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Water quality analysis of Disposal site and its adjacent area of Guwahati, Assam, India

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Abstract

Due to increase of human population and life style, the solid waste is also in increasing manner. Guwahati is one of the major commercial and business places of Northeast India and its holding 149865.9 million populations in a density of 2700 per square kilometer. Due to rapid growth of urbanization 500 hundred metric tonne waste is generated daily from the entire Guwahati city and is dump in Boragaon disposal site near Deepor Beel (A wildlife sanctuary). The present paper investigated the water quality in around the disposal site. The sample was collected from different sampling station like Well, Hand pump, Surface water for a period of one year. Results suggested that the water quality parameters were changing with time and locations but there is no specific pattern is observed. Therefore, it is very difficult to predict whether these changes are due to leachate produced by waste disposal site or some other source. However, water bodies near to the dump site are showing some frequent changes in water quality parameters, may be because of leachate formation.

Keywords: Solid waste, disposal site, deepor beel, water quality.

Introduction

The term municipal solid waste refers to solid waste from houses, streets and public places, shops, offices, and hospitals. Management of municipal solid waste is most often the responsibility of municipal/urban local body (ULB) or other governmental authorities. The overall responsibility for Solid waste management in cities is come under Indian municipalities for proper management. But they are failing to fulfill their duty in proper way of Management like dealing with waste generation, collection, transport, treatment and disposal in sustainable way. Although there are no comprehensive data regarding waste generation rates, collection coverage, storage etc. The Central Public Health and Environmental Engineering Organization (CPHEEO) estimated a per capita waste generation in Indian cities and towns in the range of 0.2 to 0.6 kg/day. According to Central Pollution Control Board, average collection coverage ranges from 50-90 %[1]. Moreover, almost 94% collected waste is disposed in an unacceptable manner without any consideration of state-of-the-art engineering principles[2]. Although insufficient solid waste disposal creates serious problem to city dwellers, the uncollected waste is indiscriminately dumped in the roads or in drains which contributing artificial flooding, breeding of insect and rodent vector, and spreading of diseases[3]. Even waste that is collected is often disposed of in uncontrolled dumpsites or burned, polluting the air and water resources. Out of the various problems due to the lack of sanitary landfill, one is the improper management of the leachate generated in the dumping sites. A release of leachate to the groundwater may present several risks to human health and the environment. The release of hazardous and non-hazardous components of leachate may render an aquifer unusable for drinking water purposes and other uses.

Guwahati is one of the major commercial and business places of Northeast India and its holding 149865.9 million populations in a density of 2700 per square kilometer. An analysis of the trend of waste disposal in many cities shows that 75% of the wastes are disposed of to dumpsites, indicating a lack of adequate treatment and disposal facilities[4]. Like other cities Guwahati is also neglected in solid waste management. Per day Five hundred metric tonne waste is generated from the entire Guwahati city and these wastes is dumped in Boragaon near Deepor Beel in unscientific manner. Deepor Beel is one of the most important Birds sanctuaries of India. Now, Deepor Beel faces lots of problem due to dumping site by Guwahati Municipal Corporation. The present paper investigated the water quality in around disposal site of Guwahati and its effect on surface and ground water.

Material and Methods

Study area: The disposal site is located at Boragaon, Guwahati, and one kilometer away from NH-37 and 12 kilometer from city area (figure-1). The disposal site is surrounded by Phatasil Hills on the east side and Meghalaya Hills on south side. Mora Nala (Bharalu River) is close to the study site which streaming from Garchug village and connected to Deepor Beel about 1.5 km. The coordinates of the site is $26^0 06.872''$ N and $91^0 40.896''$ E, 46.9m elevation.

Sampling Strategy: Sampling strategy was planned to cover a

range of physico-chemical parameters at key sites in order to accurately represent the quality of surface and ground water of the study area. In order to study the seasonal variations of the water quality, sampling was conducted during rainy (July month), winter (October month), spring (January month) and summer (April month) seasons. A preliminary survey work for this project began in early July 2010 with the aim to select the sampling points around the disposal site. Based on the survey, 15 sampling points were selected (figure-2)

Analytical procedure: Analytical procedures described in the Standard Methods for the examination of water and waste water[5], (table-1) was followed throughout the analysis for determining the parameters indicated in table below. Certain parameters such as pH, electrical conductivity (EC), turbidity, sulphate and nitrate were analysed as early as possible in the laboratory. A quality control procedure was maintained throughout, including recalibration of instrument. All chemicals and reagents used in the analysis were of analytical grade unless otherwise stated. Distilled water was used for all dilutions. Standard solutions were prepared by diluting the stock solutions.

