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Statistical Assessment of Groundwater and Surface water Contamination Due to Municipal Solid Waste dumping -A Case Study at Karadiyana Garbage Dump

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ABSTRACT

This study was conducted to measure the impact of a municipal solid waste landfill on groundwater quality and Surface water quality around Karadiyana, a solid waste dumping site in Western Province Sri Lanka. One of the main complications related with dumping of municipal solid waste in a landfill site is the leachate release and its impact on the nearby water sources. This study has utilized the analysis on physio-chemical parameters of the surface and ground water samples collected during both wet and dry periods covering the leachate region of the site. Compared with the permissible limits for drinking water quality and Inland Surface water Standards set by the Bureau of Indian Standards (BIS) and World Health Organization (WHO), it was identified that majority of the water samples have been contaminated far beyond the levels of set limits. Mean values of the physicochemical parameters of water samples have been taken as the data which were analyzed using descriptive analysis. The T-test, have been used for explaining the temporal variations of the perceived water quality parameters. Preceding to examining the seasonal influences on water quality parameters, the whole observation samples were divided into two main seasons as Dry (August) and Wet (October). The Bi-variate correlation was calculated in order to identify the nature and magnitude of the connection among different physicochemical parameters in order to determine whether there was any important association among water quality parameters or not. Characterization of leachate and water samples revealed that, the water sources around the dumping site which is within 500m from the dump site has been deteriorated in reaction to the leachate percolation. Additionally spatial and statistical analysis exposed that maximum contamination was present in the locations which are close to the leachate drains.

1. Introduction

Groundwater has long been thought-about as a very important water supply as a result of its comparatively low status to pollution and huge storage capability. Groundwater is relatively safe and reliable in comparison with surface water (Gupta N. 2014). However, deterioration of groundwater quality has become a significant drawback in recent years. Groundwater isn't simply contaminated, however once this happens it's troublesome to repair. consequently, the indiscriminate dumping of municipal solid wastes over vast areas that happens in developing countries, poses a significant threat to the groundwater quality. The 'throw away' societies of cities generate the foremost trash disposal. within the main cities the daily quantity of waste are often huge and laborious to handle, however they need correct approach of disposal mechanisms and in developing cities the number of waste isn't larger than developed, however the matter is that the poor waste management system. There is no any bare land or space in urban areas to continue this waste dumping process; therefore wet lands have been using to dispose garbage. Then all the urban disposals are open to dispose on valuable green lands. Many wet lands, marshy lands, low lying areas, forest, wild life areas, mangroves and water resources such as ocean, lakes were recently subjected to this huge problem. This causes many numerous negative environmental impacts for atmosphere, hydrosphere, lithosphere and biosphere.

Currently, disposal of solid waste is a severe environmental problem in Sri Lanka and also has become a national issue. The National Action Plan of Sri Lanka has noticed haphazard solid waste disposal to be one of the major reasons for national environmental degradation. But, in almost all of the urban municipalities in Sri Lanka, open dumping is the most common method of Municipal Solid Waste (MSW) discarding. This matter of MSW is most critical especially in Colombo Municipality and equally severe in adjoining municipalities in Colombo suburbs. In Sri Lanka, the responsibility of dumping MSW primarily goes to the public sector.

Many garbage disposal issues in the Western Province have been evidence during the last few years. In this background, Karadiyana in Piliyandala is one of the many locations in Sri Lanka which was used for garbage disposal over 16 years even it has been drawing the continuous criticism of environmentalists. At the same time however, Karadiyana area is also noted as a biodiversity hotspot and a saturated greenery land of the country. Nevertheless, in disposing the MSW land filling is the most commonly used way due to its cheaper economics (Wijesekara and Mayakaduwa et al. 2014). Areas adjoining the landfills have a larger leeway of groundwater and surface water contamination because of the probable landfill leachate to penetrate to ground and also runoff through. Therefore, it is significantly needed to reflect this problem as one of the foremost environmental anxieties in developing countries as it may cause numerous adversative effects in future. Therefore Protection of groundwater is a most important environmental issue since the significance of water quality on human health has attracted a great deal of interest in recent years (Akinbile and Yusoff, 2011). Solid Waste goes through uncountable changes in physical, chemical and microbiological processes once it is disposed while releasing 'leachate'. It is a toxic liquid comprised with massive amount of organic and inorganic compounds. This leachate migrate via the soil structure continuously and leads to ground water contamination if not prevented using necessary structural measures (Kanmani and Gandhimathi, 2013). The degree and features of the produced leachate is determined by several aspects such as solid waste structure, particle size, degree of compaction, , age of the landfill, the site's hydrology, temperature and moisture situations and oxygen availability (Jhamnani and Singh, 2009).

