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Research

Assessment of Leachate Impact on Ground Water and Soil Quality Near Kasabe Digraj Dumping Site, Sangli, Maharashtra, India

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Abstract: Based on population Maharashtra ranks first in urbanization among the all-major states in the country. Sangli city ranks in top 20 major cities in Maharashtra in urbanization. As compare to rural population the requirement of urban population is also a wide range of needs like clean water supply, sewerage and solid waste management etc. In most urban areas, the strong waste is dumped in open dumps without appropriate coating which influences the ecological media, for example, air, water and land. Along these lines, the present examination was centered around the effect of leachate permeation on ground water quality and soil quality. Leachate, soil and ground water samples were collected from Kasabe Digraj site and the surrounding areas of within 1.5 Km radius. The concentration of pH, EC, TDS, TH, Cl^-, SO_4^{2-}, NO_3^- and heavy metals is high in the sampling site near to the dumping yard. The high concentration of these chemical parameters and heavy metals reveals that there is a ground water and soil contamination from leachate percolation in the study area.

Keywords: Solid Waste, Landfill, Kasabe Digraj Dumping site, Leachate percolation, Water Quality.

1. INTRODUCTION

One of the most significant emergency looked by numerous individuals of the urban and modern territories in both developed and under developing nations is strong waste generation issue in day today life. Large amount of solid waste is generated every day and its management is a huge and critical task. Solid waste age has seen an expanding pattern corresponding to the advancement of industrialization, urbanization and fast development of populace. The solid waste administration envelops everything from assortment, transportation and removal of waste. Before, overseeing solid waste include shipping waste from urban areas to inaccessible spots for dumping and for the nature to fare thee well (Eshanthini P and Padmini.T. K). Be that as it may, today, the expanding land esteem, deficient space, constrained limit of nature to deal with undesirable emanations and deposits present long haul ecological and human medical issues. Unrestricted open dumping is normally predominant in most under developing nations as it is the least difficult and most practical strategy for squander removal. This training is likewise embraced in the developed nations somewhat. Hence, it urgently needs prompt move to be made to limit the related hurtful effect. Sangli has additionally seen exceptional development of populace and urbanization in the previous two decades. Because of rapid urbanization, the generation of solid waste is increased and also it affect the groundwater and soil quality (E. Khazaei, R. Mackay). In the present study the effects of leachate percolation on groundwater and soil were analyzed an unlined landfill at Kasabe Digraj, Sangli, Maharashtra. The physiochemical and substantial metal fixation were tried from the gathered leachate and groundwater tests. The impact of profundity and separation of landfill from groundwater were considered and healing measures were recommended to keep away from future defilement by leachate permeation.

Leachate is created by virtue of the penetration of water into dumpsites and its permeation through waste just as by the pressing of the loss because of self weight. Water that infiltrates into landfill gets the solvent constituents from the squanders and may enter either the ground water or the surface water and consequently go about as a vehicle, conveying conceivably dangerous issue landfill to the surface and subsurface water sources. The significant components that impact leachate quality are squander creation, slipped by time, temperature, dampness and accessible oxygen (Nitin Kamboj and Mohrana Choudhari). As a rule, leachate nature of a similar waste sort might be distinctive in landfills situated in various climatic locales. Dumpsite operational practices likewise impact the leachate quality.

Critical amount of leachate is created from the dynamic periods of a landfill under activity during the rainstorm season. Leachates which develop out of the dumpsite permeate down to the spring (Benze D., 1997). Portrayal of the leachate is essential in the evaluation of ground water sullying close to removal destinations.

The accompanying chief gatherings are contained in leachate. Inorganic large scale parts: calcium, magnesium, sodium, potassium, ammonium, iron, manganese, chloride, sulfate and bicarbonate. Disintegrated natural issue communicated as COD, Complete natural carbon and including methane and unstable unsaturated fats.

2. STUDY AREA:

The Sangli region is arranged in the Southern piece of Maharashtra and is a division of Deccan plateau. Kasabe Digraj dumpsite 16.879 N, 74.522 E in the North West part of Sangli Corporation city is growing at much faster rate. The total area covered by landfill site is about 100 acres. The area mainly covered by black cotton soil of recent age. Compact Basalt is the prime rock type of the study area. The Deccan lava streams are found for the most part as evenly had relations with sheets. They are pretty much uniform in organization comparing to basalt. In shading Deccan lava streams are dull dark or greenish dim. At several places it is dissected by horizontal and vertical joints. These joints are responsible for percolation of leachate to greater depth up to water table level of the area.

The average dark soil is found in certain pieces of the Sangli locale especially the waterway valley region. A gathering of magma is a fundamental organization and wealthy in aluminous and ferromagnesian mixes. Figure 1 reflects the study area map.