Table-1
Methods of determination of water quality parameters[5]

Sr. No.	Name of parameter analysis	Equipment/ method
01	Alkalinity	Titration method
02	Electrical Conductivity (EC)	Conductivity meter
03	Hardness	EDTA method
04	pH	Digital pH meter
05	Total Iron	UV Visible Spectrophotometer
06	Total Solid (TS)	Gravimetric method
07	Turbidity	Nephloturbidity meter
08	Calcium (Ca^{2+})	Flame photometer
09	Potassium (K^{+})	Flame photometer
10	Sodium (Na^{+})	Flame photometer
11	Chloride (Cl^{-1})	Argentometric method
12	Fluoride (F^{-1})	UV Visible Spectrophotometer
13	Sulphate (SO_4^{2-})	Nephloturbidity meter

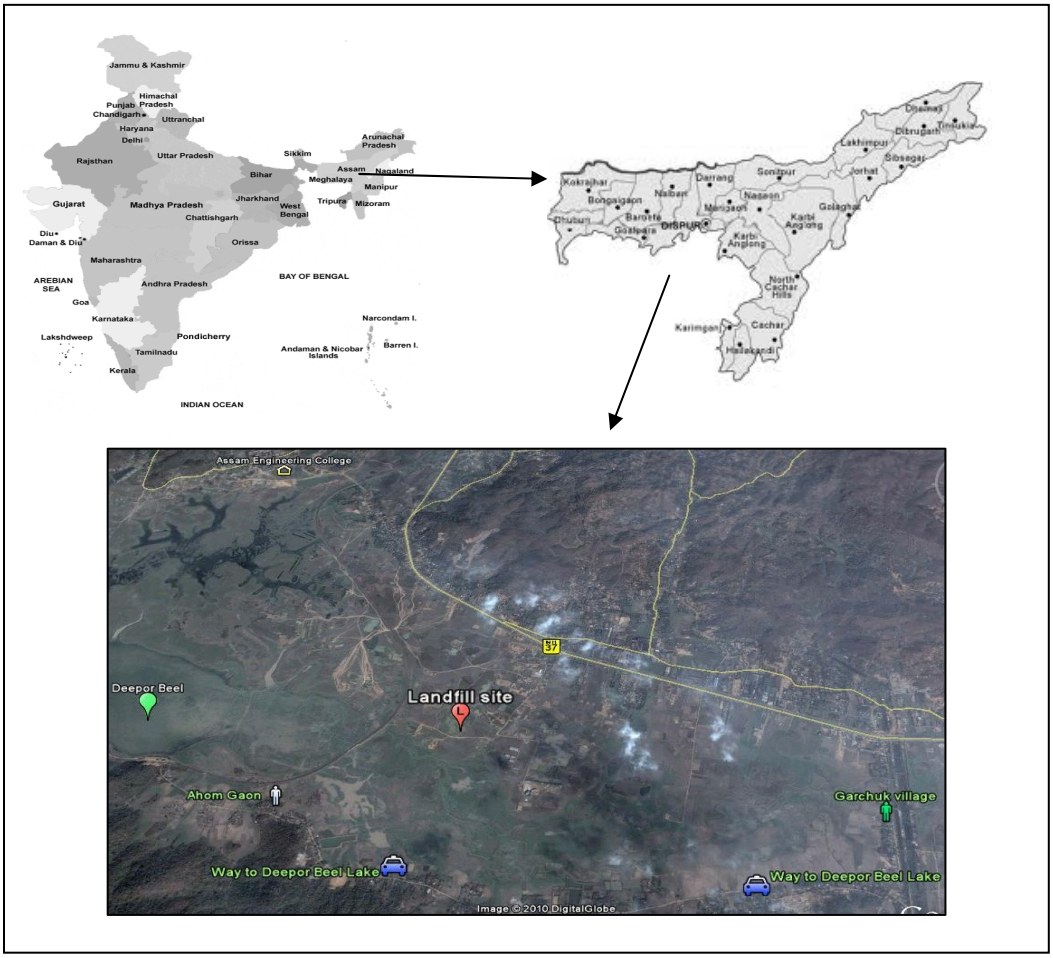

Figure-1
Study Area (Boragaon, Garchug village, Maghuwapara village, Ahomgaon, Assam Engineering College and Deepor Beel

