ASSESSMENT OF GROUNDWATER QUALITY NEAR MUNICIPAL SOLID WASTE LANDFILL SITE OF DUBAGGA, LUCKNOW

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ABSTRACT-Groundwater sample collected from nearby sources of Dubagga landfill site to study the impact of pollution caused due to open dumping. Physico-chemical parameters, heavy metals (Cd and Cr^{6+}) and microbiological parameter (total coliform(TC)) and water quality index(WQI) of groundwater were determined to study the extent of pollution caused due to municipal solid waste site. The concentrations of Mg^{2+} and Cr^{6+} have exceeded their respective permissible limits recommended by Bureau of Indian Standards (BIS). The presence of TC indicates the contamination of groundwater. WQI warns about the quality of groundwater.

KEYWORDS- **Groundwater, Muncipal landfill site, Water Quality Index, Dubagga.**

1. INTRODUCTION

Development often leads so many changes that have serious impacts on earth's environment encompassing ecology, water resourcesand flora. Fast growth of city has additionally influenced the ground water resources. Generation of municipal solid waste increased by many fold due to rapid urbanization and population.

Leachate, a fluid generating from MSW, has been considered as a genuine threat to waters resources, human health and cleanliness.It is a foul fluid exuding from the base of the solid waste sites, for example, leachate are exceedingly concentrated complex effluents oforganic matter; inorganic mixes and heavy metals substances during acid phase of waste decaying process leachate gets generated. Its composition depends upon waste composition and depth, moisture and age.

Groundwater one of the principle source of drinking water on earth. More than 90% fresh water is groundwater and vital storage of clean water.As compared to surface water groundwater is less polluted.The appropriateness of groundwater as a source of water relies on its arrangement for the utilization of human and animal utilization, agricultural use, and for industrial and different purposes. In this manner, checking the quality of water is imperative since clean water is fundamental for human wellbeing and the dependability of aquatic communities.

This investigation intends to locate the nature of groundwater quality adjacent Dubagga waste site in Lucknow through the hand pumps and tube wells that have been chosen for this reason. To evaluate how far groundwater quality has been influenced by the open dumping at Dubagga site. Groundwater samples were gathered and find different physicochemical parameters, microbiological contamination and heavy metals.Water quality index of groundwater are also accessed to determine extent of pollution due to open landfill.

2. STUDY AREA

Lucknow is capital of the province of Uttar Pradesh in India, with a zone of 2528 sq. km and a populace of around 4.58 million (Census of India, 2011). The monsoon season is from July to September when the city gets an average precipitation of 896.2 millimeters from the south-west monsoon winds, and sometimes frontal precipitation will happen in January. Lucknow city creates around 1600 tons of MSW every day, out of which the organics portion is a noteworthy contributor (47-55%). Open dumping in discouraged or low-lying territories without liners and without a leachate collection facility is the typical practice. The Lucknow Municipal Corporation (LMC) as of now works a few unsecured landfill sites for the transfer of gathered solid wastes. The LMC has tried to manage the collection of waste through a private association, while squander processing and disposal have unregulated. In Lucknow there are around 23 new and old municipal strong waste dumping destinations, among which Dubagga is main one.

Dubagga landfill lies at 26.47” North and 80.55” East. It is located at 160 meter distance of the Chandoia Village in north near Musabagh and western direction of Lucknow city (Fig. 1) is low lying area and close to the fish market and Kadimikabristan, receives about 1000 Metric tons municipal solid waste daily. The Dubagga landfill started in the year 2007 and still in use. It extends over a zone of roughly 61420.08 m2. About 2500 MT/day of waste is dumped and the landfill height is about 4 m to 5 m.

3. MATERIALS AND METHODS

3.1. Sampling of groundwater

To comprehend the impact of open dumping on the groundwater samples are gathered from nearby sources. Groundwater samples were gathered from the hand-pumps and tube-wells exhibit close to the landfill site. Site specifications for sampling points are presented in Table 1.

3.2 Sample Analysis

5 groundwater sample locations were chosen nearby the Dubagga municipal landfill site. Groundwater samples were collected in 5 liter capacity plastic containers. Before collection of samples all the bottles were washed and rinsed with water as part of the quality control measures.

