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ENVIRONMENTAL IMPACT ASSESSMENT OF GROUND WATER QUALITY AROUND VELLALORE DUMPING YARD

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Abstract - *Waste management rules in India are based on the principles of sustainable development, precaution and polluter pays. The principle is to act in an environmentally accountable and responsible manner restoring balance, if their actions disrupt it. The increase in waste generation as a by-product of economic development has led to various subordinate legislations for regulating the manner of disposal and dealing with generated waste are made under the umbrella law of Environment Protection Act, 1986 (EPA). Coimbatore city in Tamil Nadu is located on the banks of the Noyyal River and surrounded by the Western Ghats at latitude of 11□0' north, longitude of 76□57' East and an altitude of 411 m above mean sea level. Generation of municipal solid waste is a major problem for many urban local bodies in India. As per research 55 million tons of municipal solid waste is generated in India every year and the yearly increase is about 5%. Coimbatore city generates around 815 tons per day of municipal solid waste having an average generation rate of 600gms/capita/day. To understand the impacts on human health population close to the landfill, a detailed health status survey was also conducted. Around the dumping yard, parameters are tested. In summary it is found that that parameters like Total Dissolved Solids, Hardness, Chlorides, Fluorides, Turbidity and Alkalinity exceeds the permissible limit. Hence the ground water is not suitable for usage of humans.*

***Key Words*: Environmental Impact Assessment, Ground quality, Leachate, Municipal Solid Waste, Human health survey.**

1. INTRODUCTION

Generation of waste is an inevitable component of the industrial and community activity. Nowadays, the waste generated is so complex in nature and consists of varied chemical or biological constituents. The waste generated is classified as hazardous waste and non-hazardous waste based on the chemical composition or reactive characteristics. The waste disposed on open land by the community or industries forms an illegal or wild waste dump site. Illegal dumping of waste is every ones problem as it can be harmful to wildlife, plant sand water, and damage the surrounding community and state economy. Open dumping is a long-standing problem in this country and others, where certain locations become routine sites and dump piles attract additional dumping. It is a very common practice to dispose the waste generated by the community and the industries on to the land, into sea or into low lying area. The site say consist of fully or the partially industrial or domestic waste .The state of Tamilnadu is one of the fast developing states in India.

1.1 CITY PROFILE AND SITE TOPOGRAPHY

Coimbatore also known as Kovai and Koyamuthur is a major city in the Indian state of Tamil Nadu. It is located on the banks of the Noyyal River and surrounded by Western Ghats. Coimbatore is the second largest city in Tamil Nadu after Chennai and the 16th largest urban agglomeration in India. It is administered by the Coimbatore Municipal Corporation and is the administrative capital of Coimbatore district.

Vellore is a panchayat town in Coimbatore district in Tamilnadu which is located at 13 km east of the Coimbatore city situated on the southern bank of Noyyal River. Population census states that, as per the year 2001 population rate is about 17340 and at the year of 2011 population rate is 32230 and now it is in the range of 35000. For years, the entire solid waste as well as sewage of Coimbatore city has been dumped in the Vellalore yard. It was reported that 1000 tons of garbage get disposed day by day within the corporation limit of Coimbatore. Around 5 lakh million tons of wastes are accumulating over a year. Due to the practical difficulties on the segregating the wastes and composting it leads in forming such bigger and bigger mountains on the waste land.

1.2 ENVIRONMENTAL IMPACT ASSESSMENT

Environmental assessment (EA) is the assessment of the environmental consequences (positive and negative) of a plan, policy, program, or actual projects prior to the decision to move forward with the proposed action. In this context, the term environmental impact assessment (EIA) is usually used when applied to actual projects by individuals or companies and the term Strategic Environment Assessment (SEA) applies to policies and plans are most often proposed by organs of state. It is a tool of environmental management forming a part of project approval and decision-making. Environmental assessments may be governed by rules of administrative procedure regarding public participation and documentation of decision making, and may be subject to judicial review.

1.3 NEED FORTHE STUDY

In Coimbatore city, MSW generated from various locations such as schools, dwellings, community halls, hotels, markets, Industries, malls, etc., are collected, transported and dumped at Vellalore dumping yard without any scientific approach, creating environmental concerns such as water contamination, land pollution and health hazards.

The prioritized goals of the project are:

1. To reduce the amount of waste generated.
2. To manage the waste in an environmentally sustainable way addressing resources conservation and pollution concerns.