3. SAMPLING OF LEACHATE, GROUNDWATER AND SOIL:

The groundwater samples were collected from 10 dug wells and 05 bore wells around Kasabe Digraj dumpsite during the month of March. In order to study the groundwater quality in Kasabe Digraj area groundwater samples were collected during pre- monsoon season (March 2020). Soil samples were taken away from all sides of dumpsite at a profundity of between 0 to 15cm utilizing a dirt twist drill. The tests were moved to a plate for homogenizing previously putting away in test sacks.

The well location coordinates were recorded by using hand held Garmin GPS. Figure 2 shows the sample location map around Kasabe Digraj dump area. The samples were collected in a clean polyethylene bottles. Before sample collection, the bottles were cleaned carefully with 1% Nitric acid and all the collected samples were analyzed (APHA, 2005).

4. SURFACE LEACHATE CHRACTERIZATION

Leachate emerge because of the penetration of precipitation to the inside of landfills, and yet water present in the squanders and discharged in various procedures occurring in a landfill additionally adds to the age of leachate. There are a few elements influencing the synthesis of leachate and their creation.

The results of physico-chemical characterization are presented in Table-1. The pH values of the leachate samples were significantly slightly alkaline. The value of pH represents the biological stabilization of the organic components. The average concentrations of EC (35558.5 µS/cm) and TDS (27695 mg/l) of the collected leachate samples were high.

The high concentration of Fe and Zn indicates the presence of Iron and batteries in the leachate (Bendz D and et.al). The leachate samples also having small amount of Pb, Cr, Cd and Cu. In the present investigation, the variety in various parameters qualities might be ascribed to the variances in squander type also, attributes, the nonappearance of waste destroying before removal, compaction of the waste which hinders debasement, and land filling meteorological conditions, for example, temperature and pressure.

Contamination Of Water

Based on models like WHO (2011) and BIS (2009), the groundwater quality can be resolved for its appropriateness for various purposes. The scopes of substance parameters and their correlation with the WHO and the BIS models were readied (Table 2). The scope of pH of the groundwater tests is from 7.77 to 8.82. A normal estimation of pH is 7.9. The outcomes show that most of the groundwater tests are basic in nature.

TDS speaks to the different sorts of minerals present in water in disintegrated structure. All TDS samples of the groundwater fluctuate from 1203 to 1810 mg/l with a average estimation of 1505 mg/l. All 100% groundwater samples exceeds WHO and BIS acceptible limit 500 mg/l. The groundwater classification dependent on TDS is available in Table 2. TDS influences water supply framework (scaling), inordinate cleanser utilization, calcification of courses, may cause urinary solidifications, illnesses of kidney or bladder and stomach issue (Etteieb, 2017). The bounty of cations is for the most part in the request $Na^+ > Mg_2^+ > Ca_2^+ > K^+$ for all samples.

The Na^+ ion fixations extend from 233 to 549 mg/l with a average value 391 mg/l. 80% groundwater samples exceeds acceptable limit (250 mg/l) The higher centralization of sodium in the groundwater might be a result of cation trade response and abundance utilization of manures in farming exercises. In spite of the fact that there is a relationship among hypertension and certain ailments, for example, coronary illness, hereditary contrasts in helplessness, perhaps defensive minerals (K^+ and Ca^+), and methodological shortcomings in tests make it hard to evaluate the relationship, and sodium in drinking-water for the most part makes just a little commitment to add up to dietary sodium. No firm ends can in this way be attracted at present with regards to the significance of sodium in drinking-water and its conceivable relationship with infection. Be that as it may, sodium may influence the flavor of drinking-water at levels above around 250 mg/l.

The calcium concentration ranges from 82 mg/l to 160 mg/l with a average value of 121 mg/l. The magnesium contain in ground water are from 84 mg/l to 272 mg/l with a average concentration of 178 mg/l. High centralization of calcium and magnesium in the groundwater might be because of the enduring followed by dissolving of minerals from basalt. The convergence of potassium in the groundwater is 67 mg/l to 115mg/l with average concentration of 91 mg/l. Purpose behind the expansion of potassium esteems in groundwater is may the drainage of unnecessary potassium manures into utilized in the rural fields in the investigation territory.

The chloride contain in the groundwater is ranging from 356 mg/l to 782 mg/l with average concentration 569 mg/l. The wellspring of chloride in the groundwater is both the normal and anthropogenic procedures like overflow containing inorganic composts, creature takes care of, water system seepage and so forth (O'Brien, 2002). The sulfate fixation in the groundwater ranges from 144 mg/l to 274 mg/l with a normal of 209 mg/l. The expansion of sulfate is chiefly by the impact of rural exercises. The hardness of the groundwater might be because of the permeation of broke up calcium and magnesium particles into groundwater. The grouping of the groundwater dependent on hardness is introduced in Table 2.