Fig. 1. Dubagga landfill site view. (source: Google earth)

Table 1: Site specification for sampling stations

Sample no.	Sampling locations	Type	Location
GW 1	M.C. Saxena College mod	Hand-pump	26°53'51" N 80°52'13" E
GW 2	Farm 1	Tube-well	26°53'49" N 80°52'22"E
GW 3	Mandir	Hand-pump	26°54'10" N 80°52'22" E
GW 4	Farm 2	Tube-well	26°53'40" N 80°52'16" E
GW 5	S S& COMPANY site office	Tube-well	26°53'58"N 80°52'10" E

Table 2: List of parameters analyzed and methodology followed

Parameters	**methodology**
pH, Electrical conductivity as (EC), Total dissolved solids as (TDS)	pH meter
Total hardness as (TH), Calcium as (Ca^{2+}), Magnesium as (Mg^{2+})	EDTA titrimetric method
Chloride as (Cl^-)	Argentometric method
Nitrate as (NO_3^-), Ammonium as (NH_4^+)	UV spectrometric method
Fluoride as (F^-)	Fluoride Meter
Sodium as (Na^+)	Flame photometric method
Coliforms	MPN method
Heavy Metals	Acid digestion method (AAS)

After each collected sample container bottle was labeled according to sampling location and all the samples were transported to the laboratory and preserved at 4ºC in refrigerator for further physico-chemical, heavy metal and biological analyses as per Standard Methods (APHA, 21st Edition). The results of the physico-chemical parameters and concentration of groundwater are compared with the limits prescribed by Bureau of Indian Standard (BIS) 2012 and World Health Organization (WHO) 1997. All parameters and methods prescribed in Table 2.

3.3 Water Quality Index (WQI)

WQI method was computed by using standards of drinking water quality recommended by Bureau of Indian Standards (BIS) to demarcate groundwater quality and its reasonableness for drinking uses (Mitra, 1998). The strategy gives the composite impact of individual water quality parameters on the general nature of water for human utilization.WQI is calculated by formulas given below.

$Q_n=[(P_a- P_i) / (P_s- P_i)] \times 100$(1)

$W_n= K/S_n$(2)

Where,

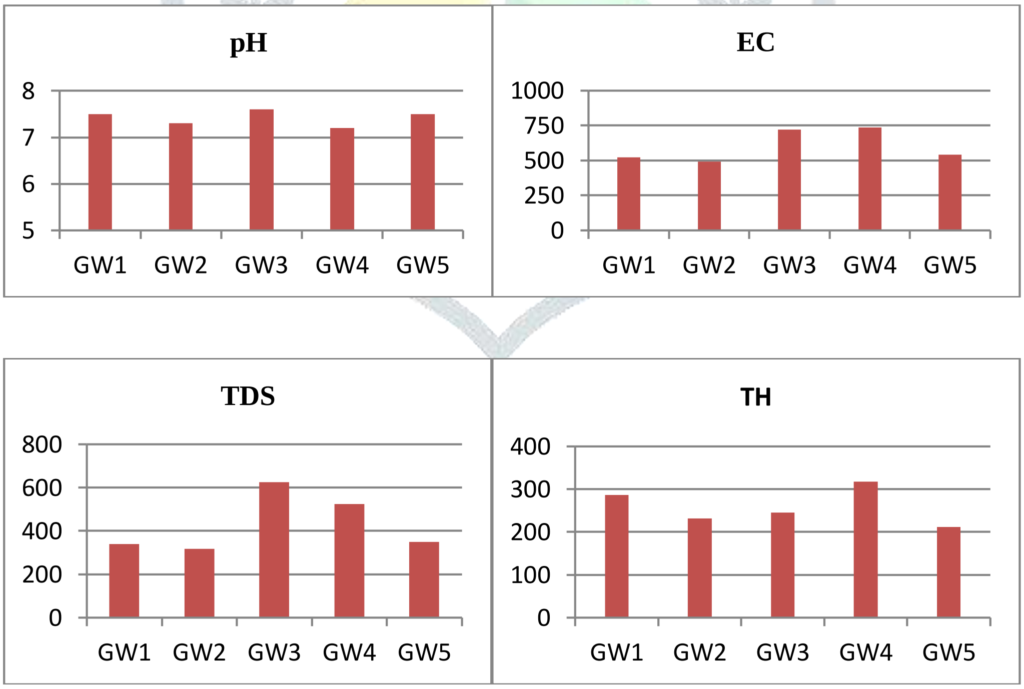
Q_n=Water quality rating of n^{th} water quality parameter.

P_a= calculated value of the n^{th} parameter.
P_s= Standard value of the n^{th} parameter.
P_i=Ideal value of n^{th} parameter (It is zero for all parameters except the pH (7 mg/l)).
W_n= Unit weight.
K= Constant of proportionality($K=1/\Sigma^n_{n=i} 1/S_n$)
S_n= Standard value of the water quality.