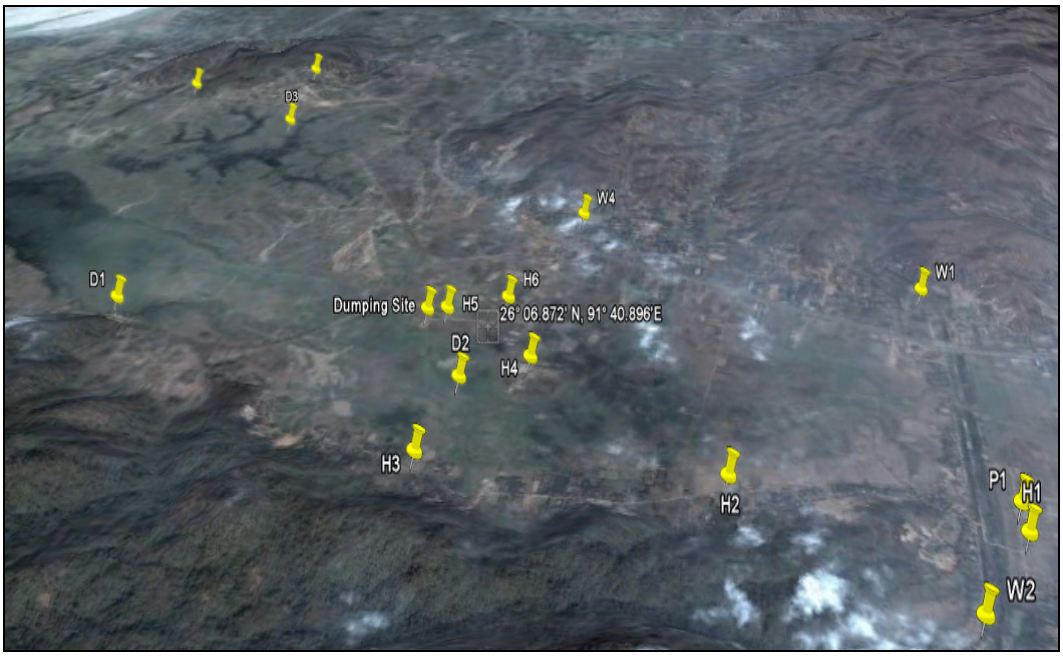

Figure-2
Sampling Stations (W = Well P = Pond H = Hand pump D = Deepor Beel)

Results and Discussion

Analysis of Water Samples: pH: The seasonal variations of pH are represented in table-2. It was observed that for all well waters the pH showed decreasing trend from July to April. However, in well 1 pH in April showed higher than October and January. For pond the trend is reverse (from July to April it showed increasing trend) except in April of pond 2. In case of hand pump the trend showed inconsistent pattern. The variations in pH showed decreasing trend except for third location of Deepor Beel which is far away from dumping site.

Electric Conductivity (EC): The seasonal variations of EC are represented in table-2. It is apparent that the EC of well water in July was observed higher than other months, whereas for pond the same was observed almost equal for all seasons. In case of hand pump and Deepor Beel not much variation were observed.

Turbidity: The seasonal variations of turbidity are represented in table-2. Turbidity of the wells showed higher value in January (winter season) when compared to the other months including rainy season, which is contradictory to general situation. This is possibly due to unusual rain before sampling day. Same is the case with pond also. In January it should be less but it is almost equal to rainy season. In hand pump as expected it is almost negligible. For Deepor Beel turbidity values were increasing from July to April, not following the trend of well and pond possibly because of other factors like disposal of industrial waste in Deepor Beel.

Hardness: The seasonal variations of hardness are showed in table-2. It is apparent that the hardness values of well water showed irregular pattern, whereas for pond the same showed increasing pattern from July to April. In the case of hand pump the hardness values showed increasing pattern for the samples withdrawn away from the dumping site while it showed irregular pattern for the samples withdrawn near to the dumping site. Hardness values of Deepor Beel samples showed increasing trend from July to January and thereafter decreasing from January to April.