The F^- concentration in the collected water samples extended from 1.46 to 5.67 mg/l. All ground water samples are beyond the limit of WHO & BIS. F-at low fixation (~1 mg/l) in drinking water has been viewed as advantageous however high focus may causes dental fluorosis (tooth mottling) and all the more truly skeletal fluorosis (Ravindra and Garg, 2005). The convergence of NO_3^- in water test ranging from 42.9 to 118.7 mg/1 (Table 2). Jawad et.al. (1998), have likewise revealed increment in NO_3^- fixation in groundwater because of wastewater dumped at the removal site and likely show the effect of leachate.

The outcomes demonstrated that the observing ground water samples had higher Electrical Conductivity 2027 µS/cm to 2965 µS/cm. High conductivity might be because of the nearness of landfill leachate in wells situated close to the site and natural quality delivered by it.

Heavy Metals:

The groundwater tests were examined for heavy metal, for example, Cu, Fe and Zn, which are described as unwanted metals in drinking water. Just Fe and Zn demonstrated their quality in groundwater tests over the limit of the present systematic strategy. Cu contain in the ground water ranging from 0.67 to 0.84 mg/l. Nearness of Fe in water can prompt difference in shade of groundwater (Rowe et al., 1995). The convergence of Zn shifted from 0.37to 0.69 mg /1.

Be that as it may, once the leachate leaves the site the circumstance changes. The leachate is commonly an emphatically diminishing fluid framed under methanogenic conditions and on coming into contact with spring materials can decrease sorbed overwhelming metals in the spring lattice. Thus the centralization of these segments increments under good conditions near a landfill and may prompt a genuine lethal hazard.

Hydrogeochemical processes: The geochemical nature of the groundwater of the study area is specifying by plotting ionic concentrations in Piper diagram (Piper, 1944). With the help of Piper diagram (Figure 3). it is observed that the alkaline earth elements (Ca^{+2}+Mg^{2+}) exceed the alkali elements ($Na^+ + K^+$). Also strong acids ($SO_4^{2-} + Cl^-$) exceed the weak acids ($CO_3^{2-} + HCO_3^-$). The anion triangle shows that HCO_3^- is the dominating ion next with Cl^-. Sulphate ion is dominant at all places this may be due to maximum use of various chemical fertilizers in agriculture. In the cation triangle the majority of samples fall into Ca^{++} and Mg^{++} category.

5. IRRIGATION WATER QUALITY ANALYSIS :

The groundwater from the examination region is broadly utilized for water system. Because of the significance of agribusiness the assessment of water quality files are completed that climate the water is appropriate for water system or not. Nature of water is a significant thought in any evaluation of saltiness or soluble base conditions in an inundated region. Great quality water can possibly cause most extreme yield under great soil and water the board rehearses (Jain et al. 2012).

Electric Conductivity (EC): The estimation of EC is straightforwardly identified with the grouping of ionized substances in water and may likewise be identified with the issues of over the top hardness and other mineral pollution. Broken down solids present in characteristic water comprise predominantly of inorganic salts, for example, carbonates, bicarbonates, chlorides, sulfates, calcium, magnesium, sodium, potassium, and limited quantity of natural issue and disintegrated gases (Krishna Kumar et al., 2017). The appropriateness of groundwater dependent on EC is recommended in Table 3. Most extreme water tests from the examination zone demonstrated EC esteems higher than 700 µS/cm showing the nearness of saltiness dangers for those examples utilized for water system. This comes as indicated by FAO guidelines that order dangers in three classifications in the accompanying Table 3 (Ayers and Westcot, 1985). Thusly, salt aggregation in the root zone prompts yield decreases (Ezlit, 2010).

Sodium Absorption Ratio (SAR) :

The reasonableness of water for water system is principally relies upon SAR esteem. The SAR worth and saltiness of water ought to be considered for the best possible assessment of impact on water penetration into soil. SAR is a significant parameter for deciding the reasonableness of water for water system since it is a proportion of soluble base/sodium risk to crops. All in all, higher the sodium adsorption proportion, the less reasonable the water is for water system.

From **Table 4** it uncovers that SAR esteem ranges from 7.64 to 19.56 which demonstrate that groundwater from the investigation region is not appropriate for irrigation purpose. A large portion of the examples are having SAR values over 10 which mean high sodium water and quality is unsuitable for water system of a wide range of yields and a wide range of soils.

United States salinity laboratory (USSL) diagram : The geochemical parameters of the water tests are plotted in USSL outline (Saltiness risks versus Sodium Perils, USSL 1954). The sodium and saltiness perils are characterized into four zones in the USSL graph (Table 5). The plots of concoction information of the groundwater tests in the US Saltiness Lab's graph are delineated in Figure 4.

All the water samples falls in C3 to C4 class which implies saltiness risk is high to extremely high. Most definitely all examples were falls under S2 and S4 classification suggesting medium to very high sodicity (Figure 4).