4. RESULT AND DISCUSSION

4.1 Physico-chemical parameters and Heavy metals

The collected ground water was analyzed for its physico-chemical characteristics. The samples were also tested for the presence of heavy metal ions Cadmium and Chromium Hexavalent. The result of groundwater samples collected from different sources is presented in Fig. 2. The analysis shows that pH is in neutral range in all groundwater samples i.e. 7.2 to 7.6. The value of EC in samples comes in range of 492 to 735 µS/l. It represents the measures of number of ions present in water. The TDS of the samples arevarying from 339 to 624. The Total hardness (TH) values groundwater samples are found in between 212 to 317 mg/l which found higher than desirable limit but lesser than the permissible limit. Total alkalinity (TA) as $CaCO_3$ in groundwater ranges from 215 to 312 mg/l.TH went from 212 to 317 mg/l. As indicated by the classification of Durfor and Becker (1964) for Total Hardness of groundwater predominantly dispersed in the considered territory. All samples are comes in very hard category of water as all samples are greater than 180 mg/l.Ca^{2+} values in groundwater varies from 21 to 65 mg/l. The concentration of Mg^{2+} particles changed from 15 to 52 mg/l. Sample of GW3 exceed Mg^{2+} permissible limit of 50 mg/l. Na^+ in samples differed from 12 to 49 mg/l. The hazard posture because of high concentration of Na^+ to people that they may experience the ill effects of cardiovascular, renal and circulatory ailment. Cl^- particle abundance in water is demonstrates the file of contamination and considered with respect to groundwater sullying. Cl^- in the groundwater found in range of 15 mg/l to 35 mg/l. The contamination hotspots for Cl^- may be because of the residential effluents, manures, and leachates. The nitrate fixation was additionally inside as far as possible (45 mg/L) in all the testing areas yet higher most importantly in area 1 (GW1) and range between 23 to 2.2 mg/l. The real source for nitrate in groundwater incorporate local sewage, spillover from agrarian fields, and leachate from landfill destinations higher concentration of NO_3^- in water causes an illness called "Methaemoglobinaemia" otherwise called "Blue-child Syndrome". This sickness especially influences babies that are up to a half year old. The SO_4^{2-} concentration in samples is within permissible values of BIS and WHO guidelines for all the gathered examples range between 43 to 4 mg/l. The concentration of F^- in the gathered water tests ran from 0.6 to 1.2 mg/l. F^- concentration up to 1mg/l is necessary for development of teeth but more than it may causes dental fluorosis and more than 1.5 mg/l causes skeleton fluorosis.Cadmium concentrationin all groundwater samples is below detection limit. But the concentration Chromium Hexavalent ion is exceed the permissible limit in groundwater sample in 2 location GW1 and GW2 as 0.15 and 0.12 mg/l respectively as the permissible of chromium hexavalent is 0.05 mg/l.