Alkalinity: The seasonal variations of alkalinity are represented in table-2. Alkalinity values of well water samples were observed to be irregular pattern. Pond 1 showed decreasing values of alkalinity while pond 2 were observed to be conflicting. In the case of hand pump the alkalinity values were observed to be lower values for the samples taken away from the dumping site while the same showed higher values for the samples taken close to the dumping site, besides this the alkalinity values were observed higher in the month of April for all samples of hand pump. Not many variations were observed in Deepor Beel.

Fluoride: The seasonal variations of fluoride are represented in table-2. The fluoride concentrations for the samples were observed to be decreasing pattern for almost all well. Moreover, the values also showed highest concentration of fluoride in July. For pond the values were showed decreasing pattern, whereas for hand pumps values showed irregular pattern. The fluoride values for the samples taken from Deepor Beel showed increasing pattern from July to January and thereafter decreasing from January to April.

Chloride: The seasonal variations of chloride are represented in

table-2. Chloride concentrations were observed to be decreasing from July to October and thereafter increasing from October to April for the samples taken from well 1, well 2 and well 4 but the same observed to be increasing from July to January and then decreasing from January to April.

Sulphate: The seasonal variations of sulphate are represented in table-2.The concentrations of sulphate showed irregular pattern for the samples of well water and hand pump whereas the same showed increasing trend July to April in almost all samples.

Potassium: The seasonal variations of potassium are represented in table-3. Potassium concentrations showed decreasing trends for well 1 and well 4 whereas the same showed increasing trends for well 2 and well 3 from July to April. While in the case of pond the concentrations showed increasing trends from July to April. Not much Variation was found in the case of hand pump samples. For Deepor Beel trend showed decreasing pattern from July to April for almost all samples.

Calcium: The seasonal variations of calcium are represented in table-3. Values of calcium concentration showed the decreasing pattern from July to January and thereafter the same showed increasing for almost all wells except in well 1. For well 1 the concentration of calcium was found to be decreasing from July to April. The calcium concentrations for pond 1 were found to be in increasing trend from July to April while for pond 2 the same was conflicting. It is apparent that the concentration was found to be decreasing from July to January thereafter; it increases from January to April. Same pattern (increasing from July to January and thereafter it decreases from January to April) was also observed in Deepor Beel 1 and 2 whereas for Deepor Beel 3 the pattern was found irregular.