Wilcox's Diagram: Wilcox's graph is utilized for the order of groundwater for water system, wherein the EC is plotted against % Na. Information of pre- and post-rainstorm groundwater tests of the region is plotted in the Wilcox's graph (Figure 5). All ground water samples are in doubtful to unsuitable class.

The agrarian yields are commonly low in lands flooded with waters having a place with dubious to inadmissible classification. This is most likely because of the nearness of abundance sodium salts (Figure 5), which cause osmotic impacts on soil-plant framework.

Permeability Index (PI) : Soil penetrability is influenced by long haul utilization of water system water with high salt substance as affected by sodium, calcium, magnesium and bicarbonate substance of the dirt (Singh et. al., 2015). The penetrability record esteems additionally shows the reasonableness of groundwater for water system. The PI is determined with the assistance of following equation

$$\mathrm{PI} = \left[\frac{\mathrm{Na^{+}} + \sqrt{\mathrm{HCO3^{--}}}}{\mathrm{Ca^{++}} + \mathrm{Mg^{++}} + \mathrm{Na^{+}}}\right] \mathrm{X100}$$

According to PI values, the groundwater of the study area in most of the stations falls under Class I and Class II (excellent to moderate category).

Kellys Ratio (KR): The centralization of sodium, calcium and magnesium in water are speaks to the soluble base peril. The estimations of KR < 1 show great quality water for water system and > 1 demonstrate terrible water (Kelly, 1940). The estimations of KR in the present investigation are ranging from 0.80 to 2.79. Hence, as indicated by KR a large portion of water tests from study region were appropriate for irrigation system.

Sodium Percentage (Na%): Sodium is a significant particle utilized for the characterization of water system water because of its response with soil, diminishes its porousness. Sodium is normally communicated regarding percent sodium or solvent sodium rate (Na%). Level of Na^{+} is generally utilized for evaluating the reasonableness of water for water system purposes (Wilcox, 1955). The Na% is figured as for relative extent of cations present in water

$$\mathrm{Na}\,\% = \left[\frac{\mathrm{Na^{+}} + \mathrm{K^{+}}}{\mathrm{Ca^{++}} + \mathrm{Mg^{++}} + \mathrm{Na^{+}} + \mathrm{K^{+}}}\right] \mathrm{X}\,100$$

For water system reason, the level of sodium is significant, in light of the fact that sodium responds with soil to lessen penetrability. The dissolvable sodium rate or sodium content is communicated as far as level of sodium. % Na ranges from 51% to 76%.

Residual Sodium Carbonate (RSC): The overabundance total of CO_3 and HCO_3 in groundwater over the aggregate of Ca and Mg additionally impacts the appropriateness of it for water system. At the point when the abundance carbonate fixation turns out to be excessively high, the carbonate consolidates with Ca and Mg to shape strong materials which settles out of the water. The overall bounty of Na regarding basic earths and the amount of HCO_3 and CO_3 in overabundance of soluble earths likewise impact the appropriateness of water for water system. RSC is a significant parameter to assess the reasonableness of water system water (Raju et. al., 2009), determined utilizing the formula

$$\mathrm{RSC} = (\mathrm{HCO_3^{-}} + \mathrm{CO_3^{--}}) - (\mathrm{Ca^{++}} + \mathrm{Mg^{++}})$$

According to Eaton (1950), on the basis of RSC the water is divided into three categories i.e., good (RCS <1.25 meq/l), medium (RSC: 1.25 to 2.50 meq/l) and bad (RSC >2.50 meq/l). Continues use of waters having RSC more than 2.5 meq/l leads to salt build up which may hinder the air and water movement by clogging the soil pores and lead to degradation of the physical condition of soil. According to this classification only one sample falls in bad category. From the observed values ground water samples are suitable for irrigation purposes.

Magnesium Absorption Ratio (MAR): For the most part Ca and Mg keep up a condition of balance in many ground water samples. During balance, more Mg in groundwater will antagonistically influence the dirt quality by diminishing harvest yield. Blemish is determined utilizing the equation

$$MAR = Mg \times 100/(Ca + Mg)$$

Abundance of magnesium in the dirt effectively influences the harvest yield. MAR >50 is viewed as destructive and inadmissible for irrigation system purposes. About 50% ground water samples are not suitable for irrigation purpose. High magnesium proportion might be because of the section of surface water and subsurface water through limestone, Kankar and stone arrangement in the examination zone (Pandian, 2007).

Potential salinity

Doneen (1964) clarified that the appropriateness of water for water system isn't subject to dissolvable salts. Since, the low dissolvability salts encourage in the dirt and amass with each progressive water system, the grouping of profoundly solvent salts increment the dirt saltiness. Potential saltiness is characterized as the chloride fixation in addition to half of the sulfate focus as appeared underneath:

$$P.\,S. = Cl + \tfrac{1}{2}\,SO4$$

The potential salinity of the water samples are from 4.45 to 8.62 meq/1. It proposes that the potential saltiness in the groundwater of the examined territory about is high, subsequently, making the water inadmissible for water system utilization. High estimations of potential saltiness in the zone can be credited to high sulfate content got from the lead mining, the significant mineral mined in the contemplated territory (Nagarjuna A., 2014).

