Estimation of Groundwater Quality in and Around Dumpsites of Cuddalore District, Tamil Nadu, India

N. Nagarajan, S. Sivaprakasam, K. Karthikeyan, P. Sivarajan

Abstract: ***Land filling of urban solid desecrate is a universal dissipate care and one of the economical technique for organizing waste in several parts of the globe. Landfill poses serious threats to the worth of the surroundings if imperfectly safe and indecently managed. The stages of different physicochemical parameters are investigated including Total Dissolved Solids (TDS), alkalinity, pH, Electrical Conductivity (EC), and hardness. The mixture of physical, chemical and microbial practice in the waste shifts the contaminant from the misuse matter to the percolating water. The study asses ground water quality of samples near the dumping area and characterized. The effects are evaluated with the world health organization (WHO) and Bureau of Indian Standard (BIS) index. Also attempt will be made by the aggregate index method to assess the excellence of ground water in Chidambaram and Cuddalore SIPCOT dumpsites.***

Keywords: Land filling, solid waste, Ground water, Total Dissolved Solids, Alkalinity, pH, Electrical Conductivity, Hardness.

I. INTRODUCTION

Huge quantity of solid waste formed in and around Cuddalore municipal region are deposited closer to SIPCOT and Chidambaram solid waste landfill site. This urban solid waste generally termed as “garbage” is a certain byproduct of person doings which is organized during dumping. Solid waste land filling is the ordinary method of solid waste disposal. The landfill sites closer to SIPCOT are open dumpsites, because the open dumpsites are little operating costs and require of skill and apparatus supply no systems for leachate gathering. Open dumps are unpleasant, unhygienic, and usually foul. They draw hunt animals, rats, insects, pigs and other pests. Surface water permeate during the waste can dissolve out or filter injurious substance that are then passed gone from the dumpsites in surface or subsurface runoff. Along with these chemicals heavy metals are mainly dangerous and guide to the occurrence of bioaccumulation and biomagnifications. These heavy metals may represent an ecological hitch, if the leachate travels into the ground water. The occurrences of bore well at the landfill sites to draw ground water warn to pollute the ground water**.**

Revised Manuscript Received on June 27, 2020.

***** Correspondence Author

Dr. N. Nagarajan*, Associate Professor, Department of Civil Engineering, Faculty of Engineering and Technology, Annamalai University, Annamalai Nagar, Tamilnadu, India Email: nnrajan.au@gmail.com

Dr. S. Sivaprakasam, Associate Professor, Department of Civil Engineering, Faculty of Engineering and Technology, Annamalai University, Annamalai Nagar, Tamilnadu, India Email: sivacdm67@gmail.com

Dr. K. Karthikeyan, Associate Professor, Department of Civil Engineering, Faculty of Engineering and Technology, Annamalai University, Annamalai Nagar, Tamilnadu, India Email: srikrish.kkarthikeyan@gmail.com

Dr. P. Sivarajan, Associate Professor, Department of Civil Engineering, Faculty of Engineering and Technology, Annamalai University, Annamalai Nagar, Tamilnadu, India Email: sivarajan.au@gmail.com

A water pollutant is a chemical or physical material in it at the excessive levels accomplished of source injury to living organisms. The physical risks are the dissolved solids and suspended solids. The chemical dangers are the copper, manganese, lead, cadmium, phosphate, nitrate *etc*. As the public physical concern, the ground water should be free from physical and chemical risk. The people in and around the removal site are depending upon the ground water for drinking and other household utility. The soil pollution occur due to the leaching of wastes from landfills and the most general contaminant occupied is the metals like copper, lead, cadmium, mercury etc., The pollution of ground water and soil is the major ecological hazard allied to dirty land filling of solid waste.

II. EXPERIMENTAL ANALYSIS

Ground water samples collected from the dumpsites in and around Chidambaram municipality and SIPCOT Cuddalore. Collected samples from the sites are show in the maps. The trials were analysis for different physical, chemical and biological factors using Standard Method.

