A Study on Groundwater Quality around Ariyamangalam Dumping Site in Trichy

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***Abstract*– Questionnaire survey was conducted in the study area to know about the health impact due to leachate from solid waste dumping site. Totally 12 groundwater samples were collected around Ariyamangalam, Trichy. Physic-chemical analyses were carried out as per APHA procedure. Analyzed result were compared with BIS (IS 10500: 2012). Water quality index were calculated from the analyzed parameters. Statistical analysis such as correlation analysis was performed by using SPSS 17 software. Finally we suggest that to improve the treatment and final disposal of municipal solid waste while people have to be co-operated with local authorities to decrease the generation of solid waste and the closing of open dumps and the implementation of modern and environmentally safe landfills or alternatives to waste disposal.**

***Keywords* – Groundwater, Questionnaire survey, Physic-chemical parameter, Water quality index, Correlation analysis.**

I. INTRODUCTION

The growth of municipal solid waste generation in India has increased with population growth in recent years. Impact dumping and management of solid waste cause hazards to the ground water & inhabitant. The estimated MSW generation in Trichy city is about 400 to 600 tons per day, which is facilitated by an open dumping yard namely Ariyamangalam garbage ground. The dumping site is positioned at 10˚48'N and 78˚43'E. The ground altitude of the dumping site is 75.875m above Mean Sea Level (MSL). It covers a total surface area of 47.7 acres. The dumpsite is in poor condition as site is freely accessible and hence visited by rag pickers as well as assortment of animals. Figures show the description of dumping site. The City Corporation collects the waste daily in all wards during 6.30-10.30hrs and 14.30-17.30hrs.

II. STUDY AREA

Trichy is well known for its high Academic Institutions, continuous perennial water flow, and high monuments of major religions. This Corporation has earned first place in Sanitation among the cities in Tamil Nadu and sixth place among the cities in India. The present population of Municipal Corporation is 1,082,975 with total 70 wards.There are 1 International Airport and 4 Railway stations in the city. The town and its famous landmark called Rockfort Temple were built by the Nayaks ofMadurai. The other main landmarks are Sri Rangam, Cauvery River, Coleroon River.

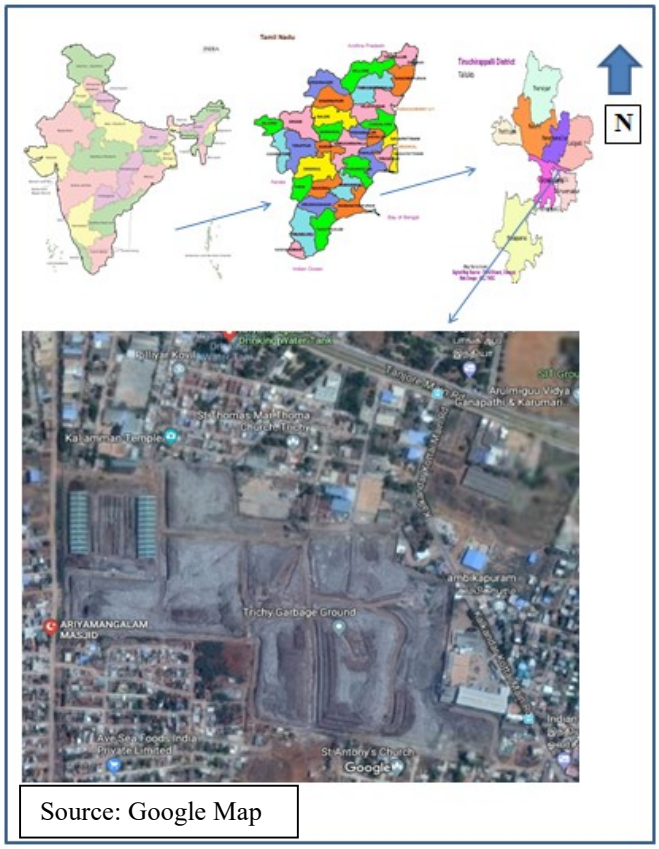


Fig. 1.Ariyamangalam dumping site, Trichy

III. MATERIAL AND METHODS

The main focus of the study is to analysis the ground water and assesses the ground water quality by using WQI and Statistical analysis. To achieve this objective, the study employs a framework of methodology illustrated in figure 4.1. The following excerpts outlines the methods entailed in the selection of study area, data acquisition, computation of results and analysis of key findings.