1.4 OBJECTIVE OF PRESENT STUDY

1. To assess the total generation of MSW from various sources in Coimbatore city and determine the total quantum of MSW generation per day.

2. To conduct a detailed Environmental Impact Assessment in the periphery of Vellalore dumping yard with reference to

3. To the present condition of water quality and evaluation of Water Quality Index (WQI) and the health status among the people living in the surroundings of the landfill.

2. LITERATURE REVIEW

Balakrishnan et al., (2018) conducted study on composition of municipal solid waste accumulated in Vellalore dump yard from Coimbatore city and samplings are based on monsoon seasons. This paper states that the wastes are mostly organic so it suggests the idea of composting for degrading the waste and inorganic waste can be reused and recycled.

Vasanthy et al., (2008) reported about the impact of poor solid waste management on ground water and water contamination analysis is done in which sample collection and analysis is done on properties of waste, leachate and soil. High concentration of parameters is because of improper segregation of heavy metals, precipitation and liquids from municipal solid waste.

Chaurasia et al., (2018) recommended the weighted arithmetic index method for the calculation and correlation study between various physical-chemical properties also reveals significant negative relationships. Ground water quality assessment using Water Quality Index (WQI) in parts of Varanasi district, Uttar Pradesh is done and it also helps in planning and management of available water resources.

3. GROUND WATER QUALITY TESTING

Ground water sample is collected from four directions (North, South, East and West) in the Vellalore area. Five numbers of samples is collected from each direction. The samples are collected around the radius of 1 km area i.e., the intervals are < 200 m, 200 to 400 m, 400 to 600 m, 600 to 800 m and 800 to 1000 m. The samples are collected using plastic bottles with proper sealing. The lab test is been done in which parameters like Appearance, Colour, Odour, pH, Alkalinity, Total dissolved solids, BOD, Conductivity, Dissolved oxygen, Hardness, Calcium, Iron, Fluorides, Chlorides, Sulphates, Turbidity are tested. The deflection in parameters values of water sample to the standard value will state the quality of ground water at Vellalore. The water sample is taken from the residence of Vellalore and the testing and compared with IS 10500 – 2012.

3.1 WATER QUALITY INDEX (WQI)

To understand the extent of pollution on ground water by the improper dumping of MSW in the Vellalore dumping yard easily, a water quality index (WQI) was developed by Weighted Arithmetic Index Method. The water quality was calculated as per equation by aggregating the quality rating with the unit weight linearly as furnished in equation .

$$WQI = ((\Sigma Wn*Qn)/\Sigma Wn)$$

$$Wn= (K/Sn)$$

i.e., $K = (1/ (1/ \sum Si))$

The Water Quality Rating was Rating was determined as give in equation is $Qn=100 \{(Vn-Vio) / (Sn-Vio)\}$

Table 1 Water Quality Rating

Water Quality Index	Water Quality Rating
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very Poor
>100	Unfit for drinking

3.2 ENVIRONMENTAL IMPACT ASSESSMENT ON HUMAN HEALTH STATUS

Generally, when all the major environments are under thrust, the people who dwell in the location or area will also suffer from pollution related diseases like asthma, fever, cold, dysentery etc. In order to assess the occupational diseases and pollution related diseases in around Vellalore dumping yard, questionnaire survey is been conducted. The questionnaire has the questions eliciting the details about different sources of drinking water, the colour of drinking

water from your bore well or from main source and the statistics of the disease caused by water pollution.

4. RESULTS

4.1 LEACHATE CHARACTERISTICS

The quality and quantity of leachate is highly variable and is directly related to fluctuations of rainfall amount, composition and characteristics of the waste, age, and landfill operational patterns. Landfill leachate composition varies greatly depending on the season, leachate collection system and landfill age. The main pollutant in the leachate is organic matter and ammonia, where in if the landfill age increases, the concentration of organic matter in leachate decreased. Fluctuations of the other parameters like phosphorus, chloride, calcium, magnesium, sulphates, dissolved solids, heavy metals which also depend on the season of the year and the age of the landfill. Hence the characteristics of leachate were referred from the journal Impact of poor solid waste management on ground water.

4.1.1 Physical Characteristics

The physical characteristics of the samples tested are shown.