1. pH
2. Electrical conductivity
3. Total dissolved solids
4. Total suspended solids
5. Total hardness

III. STUDY AREA

The study area contains water contamination by the leach out of risks from the solid waste. The soil and water gathering in SIPCOT is located at Cuddalore SIPCOT and Chidambaram. Land filling dumpsite is enclosed by inhabited areas in which they are heavily influenced by equally soil and from the SIPCOT and Chidambaram which is closer to the solid waste dumpsite. W1, W2… W12 are the water samples collected in SIPCOT nearer to Cuddalore and Chidambaram landfill dumping site. S1, S2, S3…S12 are the soil trial collected in the same landfill dumping site. SW1, SW2, SW3 and SW4 are the solid waste trial collected in the same landfill dumping site.

Fig. 1 SIPCOT dump site

A. Sampling and Methodology

The Preliminary study on the quality of ground water, soil and solid waste test was performed in the month of **January 2019**, as the ground water and soil gets contaminated due to solid waste dumping closer to the locality.

B. Soil Samples

Sample collection, preservation and analysis were done as per the usual technique. The study of soil was done using hand augur. The samples were gathered directly from the augur.

Fig.2 Soil sample collected from dump site

C. Water

Sample gathering, protection and study were done as per the usual technique. Water trials were taken at every location.

Fig. 3 groundwater sample

D. Laboratory Analysis

The two location supply of analytical limitation such as physical parameters and metals and the study is done as per the standard technique.

E. Chidambaram

Solid waste trials were accumulated from the location in Chidambaram to know water quality and its fitness. Geologically, the region consists of mio-pliocene sedimentary structure and geomorphologically alluvial plain and pediplain. The parameters of pH, Electrical conductivity (EC), Total Dissolved Solids (TDS) in solid waste from 7.5 to 7.9, 870 micromhos/cm to 990 micromhos/cm and 556.8 mg/l to 633.6 mg/l are respectively.

Fig. 4 Solid waste dump site

The review exposes that canal and groundwater have gone beyond the enviable border of WHO for drinking purpose in exact place. The considered significance of SAR, RSC, Cl classification, Na% and CR in both the canal and groundwater is favouring for irrigation performances. It can be used for household and drinking after the effect of easy cleaning processes. The manure and human ravage, irrigational arrival water is the supply for the canal water spot whereas termination and ionic exchange are for the groundwater.

F. CHIDAMBARAM

Fig. 5 Chidambaram Location map

G. SIPCOT- Cuddalore

SIPCOT industries have contaminated the area around the Cuddalore chemical manufacturing area for the last 20 years. While, the Tamilnadu Pollution Control Board (TNPCB) and the industries maintain that the situation has better extraordinarily over the last decade, neither suggest even a slice of controlled proof to back their assert. There are no time trend data on the status of pollution over the last 10 years.

H. Cuddalore SIPCOT

Fig. 6 Cuddalore SIPCOT location map

IV. RESULTS AND DISCUSSION

The Physical, Chemical, Biological parameters and dissolved nutrients determined are given in Table 1 and 2. The sample Union-1 (C1 – C12) represent the water sample collected very close to the dumpsites within 2 Km. Union-2 (S1 – S12) represent the water sample collected from the location near from the SIPCOT unit at Cuddalore.

Table I Number of the dumpsites

Sl. NO	Name of the Dumpsite	Depth of the Sample In 'Feet'	Distance from Factory in 'M'	Source of Sample
1.	Chidambaram	75	50	TAP WATER(1)
2.	Chidambaram	100	65	TAPE WATER (2)
3.	Chidambaram	88	100	HAND PUMP WATER (1)
4.	Chidambaram	10	10	SURFACE WATER (1)
5.	Chidambaram	95	105	HAND PUMP (2)
6.	Chidambaram	130	200	HAND PUMP WATER (3)
7.	Chidambaram	112	150	BORE WATER (1)
8.	Chidambaram	170	315	BORE WATER (2)
9.	Chidambaram	355	950	TAP WATER (3)
10.	Chidambaram	07	800	SURFACE WATER (2)
11.	Chidambaram	30	2600	TAP WATER(4)
12.	Chidambaram	20	3000	TAP WATER (5)
13.	SIPCOT	70	270	TAP WATER
14.	SIPCOT	65	50	HAND PUMP(1)
15.	SIPCOT	120	200	BORE WATER(1)
16.	SIPCOT	30	480	WELL WATER
17.	SIPCOT	93	150	TAP WATER (2)
18.	SIPCOT	08	75	SURFACE WATER(1)
19.	SIPCOT	85	230	HAND PUMP(2)
20.	SIPCOT	140	900	TAP WATER(3)
21.	SIPCOT	10	450	SURFACE WATER(2)
22.	SIPCOT	15	1250	SURFACE WATER (3)
23.	SIPCOT	38	670	HAND PUMP(3)