Table-2
Showing the Analytical data

Parameters (Unit)	Month	Well				Pond		Deepor Beel			Hand Pump					
		w1	w2	w3	w4	p1	p2	D1	D2	D3	H1	H2	H3	H4	H5	H6
pH	July	6.90	6.70	6.56	6.90	6.12	7.10	7.04	6.84	6.90	6.24	6.30	6.80	7.00	7.45	7.06
	October	6.60	6.65	6.52	6.80	7.23	7.30	6.85	6.50	7.08	6.17	6.23	6.50	6.32	7.00	6.85
	January	6.54	6.49	6.53	6.49	7.24	7.42	6.60	6.30	7.32	6.04	6.00	6.68	7.00	6.68	6.85
	April	6.68	6.12	6.23	6.26	7.35	6.79	6.30	6.12	7.12	6.07	6.32	6.72	6.79	6.63	6.85
Electric Conductivity	July	0.921	0.482	0.215	0.449	0.173	0.118	0.168	0.200	0.182	0.127	0.156	0.258	0.299	0.298	0.365
	October	0.652	0.356	0.256	0.318	0.179	0.941	0.176	0.220	0.266	0.125	0.146	0.256	0.288	0.275	0.365
	January	0.440	0.220	0.310	0.240	0.180	0.150	0.240	0.260	0.190	0.110	0.120	0.230	0.270	0.250	0.310
	April	0.402	0.400	4.200	0.367	0.185	0.160	0.203	0.253	0.185	0.119	0.125	0.240	0.279	0.274	0.342
Turbidity (NTU)	July	0.50	4.20	1.00	3.00	10.90	5.00	0.10	4.30	2.30	0.20	0.50	3.20	2.30	0.10	1.80
	October	1.20	23.40	3.60	10.80	10.60	5.60	2.60	4.65	5.20	0.20	0.80	2.30	1.70	0.60	1.20
	January	2.20	31.70	4.50	16.20	10.20	6.70	4.70	5.00	5.80	0.30	0.90	0.70	1.00	0.80	0.80
	April	10.60	5.70	3.50	4.80	12.20	6.70	12.50	7.80	6.50	0.10	0.80	1.20	7.40	1.20	2.10
Hardness (mg/las CaCO3)	July	214	140	52	102	42	58	42	80	56	22	42	84	90	98	126
	October	230	110	69	95	56	70	64	95	64	23	56	110	142	156	165
	January	254	94	130	84	72	80	90	102	80	22	70	154	182	162	188
	April	68	58	65	70	83	86	42	68	72	38	82	165	76	86	94
Alkalinity (mg/las CaCO3)	July	130	62	184	90	52	60	40	48	52	40	56	96	106	108	136
	October	110	65	110	75	49	63	42	52	86	38	59	90	110	102	116
	January	102	68	90	60	46	0	41	49	52	40	58	80	142	98	120
	April	38	136	225	88	42	53	42	46	50	54	65	102	142	156	198
Fluoride (mg/l)	July	0.997	0.085	0.723	0.772	0.506	0.547	0.112	0.560	0.745	0.232	0.322	0.830	0.780	0.020	0.690
	October	0.569	0.081	0.562	0.678	0.300	0.237	0.135	0.621	0.960	0.152	0.231	0.450	0.560	0.120	0.560
	January	0.000	0.065	0.574	0.155	0.150	0.014	0.160	0.625	0.330	0.000	0.050	0.484	0.332	0.147	0.238
	April	0.428	0.056	0.690	0.052	0.102	0.015	0.060	0.135	0.320	0.217	0.040	0.612	0.238	0.000	0.610
Chloride (mg/l)	July	364	220	66	174	80	74	50	70	56	30	27	38	14	42	34
	October	110	136	78	110	75	72	56	62	90	30	33	30	28	37	33
	January	165	178	110	125	70	68	63	78	64	42	36	38	26	35	36
	April	168	152	45	148	71	85	58	52	65	38	45	32	22	20	30
Sulphate (mg/l)	July	21.11	14.08	12.99	24.80	7.01	5.65	8.07	2.01	4.35	4.46	2.85	4.76	10.16	2.21	1.70
	October	22.38	20.65	12.65	20.35	8.37	7.56	9.64	2.35	5.94	3.30	2.63	4.56	5.56	2.36	2.56
	January	35.52	23.42	12.96	17.80	16.84	10.84	14.00	6.00	14.32	3.71	2.48	5.16	2.23	2.61	3.10
	April	25.40	34.43	20.54	14.44	12.32	11.26	22.83	9.68	16.49	4.84	2.56	3.65	4.11	3.72	6.28

Sodium: The seasonal variations of sodium are represented in table-3. Sodium concentrations were found to be inconsistent for all water wells, while the concentrations were found to be almost increasing from July to April in case of all samples of pond and Deepor Beel. The concentration of sodium for samples of hand pump showed irregular pattern.

Total Solids: The seasonal variations of total solids are represented in table-3. Almost decreasing trend from January to April for almost all samples of water wells, pond and Deepor Beel were seen. However, the concentrations showed irregular pattern for samples of hand pump.

Total dissolved solids: The seasonal variations of total solids are represented in table-3. All Wells showed a decreasing pattern in the TDS concentration from July to April, whereas Ponds showed almost no variation for the first pond but the second one showed a decreasing pattern. While the Hand pump and Deepor Beel water showed an irregular pattern.

Total suspended solids: The seasonal variations of total suspended solids are represented in table-3. Almost all samples of Deepor Beel, pond and hand pump showed decreasing trend of concentration whereas the concentrations showed irregular pattern for water well.

Iron: The seasonal variations of iron are represented in table-3. It is clear well 1 showed drastic increment in April, not much variation was observed for other seasons. For well 2 the concentrations showed decreasing whereas well 3 showed increasing trend from January to April. Not many variations were observed in pond 2 while pond 1 showed decreasing trend. From the figure-2 it is clear that the hand pumps 4 and 6 showed the higher concentrations values in all seasons which are nearer to the dumping yard site. The concentrations of Deepor Beel showed irregular pattern.

