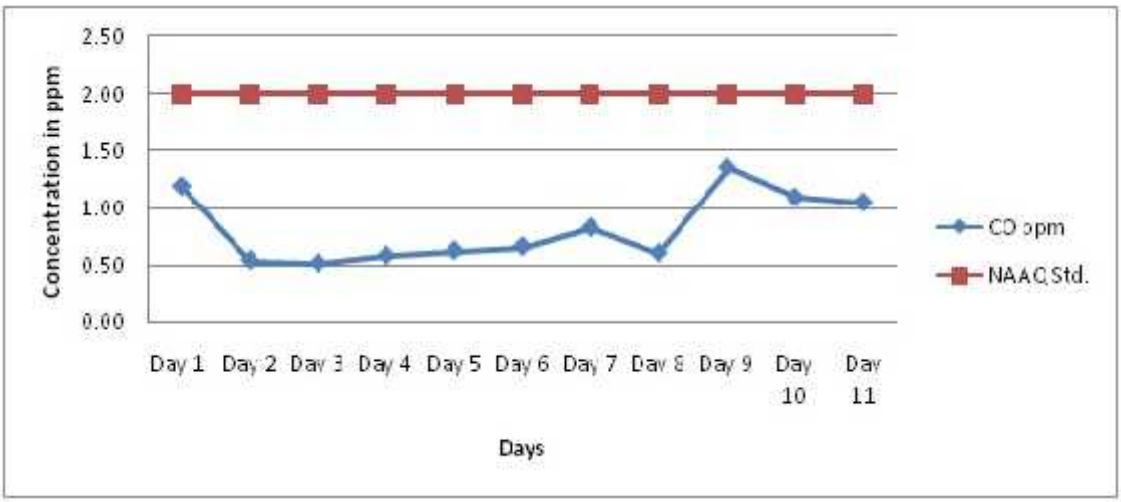

Figure 8. Comparison of CO with NAAQ Std. at Ghazipur landfill site

Table 3 Ambient Air Quality Data of NO_2 and PM_{10} of Boragaon dumping site for the month of April, 2019

Sampling date	General Weather	N02 (µg/m³)	PM10 (µg/m³)
01-04-19	Cloudy/Rainy	17	99
03-04-19	Clear	20	88
05-04-19	Cloudy/Clear	17	71
08-04-19	Cloudy/Rainy	18	64
10-04-19	Clear	17	68
12-04-19	Clear	21	112
17-04-19	Clear	17	87
22-04-19	Clear	17	90
24-04-19	Clear	18	177
26-04-19	Clear	19	153
29-04-19	Cloudy	18	57

The results obtained for air quality parameters has been listed above in Figures 4,5,6,7,8 and Table 3. It can be observed from Figure 4 & 5 that the PM_{10} and $PM_{2.5}$ values for Ghazipur landfill site has crossed the permissible limit as mentioned by NAAQ standards whereas NO, NO_2 and CO values as shown in Figure 6,7 and 8 are still within the limit i.e. less than NAAQ standards. Again in Boragaon dumping site as shown in Table 3, it is ob-

served that in some occasions the PM_{10} value exceeds the NAAQ standards but NO_2 is still within the permissible limit of NAAQ standards.