Table II Samples In Chidambaram

Parameters	C1	C2	C3	C4	C5	C6	C7	C8	C9	C1	C1	C1
Temperatur	27.43	28.32	27.13	26.39	25.12	25.80	26.89	26.16	24.31	25.17	25.32	26.83
pH	7.61	7.02	7.58	8.6	7.2	7.1	8.4	7.5	7.5	8.7	7.5	7.1
Turbidity	5.3	4.8	6.1	3.0	2.0	5.3	3.9	5.5	5.2	4.8	5	6.0
EC(µs/cm)	925	80	823	876	560	900	756	950	743	820	898	890
TDS(mg/l)	803	75	840	1853	550	862	1762	863	751	1854	831	815
TSS (mg/l)	70	40	36	29	39	65	40	66	54	39	40	50
TS (mg/l)	903	80	823	900	550	923	796	968	813	911	835	825
TA (mg/l)	153	15	114	92	73	96	93	132	100	101	123	92
Cl^- (mg/l)	123	24	220	113	103	148	153	203	255	197	196	202
TH (mg/l)	289	29	273	266	143	165	197	250	232	199	209	220
Ca (mg/l)	123	25	145	203	97	180	135	201	213	195	143	170

Mg (mg/l)	62	43	35	60	53	39	72	61	55	40	42	50
DO (mg/l)	4.00	3.2	3.9	3.2	4.9	4.2	5.9	5.6	4.1	3.6	4.1	5.3
BOD (mg/l)	1.3	1.9	1.7	20.	3.8	2.3	14.	1.2	1.1	36	2.4	2.1
COD (mg/l)	9.2	5.7	2.8	40	9.4	23.	72.	8.9	13.	96.	11.	20.
NO_3^- (mg/l)	2.1	20.1	2.53	22.	6.9	51	5.3	7.0	3.1	4.7	ND	4.1
NO_2^- (mg/l)	0.41	0.45	0.32	0.1	0.2	0.4	0.3	0.3	0.0	0	0.2	0.3
F^- (mg/l)	0.8	0.2	0.15	1.0	0.5	0.6	1.2	0.3	0.5	1.0	0.9	0.8
PO_4^{3-}	0.01	0.7	0.05	0.1	0.0	0.2	0.3	0.0	ND	0.2	0.5	0.0
$SO4^-$ (mg/l)	9.2	6.3	3.0	9.2	11.	103	53	162	43	62	59	56
NH_4^+	1.3	1.5	1.1	2.9	1.8	4.0	1.1	2.8	3.5	1.2	1.5	3.2
Fe^{++} (mg/l)	0.1	0.8	0.6	0.1	0.2	0.3	0.2	0.1	0.5	0.3	0.2	0.2