Table-3
Showing the Analytical data

Parameters (Unit)	Month	Well				Pond		Deepor Beel			Hand Pump					
		w1	w2	w3	w4	p1	p2	D1	D2	D3	H1	H2	H3	H4	H5	H6
Potassium (ppm)	July	42.4	7.28	4.12	8.66	3.93	3.76	5.33	6.32	6.32	2.59	1.67	2.03	1.37	1.73	1.07
	October	26.3	15.63	4.15	6.52	6.53	3.86	5.65	6.68	6.57	1.56	1.7	1.89	0.89	1.65	0.98
	January	19.7	20.57	4.06	1.54	10.2	3.86	5.78	7.02	1.41	0.64	1.72	1.63	0.87	1.65	0.94
	April	15.8	24.99	16.6	3.09	12.2	10.36	2.03	4.36	2.48	2.1	1.32	1.65	0.05	1.34	0.64
Calcium (ppm)	July	34.2	15.55	4.81	17.77	4.35	9.03	4.35	5.17	4.02	3.72	3.56	4.43	4.97	4.52	5.42
	October	20.4	12.36	2.86	10.75	4.67	5.03	3.26	4.59	6.77	2.76	3.02	3.45	3.96	2.56	1.23
	January	14.2	5.71	0.29	4.62	5.7	0.12	1	2.06	5.36	1.32	2.13	2.36	2.61	1.51	0.14
	April	11.6	12.3	3.65	7.4	6.3	4.03	5.2	5.67	6	4.11	4.02	5.65	3.36	4.7	6
Sodium (ppm)	July	33.63	12.53	14.96	26.06	11.09	4.02	9.78	10.71	10.36	10.90	12.80	14.53	14.15	15.15	17.18
	October	22.36	12.36	16.56	20.36	12.03	5.20	10.65	10.78	11.46	12.30	12.60	15.63	13.65	14.12	15.63
	January	20.65	12.56	18.36	22.14	10.23	6.32	12.69	11.01	11.49	10.80	5.56	16.32	12.36	16.35	17.56
	April	18.1	12.21	16.3	23.69	13.2	8.32	13.34	12.03	12.1	11.46	13.2	15.53	13.5	14.34	18.18
Total Solids (mg/l)	July	265	256	265	289	251	415	250	456	265	223	400	182	256	450	270
	October	189	278	226	265	198	389	236	402	125	140	165	156	225	326	220
	January	221	216	156	132	152	221	150	265	170	210	260	260	165	402	186
	April	169	132	96	132	124	152	126	165	156	136	198	173	153	265	210
Total Dissolved Solids (mg/l)	July	150	146	148	156	65	98	65	98	56	96	185	125	132	200	152
	October	149	135	126	129	60	86	60	86	39	45	67	110	115	148	126
	January	130	125	113	118	65	69	65	69	56	89	156	136	96	251	112
	April	110	96	54	89	45	58	45	58	60	46	96	130	53	123	97
Total suspended solid (mg/l)	July	130	156	145	189	186	356	186	356	193	126	180	56	112	265	120
	October	65	89	150	152	164	310	164	310	65	110	123	63	105	168	96
	January	110	123	68	45	95	159	95	159	85	94	103	102	78	156	86
	April	68	48	65	56	85	110	85	10	78	95	96	65	85	125	115
Iron (mg/l)	July	0.309	1.525	0.480	0.451	3.210	1.113	0.824	0.827	0.800	0.297	0.268	1.230	2.450	0.920	1.920
	October	0.322	1.230	0.602	0.485	2.165	1.265	1.260	0.100	0.920	1.180	1.020	1.650	3.450	1.380	2.130
	January	0.421	0.503	0.800	0.572	0.051	0.749	1.590	2.350	1.200	0.000	0.565	0.503	3.510	0.390	2.543
	April	0.618	0.843	1.230	0.585	1.360	1.254	1.160	2.870	0.926	2.180	2.320	3.250	5.350	1.670	4.870

Conclusions

Results showed that the water quality parameters were changing with time and locations but there is no specific pattern is observed. So it is very difficult to predict whether these changes are due to leachate produced by waste disposal site or some other source; because of dump site area is surrounded by hills, Bricks industries and agricultural land and one outlet of Bharalu river is go through the Disposal site and connected to Deepor Beel. Waste water generated by industry or house hold, and water flowing through the agricultural land may also affect the water quality. However water bodies near to the dump site is showing some frequent changes in water quality parameters. So it clear that the leachate is affecting the water bodies, but how and how much, it cannot be predict from the present work.

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