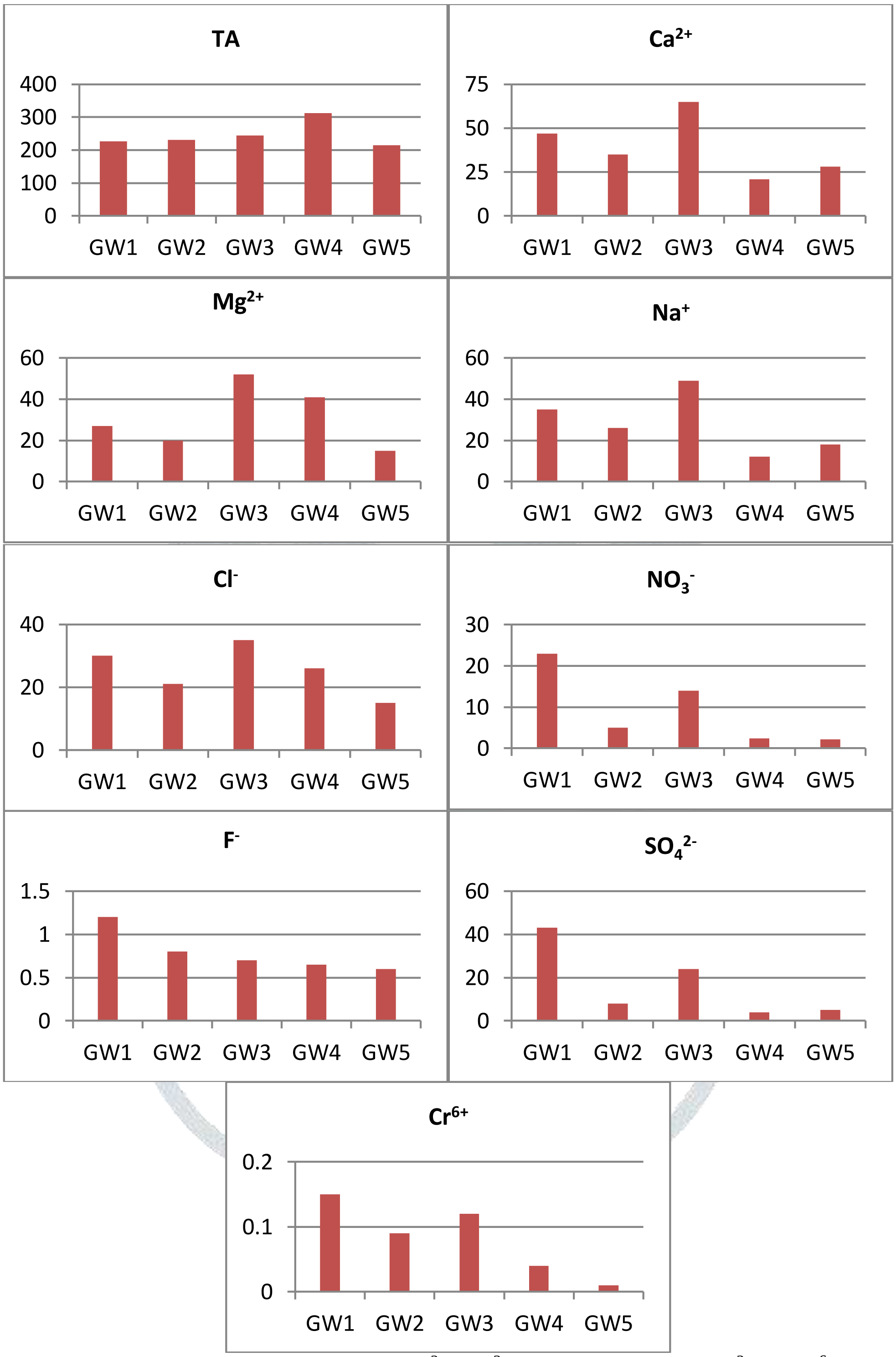


Fig. 2. Concentration of pH, EC, TDS, TH, TA, Ca^{2+}, Mg^{2+}, Na^{+}, Cl^{-}, NO_3^{-} F^{-}, SO_4^{2-} and Cr^{6+}groundwater.

4.2 MICROBIOLOGICAL EXAMINATION

Table 3: Microbiological analysis of water

Samples	Combinations of positive	Total coliform (MPN index/ 100ml)
GW1	3-1-0	11
GW2	2-0-1	7
GW3	1-0-1	4
GW4	0-0-0	<0
GW5	0-0-0	<0

Table 3 exhibits the present of coliform in 3 samples, demonstrating the sullying of groundwater maybe due to leachate permeation in groundwater. The GW1 test demonstrate the greatest number of total coliform 11 while at the same time GW2 and GW3 samples indicates 7 and 4 separately. The coliform microorganisms can increment when leachate enters in an oxygenated system.

4.3 WATER QUALITY INDEX (WQI)

Water quality index of groundwater samples is calculated on the basis of parameters pH, TDS, TH, TA, Ca^{2+}, Mg^{2+}, Na^{+}, Cl^{-}, NO_3^{-}, $SO_4^{2-}$and F^{-}. From Table 4 quality GW1 is 108.07 which come in category of unfit for drink as described in Table 5. Quality GW2, GW3, GW4 and GW5 come in category of very poor, poor, poor and poor,respectively.

Table 4: Water Quality Index of groundwater samples

Samples	pH	TDS	TH	TA	Ca^{2+}	Mg^{2+}	Na^{+}	Cl^{-}	NO_3^{-}	SO_4^{2-}	F^{-}	WQI
GW 1	7.5	339	286	226	47	27	35	30	23	43	1.2	108.07
GW 2	7.3	318	231	200	35	20	26	21	5	8	0.8	80.17
GW 3	7.6	624	245	213	65	52	49	35	14	24	0.7	66.65
GW 4	7.2	525	312	247	21	41	12	26	2.4	4	0.65	60.68
GW 5	7.5	348	215	196	28	15	18	15	2.2	5	0.6	55.88

Table 5: Water quality index categories

Location	WQI	Category of water
GW1	108.07	UNFIT FOR DRINKING
GW2	80.17	VERY POOR
GW3	66.65	POOR
GW4	60.68	POOR
GW5	55.88	POOR

Table 6: parameters wise standards and their assigned weight.

Parameter	**BIS standard**	**Assigned unit wt**
pH	8.5	0.09743
TDS	500	0.00166
TH	300	0.00276
TA	150	0.00552
Calcium	75	0.01104
Magnesium	30	0.0276
Cl-	250	0.00331
Nitrate	45	0.0184
Sulphate	200	0.00414
F-	1	0.082813

5. CONCLUSION

From the analysis it is clear that quality of groundwater is being deteriorated around the Municipal open dumping landfill. Mg^{2+}, $F^{-}$and Cr^{6+}exceeds their respective permissible limit in groundwater samples. Water Quality Index of groundwater samples indicates that quality of water is unfit for drink in GW1 sample and very poor in GW2 sample and poor in GW3, GW4 and GW5.Despite the fact that, the concentration of some of contaminants don't surpass drinking water standard even then groundwater quality speak to a significant danger to public health. The study demands the proper municipal waste management practices.

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