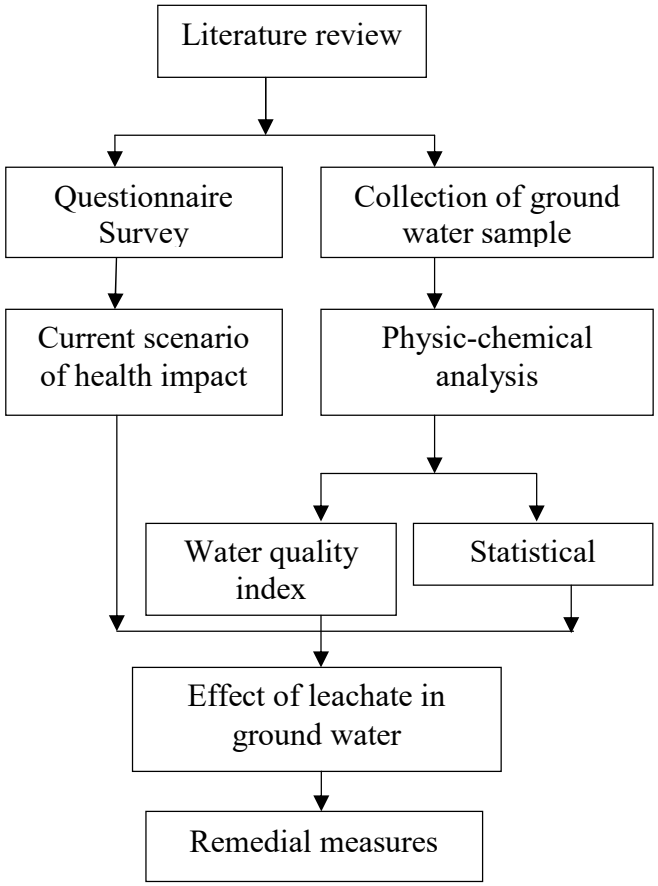
A. Questionnaire survey

The questionnaire survey was conducted around the solid waste dumping site. For this 20 sampling point was selected and it contains a questions about current scenario of groundwater quality and its impact on health.

B. Physic-chemical parameters

In this study 12 water samples were collected in a 1000ml plastic bottle from bore wells and open wells randomly around the Ariyamangalam solid waste dumping yard, Trichy inFebruary 2019.

The samples were analyzed using standard procedures of APHA for pH, EC, Cl, Bicarbonate, Ca, Mg, Na, K, F, SO_4, Cr, Cu andZn. Thesephysic-chemical parameters were compared with limits as per BIS10500:2012.



C. Water quality index

Water quality index was computed by to determine the suitability of the groundwater for drinking purposes. It can be calculated by using the formula given below

$WQI = \sum SI_i$.

Where $SI_i = W_i x\ Q_i$.

$Q_i = (C_i/S_i)\ x100$

$W_i = w_i / \sum w_i$, w_i = weight of each parameter

W_i = relative weight & Q_i = quality rating

Ci = concentration of each parameter in each water sample

Si = Indian drinking water standard for each parameter

Table. 1. Details of groundwater sample

SAMPLE NO	LATITUDE & LONGUTIDE	VILLAGE	SOURCE OF WATER
S1	10.807248N, 78.723302E	THIRUMAHAL STREET	BORE WELL
S2	10.806569N, 78.724444E	THIRUMAHAL STREET	BORE WELL
S3	10.806380N, 78.724187E	THIRUMAHAL STREET	BORE WELL
S4	10.802483N, 78.722237E	THIDIR NAGAR	HAND PUMP
S5	10.807096N, 78.723843E	THIDIR NAGAR	HAND PUMP
S6	10.799667N, 70.723224E	THIDIR NAGAR	BORE WELL
S7	10.8001640N, 78.721794E	KAALIYAMMAN KOVIL STREET	BORE WELL
S8	10.801292N, 78.723013E	PERIYAR NAGAR	BORE WELL
S9	10.803695N, 78.721808E	PERIYAR NAGAR	HAND PUMP
S10	10.8001710N, 78.727173E	PERIYAR NAGAR	BORE WELL
S11	10.795175N, 78.730870E	RAJEEV GANDHI NAGAR	OPEN WELL
S12	10.784289N, 78.700667E	RAJEEV GANDHI NAGAR	OPEN WELL

The values for the water quality index have been divided into five stages as shown in table 2.