6. SOIL ANALYSIS:

Soil pH is critical on the deterioration of mineral and rocks into basic components that plants can utilize. The examples were fundamentally not the same as one another. The pH of soil samples of study area is ranging from 7.58 to 8.51 (Table 6). The alkaline nature of the waste examples gathered from the dumpsite and away from the dumping action demonstrated expanding pH level which is all the time experienced at landfills maturing 10 years after removal [El-fadel et al. 2002]. The expansion in soil pH diminishes the dirt miniaturized scale supplement accessibility to the plants. While both of the outrageous pH conditions can influence the endurance of plants which must be changed for explicit harvests.

The investigation distinguished that the waste examples both at the dumpsite and the control site are over the passable range which is dangerous to plants and may keep them from getting water from soil [Goswami and Sarma 2008]. The dirt natural carbon recorded at the dumpsite was lower than that of the control and it was unimportantly not quite the same as one another. The higher incentive at the dumpsite was because of deterioration of natural issue. The all out nitrogen was higher at the control site than at the dumpsite. The phosphorus content at dumpsite was higher than the control. The high phosphorus content recorded in dump site soil could be credited to high natural issue found in dump soil [Soheil et al. 2012]. In spite of the fact that potassium is a dirt supplement supportive for the plant development the anthropogenic exercises could bring about increment in the potassium levels which is wellspring of groundwater pollution. Interchangeable bases (Ca, K, Mg and Na) where for the most part brought down at the dumpsite and they were essentially not quite the same as one another aside from Ca which was unimportant. The grouping of chloride in control soil was seen as significantly less than that of the dumpsite. The complete hardness of the control test was seen as a lot higher than the hardness of the contaminated samples. There is a slight increment in the hardness of the dirt samples; this might be credited to the expanding calcium fixation in leachate.

The mean of soil physical and synthetic properties for tests taken from the two destinations (dumpsite and control site) are introduced in table I. Soil tests from the two destinations were antacid. The absolute natural carbon and complete nitrogen were higher at the control site than at the dumpsite. Accessible P and electrical conductivity were higher at the dumpsite than the control site. The Ca, K, Mg, Na and absolute hardness were all commonly higher at the control site than the dumpsite.

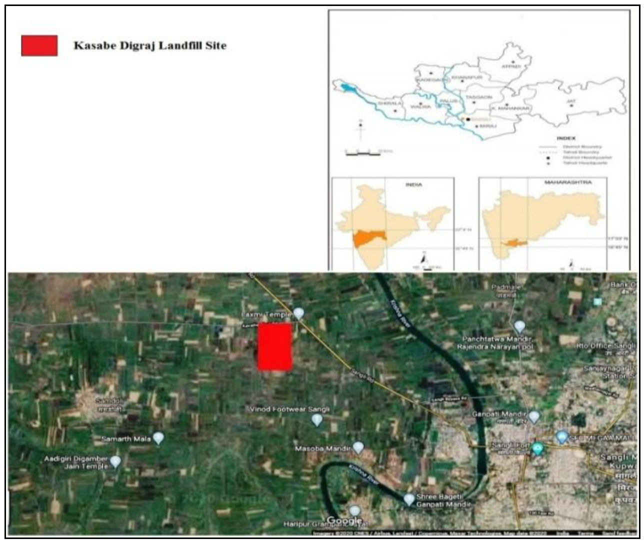

Figure 1 : Study Area Map of Kasabe Digraj Landfill site, Sangli district, MH, India