3.4 Result for soil properties

Table 4 Properties of soil

Point	1	2	2	3	3	4
Position Long	SE	SW	SW	NW	NW	NE
	147.4546	147.4522	147.4522	147.453162	147.453162	147.456602
Lat	284.1598	274.1	274.1568	274.1537	274.1537	274.153
Depth (cm)	0-20	0-20	0-20	20-50	20-50	20-50
pH(1:5 Water)	4.9	3.9	4.5	4.7	4.3	4.8
%C	1	1.1	0.5	1.2	0.3	1
NO3(mg/kg)	6	4.3	1.2	9.8	3.1	13.6
SO4(mg/kg)	5	3	3	3	2	3
P(mg/kg)	27	20	6	19	9	30
K(mg/kg)	1.3	1.34	0.78	1.19	0.81	1.28
Ca(meq/100g)	2.62	3.63	4.87	2.77	1.86	3.27
Mg(meq/100g)	0.34	0.43	0.7	0.4	0.43	0.42
Al(meq/100g)	0.1	0.07	0	0.16	0.78	0.07
Na(meq/100g)	0	0	0.02	0	0.03	0
Cl mg/kg	10	10	5	5	10	10
EC ds/m	0.04	0.03	0.05	0.04	0.02	0.04
AmmN(mg/kg)	8	3	0	3	0	11
CEC (meq/100g)	4.37	5.48	6.36	4.53	3.9	5.04
Ca/Mg ratio	7.68	8.35	6.96	6.95	4.37	7.81
Al Sat%	2.3	1.2	0	3.4	19.9	1.3
ESP %	0	0.18	0.24	0.22	0.79	0.2

From the result obtained for determination of the soil properties in Ghazipur landfill site, as listed in Table 4 it was found that the soil is acidic. Most plant nutrients, particularly calcium, potassium, magnesium were fluctuating from normal ranges whereas other parameters have also shown negative impacts. Thus the soil is not only creating foul smell but also affecting water quality. The soil is unfit for any agricultural or irrigation works and due to the contamination it is posing health hazard to the residents nearby.

3.5 Result of Survey Conducted

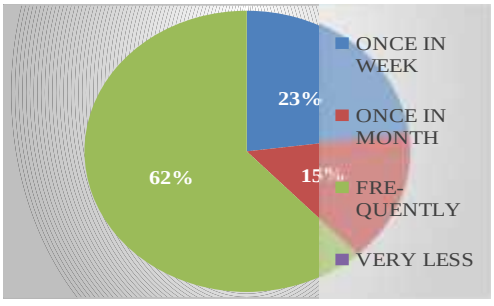

Fig. 9 How often do you fall ill?

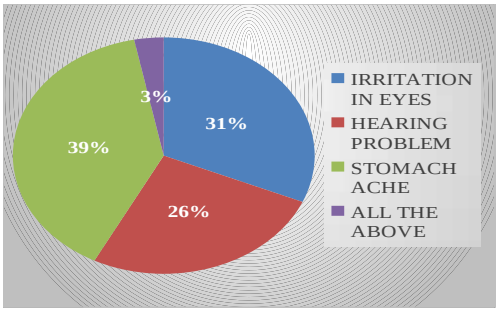

Fig. 10 What health problems do you face?

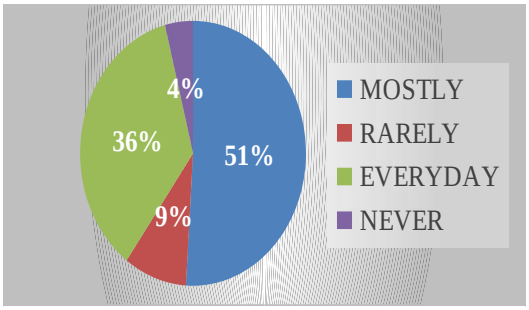

Fig. 11 How often do you find unbearable foul smell here?

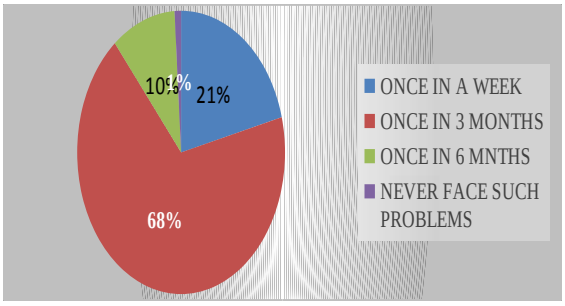

Fig.12 How often your electric appliance stop working?