2. Material and Methods

2.1 Study Area

Karadiyana, a solid waste dumping site of Kesbawa Municipal Council area, is sited in Western Province. Kesbewa is situated in the Low Country Wet zone, which is categorized conferring to the altitude from mean sea level and amount of average rainfall reception. The daily capacity of this garbage intake is normally 550 metric tons, from 250 waste carrying vehicles in to 25 acres area with two dumping sites. The GIS coordinates of this dumping site is Longitude: 79.902855, Latitude: 6.815720. The wetlands of Boralesgamuwa – Borupana has being utilized as an open pit for the Karadiyana garbage dump. The land utilized to this garbage dump is located nearby the Weras Ganga, which belongs to the Bolgoda Lake catchment. This dump is about 3 to 4 meters in height above the ground level. It accommodates a daily dump of average 60 – 80 tons of organic waste from markets and households including vegetable, meat and fish waste. The landfill is only catering to non-hazardous solid wastes and it accepts both degradable and non-degradable waste. Karadiyana waste treatment plant treats the organic solid wastes. Yet, there is no facility in the dump yard for the leachate treatment. The drains parallel to the dump yard collects the leachate from the plant.

There are four main rainy seasons influencing the region including First Inter-monsoon period (March to April), Southwest Monsoon period (May to September), Second inter-monsoon period (October to November) and Northeast monsoon period (December to February) according to the Department of Meteorology, Sri Lanka.

Throughout the Southwest monsoon phase, the region takes rainfall more than 500mm and during the second inter-monsoon and northeast monsoon periods it obtains average rainfall more than 200 mm. The air temperature of the area (average), from year 2008 to 2013 was 28.05 0C, reaching to Maximum 31.33 0C from Minimum 24.50 0C with some substantial deviancies. During the Southwest Monsoon period (May to September) typical temperatures were relatively low when comparing with the 1st inter-monsoon period and the northeast monsoon period. Average soil depth is 30m and water table varies in between 0.1 to 1m. Figure 1 shows the details of Karadiyana dumping site and the sampling locations.

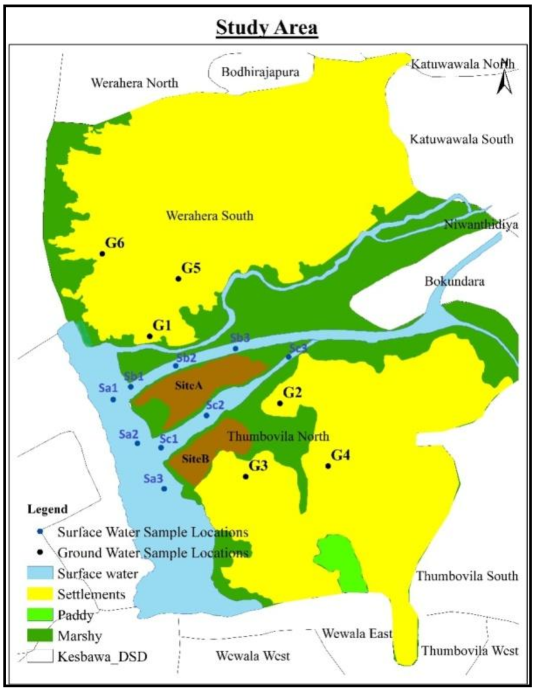

Figure.01: Study area with sample location
Source: Compiled by the author using Arc GIS 10.1 (2017)

3. Sampling and Analysis

The surface sampling technique was systematic sampling method on three main water bodies which are Weras gaga, Meda Ela and the new cannel. The distance between two samples was 500 m along each water stream. Six samples of ground water were gathered from randomly chosen wells located near to the dumpsite to evaluate the contamination scope of groundwater within 1000 m radius of the landfill site. Selection of the sampling sites was completed grounding on the overall objective of the present study. Samples of Surface water also gathered from randomly chosen 9 sampling points from each of the three studied water bodies named as A, B and C respectively only for identification and sampling..

At each sampling point samples were gathered in August and October mainly covering dry and wet seasons to identify whether there is an impact to water resources from garbage dumping site. Each Sample was stored in a 1 L plastic container. These container bottles were thoroughly rinsed with detergent and dried prior to use. Before collecting the sample, the bottles were rinsed once again with the sample water of each point. Then the samples were taken after several flush outs by letting the water to flow for about 4 minutes from the source to make it similar with the minimum number of well volume and to steady the electrical conductivity values. All the containers were totally filled and caped tight giving no space to enter air inside.