Table.2. Water quality classification

RANGE	<50	50-100	100-200	200-300	>300
TYPE	Excellent	Good	Poor	Very poor	Unsuitable

D. Statistical analysis

Statistical analysis was carried out using statistical package for social sciences (SPSS- Version 17) Statistical parameters viz., mean and Standard deviation, correlation coefficient factor analysis and cluster analysis for physicochemical parameters. The mean and standard deviations are calculatedto know the chemical parameters which are deviating from WHO standard. Correlationanalysis measures the closeness of the relationship between chosen variables. If the correlation coefficient is nearer to +1 or –1, it shows the perfect linear relationship between the two variables. This way analysis attempts to establish the nature of the relationship between the water quality parameters.

IV. RESULT AND DISCUSSION

E. Questionnaire survey

People around dumping yard using groundwater for their domestic uses. The groundwater is not good in the south side

and East side of the dumping site. Thidir Nagar and Periyar Nagar are located south side of dumping site. Thirumahal Street and Anna Nagar are located in east. People belongs to these area were under the poverty line. Ground water quality in North and west side of the dumping site is little better than other two sides. Rajiv Ghandhi Nagar and Kali Amman Kovil Street were located in North and west side of the dumping yard. During monsoon health implication is high. In the beginning when the dumping yard was setup there is no residents in that area. When the city develops, peoples were migrants to area around Ariyamangalam dumpsite. The corporation water is not regularly distributed. The frequency of corporation water distribution is three or four days once during summer.In summer, cause of fire in the garbage storage yard is frequent. When those yards get fired, it incineration in air that is the major problem they faced by them in there day to day life. Air pollution is also affecting the neighboring people.

Table 3.People responses for questionnaire survey

Sl. No.	Questions		Yes	No
1	Using groundwater for		-	-
	A	Drinking purpose	0	20
	B	Domestic purpose	12	8
	C	Single	8	4
	D	Sharing	4	8
2	Using corporation water for		-	-
	A	Drinking purpose	20	0
	B	Domestic purpose	20	0
	C	Single	14	6
	D	Sharing	6	14
3	Ro treatment before using groundwater		0	20
4	Ro treatment before using corporation water		5	15
5	Rainwater harvesting		0	15
6	Health implication		-	-
	A	During monsoon	11	9
	B	During summer	2	18

F. Physic-chemical parameters

The table 5shows that the physic-chemical parameters of the collected water samples.

G. Water quality index

Water Quality Index has been computed to assess the suitability of groundwater of fifteen different parameters for drinking purposes in and around Ariyamangalam dumping site.

Table.4. Water Quality Index

Sl.No.	SAMPLE ID	WQI	TYPE
1	S1	103	Poor
2	S2	177	Poor
3	S3	130	Poor
4	S4	161	Poor
5	S5	118	Poor
6	S6	165	Poor
7	S7	119	Poor
8	S8	132	Poor
9	S9	196	Poor
10	S10	151	Poor
11	S11	152	Poor
12	S12	183	Poor

Groundwater samples of bore wells (BW), open wells (OW), and Hand Pumps (HP), collected from 12 different locations around Ariyamangalam dumping yard, Trichy. The present study was undertaken to characterize the physicochemical parameters such as pH, Electrical Conductivity (EC), Calcium Hardness (Ca), Magnesium Hardness (Mg), Total Hardness (TH), Bicarbonate (HCO_3), Chloride (Cl), Sulphate (SO_4), Sodium (Na), Potassium (K) Total Dissolved Solids (TDS). Each parameter was compared with its standard permissible limit as prescribed by World Health Organization (WHO). The Water Quality Index (WQI) was calculated and it reflected that all the samples were of poor quality. It is due to the leachate from the waste dumping yard.

Table 5. Physic-chemical parameters of samples

ID	pH	EC	Ca	Mg	Cl	Na	SO_4	HCO_3	Cr	Cu	Zn	F	TDS	TH	K
Unit	-	µS/cm	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
S1	7.6	2045	112	106	141	234	37	651	0.01	0.1	0.1	0.11	1250	398	0
S2	7.1	1320	846	272	223	560	12	632	0.03	0.1	0.05	0.15	678	1152	12.6
S3	7.3	1890	326	112	346	112	7	412	0.02	0.2	0.03	0.1	1152	372	0
S4	6.6	1421	457	354	137	276	16	646	0.04	0.12	0.02	0.17	876	898	10
S5	7.1	2140	100	98	116	126	36	324	0.05	0.09	0.3	0.2	1325	2140	12.4
S6	7.1	2990	210	96	176	352	25	612	0.12	0.2	0.36	0.23	1913.6	386	9.5
S7	8.1	1050	150	281	243	247	20	376	0.05	0.07	0.26	0.2	672	600	0
S8	7.4	1765	172	194	321	118	18	576	0.1	0.1	0.25	0.1	1122	542	3.2
S9	7.2	2274	468	153	187	345	15	516	0.3	0.1	0.01	0.13	1456	878	24.2
S10	7.3	1370	561	310	347	396	18	341	0.03	0.08	0.03	0.1	785	348	0
S11	7.4	1654	944	98	114	276	49	457	0.1	0.08	0.09	0.12	1012	415	0
S12	7.9	986	387	245	276	178	22	458	0.4	0.08	0.03	0.1	658	352	1.2