Table III Samples In SIPCOT

Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Temperature	25.42	25.21	27.13	26.39	25.11	25.89	26.89	26.84	27.31	26.18	25.49	26.85
pH	7.81	7.02	7.85	8.61	7.23	8.11	7.43	7.59	7.68	8.77	7.52	6.03
Turbidity	6.00	4.20	5.90	3.20	2.10	5.70	4.10	6.20	5.70	5.20	5.10	5.00
EC(µs/cm)	952	814	865	902	571	912	794	959	751	869	853	902
TDS(mg/L)	896	790	837	1879	546	1874	756	907	1751	1869	852	807
TSS (mg/L)	75	36	42	31	41	69	47	71	65	52	49	63
TS (mg/L)	971	826	879	910	587	943	803	978	816	921	901	899
TA (mg/L)	189	167	121	98	76	101	113	198	129	106	103	114
Cl^- (mg/L)	140	285	213	109	121	148	169	252	278	201	210	235
TH (mg/L)	295	307	280	298	150	200	197	247	261	219	203	241
Ca (mg/L)	110	265	145	234	102	167	129	196	202	182	135	168
Mg (mg/L)	58	42	35	64	48	33	68	51	59	37	39	46
DO (mg/L)	4.12	3.90	4.01	3.91	5.13	4.97	6.29	6.23	4.57	4.08	4.15	5.35
BOD (mg/L)	1.30	1.90	1.70	22.30	3.80	68.50	1.40	1.20	39.00	43.80	2.40	2.10
COD (mg/L)	9.20	5.70	2.80	57.00	9.40	88.40	12.30	8.90	92.30	94.40	11.40	10.60
NO_3^- (mg/L)	2.10	ND	ND	22.10	6.90	54.00	ND	7.80	0.10	4.70	ND	4.30
NO_2^- (mg/L)	0.51	ND	ND	0.02	0.08	0.46	ND	ND	ND	0.03	0.21	0.15
F^- (mg/L)	1.10	0.20	0.10	0.50	ND	ND	0.70	ND	0.20	0.90	0.50	0.30
PO_4^{3-} (mg/L)	0.01	ND	ND	0.01	0.05	ND	ND	0.07	ND	0.02	ND	0.03
SO_4^- (mg/L)	11.20	6.00	2.90	8.10	12.70	122	46.00	171.00	49.00	78.00	63.00	56.00
NH_4^+ (mg/L)	ND	1.20	0.10	2.70	0.80	4.30	1.60	1.80	0.50	1.70	1.50	1.20
Fe^{++} (mg/L)	0.10	ND	ND	0.10	ND	0.30	0.20	0.10	ND	ND	0.20	0.20

- The range of pH values (7.10-8.70). But WHO recommended pH value is around 6.5 - 8.5. Most of the samples are within the permissible limit few samples are only in alkaline condition which may be due to the deposition of the waste from the dumpsites.
- The turbidity is within the tolerable limits.
- The permissible limit for Electrical Conductivity according to WHO standard 1400µscm^{-1} samples taken from Chidambaram and SIPCOT dumpsite is within the limits.
- Total Dissolved Solids from the samples C4, C7 and C10, S4,S6, S9 and S10 showed very high values, which are all taken from the surface water and increased values is due to impact of pollution. Other samples showed normal values.
- The results of Total Alkalinity are drastically increased irrespective of all samples C1 – C12 and S1 - S12 which showed that the concentration of alkalinity higher range.
- The BOD of the trials are mostly within the allowed constrains only three trials were slightly higher than the limits.
- COD values all so within the allowed constrains and only the surface and sub-surface water are slightly higher due to the contamination.
- The permissible limits of Chloride from 200-1000 mg/l and we got within the permissible range only the samples are fit for drinking and cooking purpose.
- The permissible limits according to the WHO standard 75-100 mg/l, but most of the samples are above limits. Hence the sample is need for treatment.

- The permissible limits 30-150 mg/l all the samples are in the allowed constrains. Such that Fluoride is also within the limits (1.5 mg/l). The concentration of fluoride at less level in ground water has been measured helpful but high concentration may cause dental and more dangerously skeletal fluorosis.
- All sample collected below 120 ft from there having desirable values. At the surface water such as pond, lake, river and well water only having higher concentration. So we are in a position to treat the water and reuse and also avoid dumping of waste and discharging untreated waste water near the coast.
- Some of the parameters showed higher range in the groundwater maybe due to the leachate of municipal solid waste.