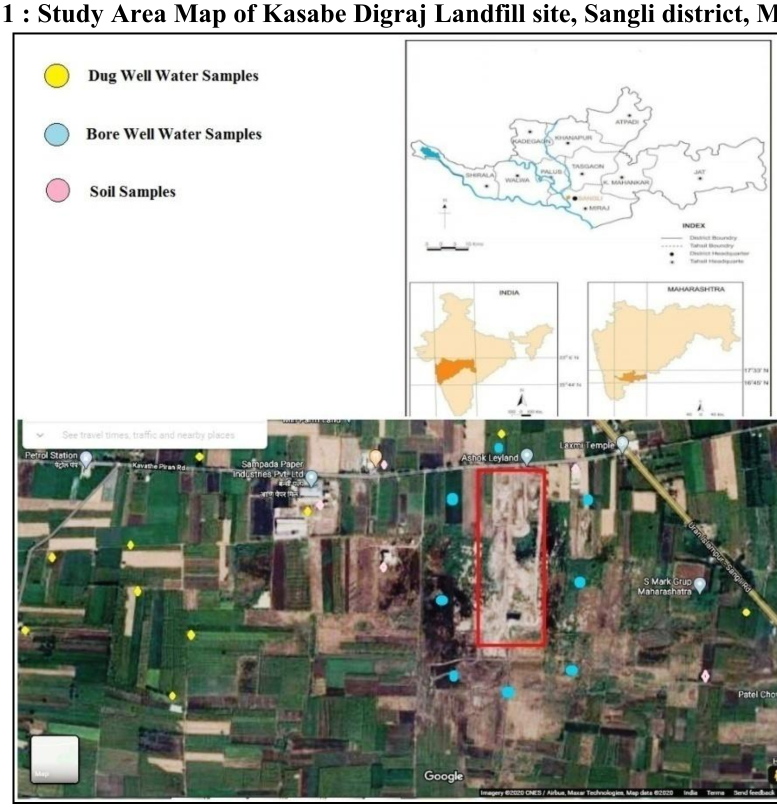

Figure 2 : Sample Location Map of Kasabe Digraj Landfill site, Sangli district, MH, India

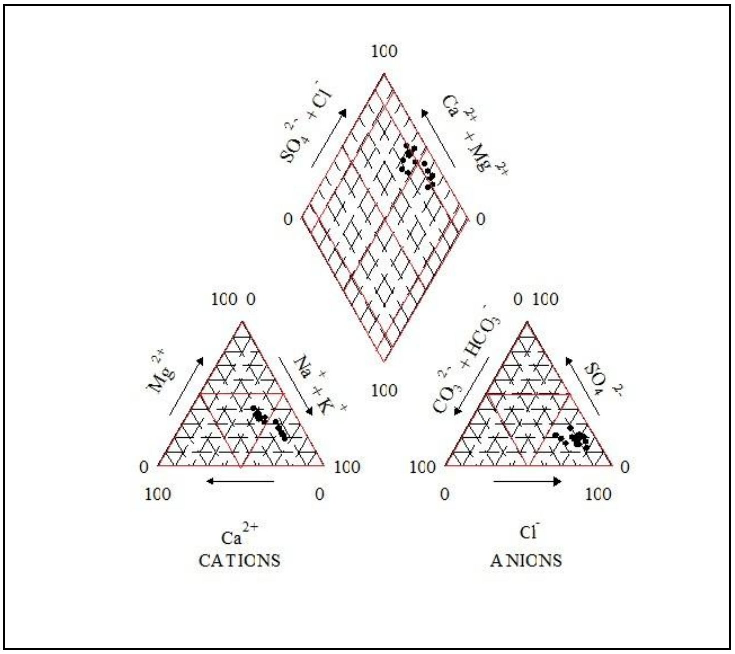

Figure 3 : Piper trilinear diagram showing hydrogeochemical facies of groundwater

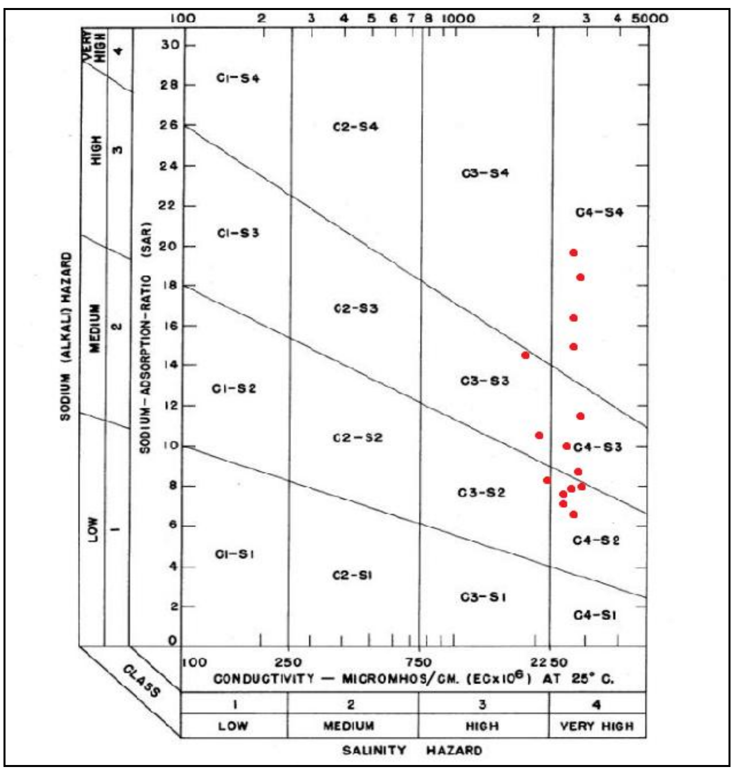

Figure 4 : Water quality ratings in relation to salinity and sodium hazard relationship plot (USSL Diagram 1954)