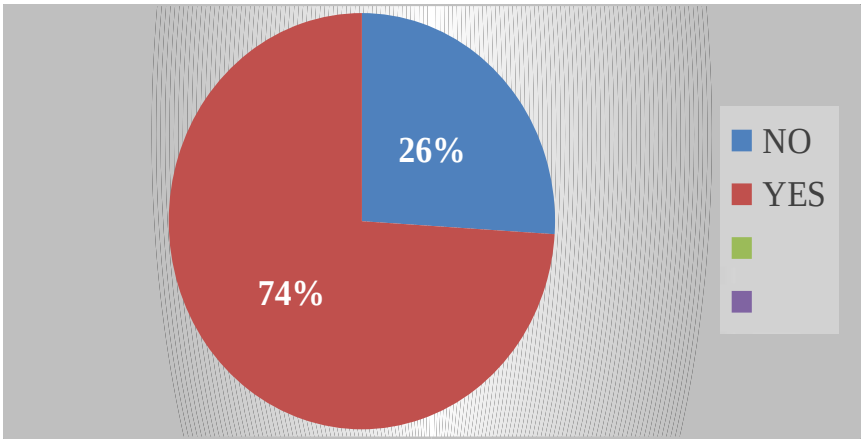

Fig. 13 Do you feel traffic problems here?

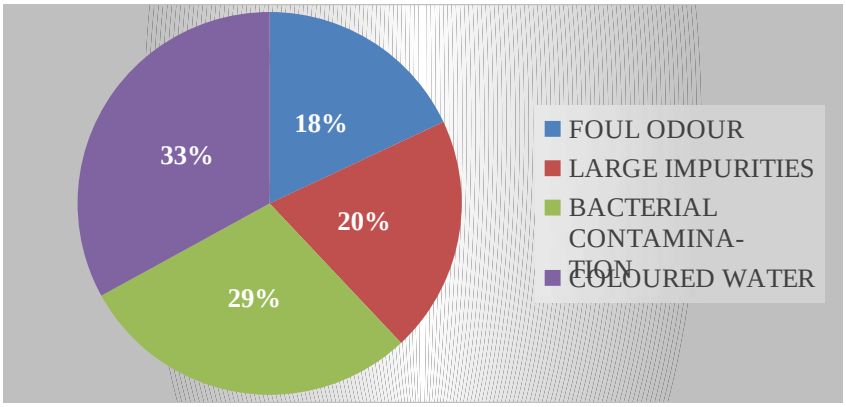

Fig. 14 What isuues you face in the water?

4 Conclusions

From the above observations of Ghazipur landfill site and Boragaon dumping site the following conclusions can be made. The results of noise monitoring in and around both the sites show that the values are exceeding the Noise Pollution Regulations as framed by Government of India. Also the air monitoring for PM10 and PM2.5 shows that the results are again exceeding the NAAQ standards in both the sites respectively. The value of total hardness, alkalinity and residual chlorine was found to just exceed limits of BIS whereas TDS values were in much higher range than the acceptable limits given by BIS in case of Ghazipur landfill site. Further from the results of the soil properties in Ghazipur landfill site, it was found that the soil is acidic. Most plant nutrients, particularly calcium, potassium, magnesium were fluctuating from normal ranges thus depriving the concept of any agricultural or irrigation works. Hence results indicate that the effect of dumping of municipal solid waste in the study areas is slowly deteriorating the ground water quality. The soil is not only creating foul smell but also posing health hazard to the residents nearby. Based on the questionnaire survey conducted on the nearby residents, it was found that majority of the respondents were frequently falling ill. Also the foul smell from these sites were hampering their daily life and they were facing traffic related issues too. Thus it can be concluded that the impact of integrated solid waste on environment at landfill site is very negative. The impact is limited not just to landfill site but it is far reaching. The area of influence of solid waste at landfill or dumping site is much greater than 10 km. People living adjacent to these areas are suffering the most in their day to day life.

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