V. CONCLUSION

Samples collected from the various spots (Union 1 and Union 2) around dump sites at Chidambaram and SIPCOT industry at Cuddalore of Tamilnadu State were analyzed for various Physical, Chemical and Biological parameters. Only few parameters of the Union 1 found more than permissible limits of various standards. The higher concentrations of ions and parameter values such as pH, EC, TDS, TA, TH, and COD have harmful and considerable impact on excellence of ground water as it is used for household purposes. Hence, the awareness may be given to the public not to drink the water which area all having higher concentrations.. However, the quality assessment of water samples showed the water quality of spots at Union 1 is superior to that of the spots of Union 2. After compared to WHO limits the water quality rating it reveals that the quality of water of few spots in Union 1 showed poor water quality, probably due to very close to dumpsite, the water samples were slightly polluted and in need off treatment before using for drinking purpose for minimizing of the parameters. The water samples of Union 2 showed average water quality. Hence the awareness should be given to the public not to drink the water without treatment in the Union-1 (spotC4, C10, C12) union-2 (spot S3, S8, S12). We recommended that they have to facilitate bore well for localities as part of municipal service as early as possible to guide against sudden condition of contamination in order to protect the wellbeing of public living in and around the area

REFERENCES

1. Abbasi, S.A. and Vinithan. S, Water quality in and around an industrialized suburb of Pondicherry. The Indian Journal of Environmental Sciences and Health, 1999, 41(4): 253-263.
2. APHA,(2000) Standard Method for examination of water and waste water American Public Health Association, Washington,DC.
3. Badmus, B.S. Leachate contamination effect on ground water exploration. African Journal of Environmental Studies, 2001, 2: 38-41.
4. Cocchi D. and Scagliarini. M, Modelling the Effect of Salinity on the Multivariate Distribution of Water Quality Index. Journal of Mathematics and Statistics 2005, 1(4): 268-272.
5. Dhere, A.M. Pawar, C.B. Pardeshi, P.B. and Patil, D.A. Municipal solid waste disposal in Pune city- An analysis of air and groundwater pollution. Current Science, 2008. 95(6): 774-777.

AUTHORS PROFILE

N. Nagarajan completed his ME (Water Resources Engineering and Management) in 2005 and PhD in Civil Engineering in Annamalai University, India awarded 2013. He is currently working as Associate Professor in Civil Engineering, Faculty of Engineering and Technology, Annamalai University, India. His research interests include surface and groundwater resources and management, watershed management, Remote Sensing and GIS. He has published 24 papers related to Water Resources Engineering in National and International seminars and journals.

S. Sivaprakasam received his Post Graduate Degree from Annamalai University, India in 2005. His field of Specialization is Water Resources Engineering and Management, and got his doctoral programme in Civil Engineering in 2014 and also working as Associate Professor in Civil Engineering, Faculty of Engineering and Technology, Annamalai University, India. . His broad area of research is Climate Change with emphasis on long-term variability in hydro-meteorological parameters, likely influence/impact on aspects of irrigation on a regional basin in the Indian context. He has published 20 research articles in International/National peer-reviewed Journals and 8 research articles in International/National Conferences. He is a life Member in Indian Association of Hydrologists (IAH), Indian Water Resources Society (IWRS) and Institution of Engineers (India).

K. Karthikeyan did his under graduate in Civil Engineering in 1997 and P.G in Water Resources Engineering and Management, 2005 and also PhD in Civil Engineering at Annamalai University, India, 2013. He is currently working as Associate Professor in Civil Engineering, Faculty of Engineering and Technology, Annamalai University, India. His present research interests include groundwater development and management, water resources management and building construction in Civil Engineering. He has published 21 papers related to water resources engineering in seminars and journals.

P. Sivarajan completed his ME (Water Resources Engineering and Management) in 2005 and PhD in Civil Engineering in Annamalai University, India. He is currently working as Associate Professor in Civil Engineering, Faculty of Engineering and Technology, Annamalai University, India. His research interests include Water Resources Engineering and Management, Environmental Engineering, Remote Sensing and GIS. He has published 21 papers related to Water Resources and Environmental Engineering in National and International seminars and journals.