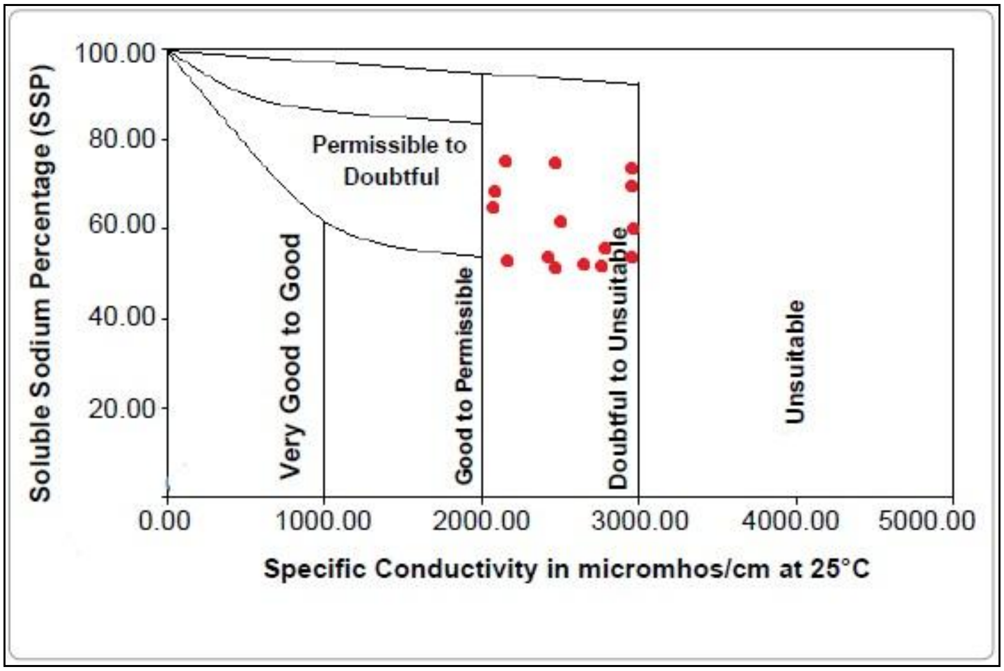

Figure 5 : Specific conductance and sodium percentage (Na %) relationship for rating of irrigation water quality (Wilcox 1955)

Figure 6: Polluted groundwater from dugwell in study area

Table 1. Physico-chemical characteristics of leachate at landfill sites

Parameters	Unit	Min	Max	Mean
pH		6.88	7.98	7.43
EC	µS/cm	30,260	40,857	35558.5

TDS	mg/l	25920	29470	27695
Chlorides	mg/l	9500	15250	12375
TSS	mg/l	3460	16375	9917.5
COD	mg/l	9700	14750	11725
BOD	mg/l	8890	13600	11745
Total Nitrogen	mg/l	390	980	685
Sulphate	mg/l	290	750	520
Phosphate	mg/l	305	725	515
Ca^+	mg/l	680	1450	1065
Mg^+	mg/l	740	1340	1040
Na^+	mg/l	360	870	765
K^+	mg/l	470	790	1280
$NH_4{}^+$	mg/l	475	1370	922.5
$NO_3{}^-$	mg/l	290	375	332.5
Phenol	mg/l	0.01	0.70	0.355
Fe	mg/l	75	90	82.5
Pb	mg/l	0.85	1.20	1.025
Zn	mg/l	2.5	2.87	2.685
Cu	mg/l	0.54	0.69	0.615
Cd	mg/l	0.03	0.08	0.055
Cr	mg/l	0.25	0.45	0.35

Table 2 : Statistical Summary of the Chemical Composition of Groundwater

Parameter	Minimum	Maximum	Average	Acceptable Limit (WHO, 2004) & (BIS, 2009)	No. 0f samples exceeding the limit	% of samples exceeding the limit
pH	7.77	8.82	8.3	6.5-8.5	11	73
EC	2027	2965	2496	1500	15	100
TDS	1203	1810	1505	500	15	100
CO_3^-	0	16	8	10	06	40
HCO_3^-	87.57	283.42	185.495	500	00	0
Cl^-	356	782	569	250	15	100
TH	510	860	685	200	15	100
Ca^{2+}	82	160	121	75	15	100
Mg^{2+}	84	272	178	30	15	100
Na^+	233	549	391	250	12	80
K^+	67	115	91	10	15	100
SO_4^{2-}	144	274	209	200	08	53
NO_3^-	42.9	118.7	80.8	45	12	80

NH_4^+	12.6	42.5	27.55	32.5	06	40
F^-	1.46	5.67	3.56	1.0	15	100
Cu	0.67	0.84	0.75	1.5	00	0
Zn	0.37	0.69	0.53	15	00	0