Table 6.Correlation between physic-chemical parameters of groundwater

	pH	EC	TDS	Ca	Mg	Cl	Na	SO_4	K	HCO_3	Cr	Cu	Zn	F	TH
pH	1														
EC	-.398	1													
TDS	-.338	**.991**	1												
Ca	-.224	-.316	-.378	1											
Mg	-.053	-.734	-.734	.219	1										
Cl	.284	-.341	-.336	-.072	.317	1									
Na	-.250	-.047	-.127	**.616**	.360	-.106	1								
SO_4	.176	.191	.201	.061	-.508	**-.671**	-.176	1							
K	-.538	.419	.404	.083	-.051	-.381	.361	-.228	1						
HCO_3	-.339	.249	.225	.075	.044	-.299	.329	-.089	.250	1					
Cr	.288	-.059	.027	.052	-.024	.054	-.091	-.049	.289	-.034	1				
Cu	-.401	**.629**	**.614**	-.206	-.385	.129	-.093	-.337	.072	.265	-.174	1			
Zn	.124	.456	.485	**-.576**	-.364	-.197	-.252	.298	-.025	-.080	-.202	.167	1		
F	-.209	.362	.370	-.282	-.045	-.508	.173	.110	.359	.039	-.194	.216	**.684**	1	
TH	-.404	.111	.076	-.113	-.063	-.451	-.016	.103	**.573**	-.187	-.154	-.208	.252	.457	1

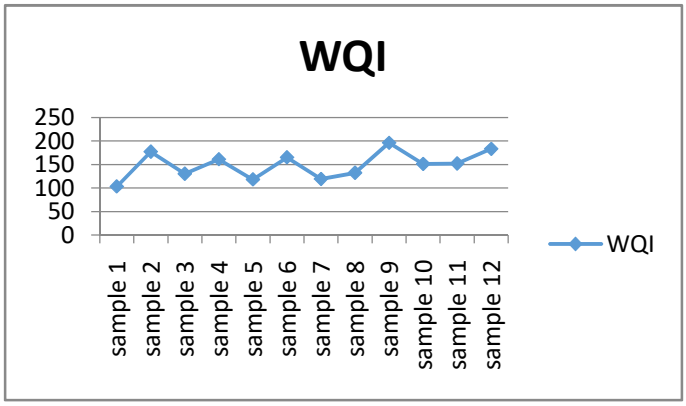


Fig. 2.Water quality index of samples

H. Correlation analysis

Table 6shows the Pearson correlation coefficients among selected water properties showed a number of strong associations. Significant correlations (0.5 and above) are in bold face. EC correlated strongly with TDS and Cu. Similarly Cu showed strong associations with TDS and Sodium showed strong associations with Ca. Total hardness showed strong associations with K and F showed strong associations with Zn. Chlorides showed strongly negative correlates with SO_4 and similarly Zn with Ca.

V. CONCLUSION

The study revealed the current stats of groundwater quality around Ariyamangalm dumping yard, Trichy. WQI concluded

the quality of groundwater was falling under the category of "POOR". Trichy, the rapidly urbanizing town has exerted greater stress in disposing of solid waste. Landfills are part of an integrated system for the management of MSW. When carefully designed and well managed within the context of the local infrastructure and available resources, landfills can provide safe and cost-effective disposal of a city's MSW.

Landfills are not designed for the routine disposal of industrial or hazardous waste, used oil, or other special wastes. If they are consistently pushed beyond their design limits, landfills, like any other engineered system, will fail. Such failure can have dire consequences for human health and the environment as the land fill then degrades into a potentially toxic open dump.

An integrated MSWM system may prioritize its waste management options according to waste minimization, material recovery/recycling, composing, incineration, and land filling. Waste minimization or source reduction focuses on reducing the quantity and potential toxicity of MSW destined for the land fill.

Materials recovery and recycling reduces the amount of material to be disposed of and extends the life of the land fill. Composting diverts organic matter from the land fill. This can reduce gas and leachate risks at the land fill and extend the life of the facility.

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