Table 3 Physical Characteristics

PARAMETERS	CONCENTRATIONS
Appearance	Blackish
Odour	Sewage smell
Turbidity (NTU)	182
Total Dissolved Solids (mg/l)	26212
Electrical conductivity (micro mho/cm)	30690

4.1.2 Chemical Characteristics

The chemical characteristics of the samples tested are shown

Table 2 Chemical Characteristics

PARAMETERS	CONCENTRATIONS(mg/l)
pH (moles/l)	7.83
Total hardness	1475
Calcium	400
Magnesium	114
Sodium	1850
Potassium	1325
Iron	5.497
Chlorides	1731

4.2 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) ON GROUND WATER QUALITY

4.2.1 Experimental Results for South Direction

The results of physio-chemical analysis for the samples collected around the Vellalore dumping yard at south direction are given in Table 4.3.

4.2.2 Experimental Results for East Direction

The results of physio-chemical analysis for the samples collected around the Vellalore dumping yard at east direction are given in Table 4.4.

4.2.3 Experimental Results for West Direction

The results of physio-chemical analysis for the samples collected around the Vellalore dumping yard at west direction are given in Table 4.5.

4.2.4 Experimental Results for North Direction

The results of physio-chemical analysis for the samples collected around the Vellalore dumping yard at north direction are given in Table 4.6

Table 4 Physio-chemical Analysis at South Direction

Parameters	IS 10500-1991 and 1993	South Direction				
		<200 m	200-400 m	400-600 m	600-800 m	800-1000 m
Appearance	C and C	C and C	C and C	C and C	C and C	C and C
Odour	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.
TDS	500	1202	1229.6	1260	1249	796.6
Conductivity	-	2.11	2.01	2.52	2.48	1.50
pH	6.5-8.5	7.9	7.6	7.41	8.04	8.10
DO	-	1.42	1.55	1.45	1.42	1.20
Total hardness	60-300	1070	960	1127	1080	960
Iron	0.3	0.007	0.009	0.010	0.012	0.017
Chlorides	250	302.7	305.2	290.3	285.29	282.89
Sodium	-	151.35	152.6	145.35	147.45	141.44
Potassium	-	30.27	30.52	29.61	29.52	28.58
Fluorides	1	1.005	1.206	1.40	1.51	1.69
Turbidity	5	5.6	7.2	6.9	7.6	5.4
Alkalinity	200	115	122.5	119.5	105.5	95

All units are expressed in mg/l except pH (moles/l) and Conductivity (milliciemens/cm) Turbidity (NTU). C and C – Clean and Clear. Unobj.–Unobjectionable

Table 5 Physio-chemical Analysis at East Direction

Parameters	IS 10500:1991 and 1993	East Direction				
		<200 m	200-400 m	400-600 m	600-800 m	800-1000 m
Appearance	C and C	C and C	C and C	C and C	C and C	C and C
Odour	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.
TDS	500	1108.25	1195	1250	1180.5	1226
Conductivity	-	2.8	2.85	2.92	2.78	2.95
pH	6.5-8.5	8.05	8.28	8.17	7.54	8.1
DO	-	1.66	1.72	1.54	1.80	1.81
Total hardness	60-300	952	978	1040	1120	1005
Iron	0.3	0.005	0.067	0.040	0.072	0.117
Chlorides	250	288	311.8	314.25	308.0	317.89
Sodium	-	144	155.9	157.125	154	158.94
Potassium	-	28.8	31.18	31.42	30.8	31.788
Fluorides	1	1.15	1.34	1.38	1.67	1.79
Turbidity	5	6.4	6.84	7.5	8.1	7.4
Alkalinity	200	188	189.05	184.5	175.50	165.89

All units are expressed in mg/l except pH (moles/l) and Conductivity (milliSiemens/cm) Turbidity (NTU), C and C – Clean and Clear, Unobj.–Unobjectionable

Table 6 Physio-chemical Analysis at West Direction

Parameters	IS 10500:1991 and 1993	West Direction				
		<200 m	200-400 m	400-600 m	600-800 m	800-1000 m
Appearance	C and C	C and C	C and C	C and C	C and C	C and C
Odour	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.
TDS	500	966.4	954.87	957	971.25	947.5
Conductivity	-	2.65	2.77	2.84	2.24	2.55
pH	6.5-8.5	7.66	7.58	7.90	7.46	7.81
DO	-	1.55	1.62	1.74	1.69	1.50
Total hardness	60-300	911.5	940.65	923	940.45	955.5
Iron	0.3	0.029	0.055	0.078	0.065	0.095
Chlorides	250	310	325.7	350	339.75	360.45
Sodium	-	155	167.85	175	169.85	180.225
Potassium	-	31	33.57	35	33.97	36.045
Fluorides	1	1.88	1.75	1.64	1.57	1.70
Turbidity	5	5.9	5.84	5.75	6.71	6.74
Alkalinity	200	184.5	200.05	198.05	204.57	207