*All in mg/l except pH and EC (µmhos/cm)

Table 6 : Summary of Chemical Composition of soil

Location No	Depth (cm)	pH	Ca	Mg	Na	K	S	P	Cu	Fe	Zn	Clay%	Silt %	Sand %	Bulk Density
S 1	15	7.5	4170	1783	568.2	324	320	6.8	17	67.3	2.3	46	24	16	1.79
S 2	15	7.9	2250	2195	522.4	167	135	4.6	6.8	54.9	1.2	38	19	37	1.83
S 3	15	7.9	2653	2973	659.7	178	320	7.4	9.4	82.8	2.3	48	28	22	1.88
S 4	15	8.2	3422	1307	475.3	126	143	5.7	6.2	60.2	5.2	32	16	32	1.78
S 5	15	8.5	3823	1880	503.4	262	132	9.6	15.5	87.6	3.5	45	27	16	1.73

Table 3: Classification of Groundwater for Drinking, Irrigation Suitability and % of Samples Falling in Various Categories.

Category	Ranges	No. of Samples	% of Samples
Based on TDS (mg/l)			
Desirable for drinking	< 500	0	00
Permissible for drinking	500-1,000	0	00
Useful for irrigation	1,000-3,000	15	100
Unfit for drinking & irrigation	>3,000	0	00
Based on Total Hardness (mg/l)			
Soft	< 75	0	00
Moderately Hard	75-150	0	00
Hard	150-300	0	00
Very Hard	>300	15	100
Based on EC (µS/cm)			
Excellent	< 250	0	00
Good	250-750	0	00
Permissible	750-2250	03	20
Doubtful	2250-3000	12	80
Unsuitable	>3000	0	00
Based on Alkalinity Hazard (SAR)			
Excellent	< 10	07	46.6
Good	10-18	06	40.0
Doubtful	18-26	02	13.4
Unsuitable	>26	00	00
Residual Sodium Carbonates			

Safe for irrigation	< 1.25	15	100
Moderate for irrigation	1.25-2.5	00	00
Unsuitable for irrigation	>2.5	00	00

Table 4: Classification of groundwater quality for irrigation on the basis of SAR

Sr. No.	Types of water and SAR value	Quality	Suitability for irrigation	Sample Nos.	%
01	Low sodium water (S1) SAR value: 0–10	Excellent	Suitable for all types of crops and all types of soils, except for those crops, which are sensitive to sodium	07	46.6
02	Medium sodium water (S2) SAR value: 10–18	Good	Suitable for coarse textured or organic soil with good permeability. Relatively unsuitable in fine textured soils	06	40.0
03	High sodium water (S3) SAR value: 18–26	Fair	Harmful for almost all types of soil; Requires good drainage, high leaching gypsum addition	02	13.4
04	Very high sodium water (S4) SAR value: > 26	Poor	Unsuitable for Irrigation	00	00

Table 5: Classification of groundwater quality for irrigation on the USSL diagram

Sr. No.	USSL Classification	Water Class	Pre-monsoon Season	
			Sample Nos.	%
01	C1 – S1 C2 – S1 C3 – S1 C4 – S1	Excellent	00	00
02	C1 – S2 C2 – S2 C3 – S2 C4 – S2	Good	06	40
03	C1 – S3 C2 – S3 C3 – S3 C4 – S3	Fair	05	33
04	C1 – S4 C2 – S4 C3 – S4 C4 – S3	Poor	04	27

7. CONCLUSION

The concentration of pH, EC, TDS, TH, Cl^-, SO_4^{2-}, NO_3^- and heavy metals is high in the sampling site near to the dumping yard. The high concentration of these chemical parameters and heavy metals reveals that there is a ground water and soil contamination from leachate percolation in the study area.

It tends to be reasoned that Kasabe Digraj dumpsite is non-designed landfill. It is neither having any base liner nor any leachate assortment and treatment framework. Consequently, the leachate produced discovers its own way into the general condition. Additionally un-isolated waste dumped in unlined landfill had seriously influenced the groundwater quality. As the dumpsite is situated in the damp region, water stagnated during the time around the dumpsite encourages the age and development of leachate at higher rate. As the dumpsite is in activity for over few more years, further dumping may harm the spring to unrecoverable condition. It is important to the update the Landfill site and logical administration to forestall future pollution of groundwater and treatment of water for residential inventory. On the off chance that the dumping is halted quickly, the examination shows that the groundwater quality will get improved following a time of few decades by regular weakening.

Following studies should be made in detail while designing and operating future landfill sites in nearby areas.

1. Geological conditions
2. Geo-technical and hydraulic characters of the landfill site area
3. Chemical parameters of clay liner and drainage carpet material
4. Chemical composition, viscosity and other parameters of leachate
5. Shape and size of drainage carpet matrial
6. Swelling properties of clay liner
7. Maximize the age of landfill.

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