All units are expressed in mg/l except pH (moles/l) and Conductivity (milliSiemens/cm) Turbidity (NTU), C and C – Clean and Clear, Unobj. – Unobjectionable

Table 7 Physio-chemical Analysis at North Direction

Parameters	IS 10500:1991 and 1993	North Direction				
		<200 m	200-400 m	400-600 m	600-800 m	800-1000 m
Appearance	C and C	C and C	C and C	C and C	C and C	C and C
Odour	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.	Unobj.
TDS	500	1110	1156.26	1178	1169.75	1186
Conductivity	-	1.91	1.74	1.85	1.90	1.89
pH	6.5-8.5	7.45	7.50	7.57	7.66	7.80
DO	-	1.66	1.45	1.57	1.64	1.71
Total hardness	60-300	1250	1340	1158	1278	1195
Iron	0.3	0.015	0.025	0.036	0.047	0.039
Chlorides	250	340	356.5	359.75	375	360.85
Sodium	-	145.02	139.75	152.40	166.12	158.65
Potassium	-	32.55	32.97	33.63	34.52	33.85
Fluorides	1	1.35	1.47	1.52	1.58	1.59
Turbidity	5	6.90	7.45	7.64	7.71	7.98
Alkalinity	200	165	171.11	157.4	167.5	163.25

All units are expressed in mg/l except pH (moles/l) and Conductivity (milliSiemens/cm) Turbidity (NTU), C and C – Clean and Clear, Unobj. – Unobjectionable

4.3 GRAPHICAL REPRESENTATION

From the above tabulation, it's very clear that parameters like Total hardness, Turbidity, Total Dissolved Solids, Chlorides and Fluorides exceeds the permissible limit as per IS 10500: 2012 and it is predominantly more in East direction. Hence the graphical representation for the results of Physio-chemical analysis and water quality indices of ground water samples collected at Vellalore dumping yard (East Direction) are presented in Fig 4.1, Fig 4.2, Fig 4.3, Fig 4.4, Fig 4.5 and Fig 4.6.

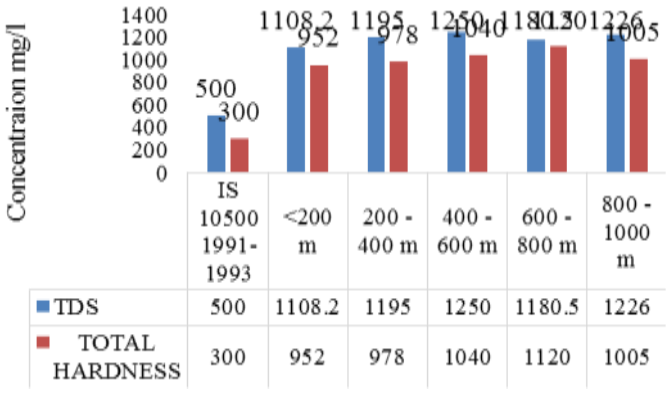

Fig 1 TDS & Total Hardness

From the above graph, its clear that TDS of 1250 mg/l and Total Hardness is in the range of 1100-1400 mg/l which exceeds the permissible limit hence it results in eye irritation and hair related problems.

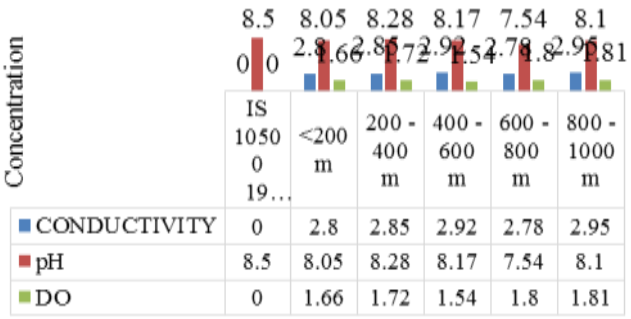

Fig 2 Conductivity, pH & DO

Conductivity falls in the range of 2.78 – 2.95 millisiemens/cm and Dissolved Oxygen is in the range of 1.5 mg/l and pH falls within 7.5 to 8.25 in which all three are within the permissible limit.

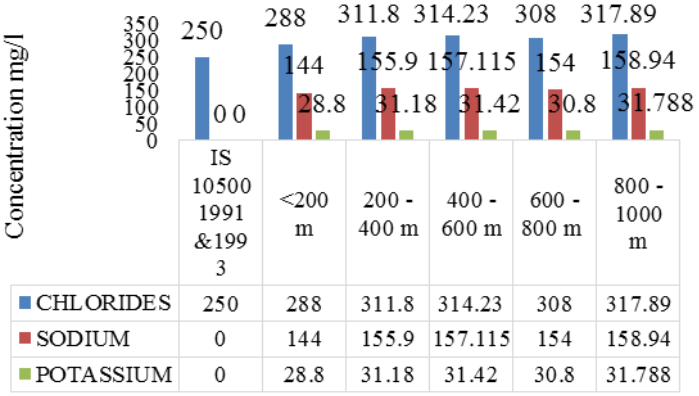

Fig 3 Chlorides, Sodium & Potassium

From the graph, the parameters like sodium and potassium are in the permissible limit but chlorides level exceeds the permissible limit of 250 mg/l which leads to disease like respiratory distress.

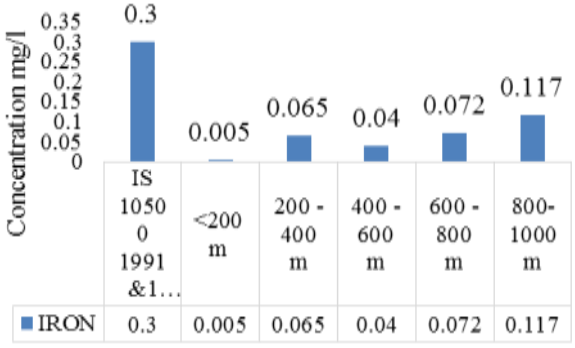

Fig 4 Iron

The permissible limit of iron as per IS 10500:2012 is 0.3 mg/l and the concentration of iron in above graph within 0.01 mg/l and its well within the permissible limit.

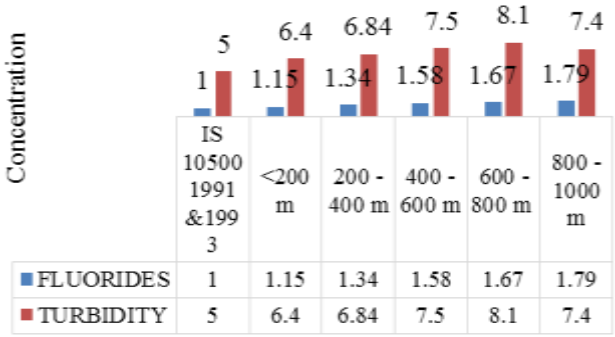

Fig 5 Fluorides & Turbidity

Fluoride in the above graph is in the range of 1.15 – 1.90 mg/l and turbidity ranges from 6.4 – 8.1 NTU. Both the parameters are not within the limit which leads to dental, bone problems and a gastrointestinal disorder includes dysentery.

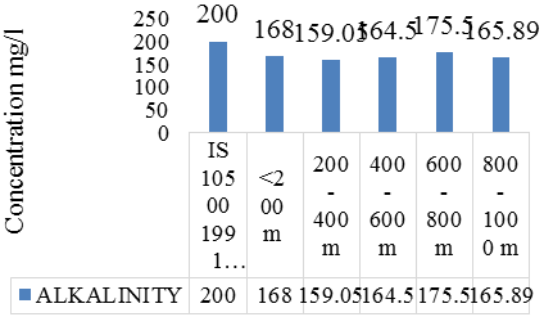

Fig 6 Alkalinity

From the above graph, the range of alkalinity obtained is within the limit as the permissible limit of alkalinity for drinking water should not exceed 200 mg/l as per IS 10500:2012.

5. CONCLUSIONS

From the data obtained, the following observations can be reported regarding the quality and use of the underground water at the various sampling sites. The underground waters near the landfill are characterized as:

- The pH of water samples ranges from 7.04 to 8.28. This shows that almost all the samples are base and this is due to infiltration of sewage at particular places and it cause alarming increase of total dissolved solids and chlorides, thereby, raising the value of hardness beyond the permissible limit given in IS 10500: 2012.

- On comparing the parameters with the standard values IS 10500: 2012, total dissolved solids, hardness, chlorides, fluorides, turbidity and alkalinity exceeds the permissible limit.

- From the questionnaire survey, the most common ill effects found around the surroundings are fever, dysentery, bone disease, eye irritation and dental problems which is due to the exceed of above mentioned parameters.

- The results obtained clearly states that the ground water around Vellalore dumping yard is contaminated and it is not suitable for usage of humans.

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