Afterwards the containers were labeled precisely declaring the location and name of the sample site, collection date and time etc. Then the collected samples were shifted to the laboratory of the National water supply and drainage board at Thelawala road, Rathmalana. The analysis of diverse parameters was completed within the next 48 hours anticipating better outcomes in lessening the effects of quality change. All the samples were tested for applicable physio and chemical parameters conferring to worldwide acknowledged procedures and standard methods (APHA, AWWA, WEF 2012). The parameters analyzed on the surface and ground water includes, Electric Conductivity, pH, Total Dissolved Solids, Turbidity, Total Suspended Solids, Total Solids, Nitrate, Phosphate, Fluorides, Dissolved Oxygen, Cadmium and lead.

4. Results and Discussion

The watery substance that leaks or 'leaches' from a landfill is named as 'leachate'. It differs extensively in composition concerning the age of the landfill and the nature of waste contains in it. Leachate typically comprises with both dissolved and suspended material (www.leachate.co.uk/main/what-is-leachate/). Landfills usually have a highly heterogeneous mixture of things, which consist of a very high organic component and also soluble mineral ingredients. Some of the organic matters decay naturally in the landfill physique. The temperature of the leachate is typically higher comparative to the usual groundwater in the region due to these exothermal processes in the landfill. This leachate matter normally have a higher turbidity and the color is brownish. It comprised with a very strong odor as well.

The landfill leachates' composition varies based on the weather, the sort of stored waste, and the holding time in the landfill physique. As the holding time in landfill rises, the degree of persistent organic pollutants also gets increased. At the same time, the holding time increment upsurges the decaying progresses in to methane production. Apart from a range of soluble Nitrogen, Sulphur composites, Sulphates and Chlorides, the leachate then comprises with a higher degree of persistent organic contaminants (www.das-ee.com/en/wastewater-treatment).

The table 01 shows few parameters of leachate at Karadiyana waste dump site in August and October. The pH value is varies in between 9.31 to 9.68 which is alkaline, it means the landfill leachate concentrated more free hydroxyl ions. This may be the reason for surface water body also to be alkaline more, because the leachate is directly flow to the surface water and the pH value in surface water close to the leachate drain was recorded as 9.06 – 9.28. When considering the Electric Conductivity and Total Dissolved Solids of leachate, it recorded as 24.27ppt (24,270 ppm) and 22.65ppt (24,651 ppm) which were very high.

Table-1
Comparison of landfill leachate quality in August and October

Parameters	**Landfill Leachate**	
	August (Dry)	**October (Wet)**
pH	9.31	9.68
EC	24.27 ppt	24.29 ppt
TDS	22.65 ppt	23.60 ppt
NaCl	29.81 mg/l	30.27 mg/l

Source: Survey data, 2017

Table-2
Physio-Chemical Characteristics of Groundwater Samples (Dry Period)

Parameters	Dry			Desirable Limit WHO/SLS/BIS
	Min	Max	Mean	
pH	7.65	9.07	8.11	6.5 – 8.5
EC	182.5	1958.00	944.08	750
TDS	285	1825.00	792.60	1000
Turbidity	0.4	1.00	0.67	5
Nitrate	0.221	1.11	0.45	50
Phoshpate	0.005	0.32	0.08	2
Fluoride	0.02	0.17	0.10	1.5
TSS	112	142.00	123.20	500
TS	397	1967.00	915.80	-
DO	3.8	6.20	4.88	6

Table-3
Physio-Chemical Characteristics of Groundwater Samples (Wet Period)

Parameters	Wet			Desirable Limit WHO/SLS/BIS
	Min	Max	Mean	
pH	7.18	8.92	8.10	6.5 – 8.5
EC	196.20	2113.00	988.37	750
TDS	268.00	1969.50	790.05	1000
Turbidity	0.11	1.21	0.62	5
Nitrate	0.22	1.45	0.59	50
Phoshpate	0.0210	0.6770	0.1597	2
Fluoride	0.11	0.21	0.18	1.5
TSS	98.10	145.20	115.50	500
TS	366.10	2114.70	905.55	-
DO	2.10	6.20	4.27	6

Source: Survey data, 2017

The physio-chemical composition of groundwater samples in the dry and wet seasons was statistically analyzed and the results provided in Table 2 and 3. Most of the samples were alkaline in nature; and the pH of the water samples varied from 7.65to 9.07 and 7.18 to 8.92 in the dry and wet respectively. The mean value relatively high in EC and TDS in the samples shown the existence of inorganic substances in both seasons. The highest dissolved solids were included in the samples gathered adjacent to the landfill site, demonstrating that free ions penetrated from the waste into the groundwater. 40% of the samples were comprised with higher dissolved solid levels than the prescribed limits by the Bureau of Indian Standards for drinking water (BIS, 2012). The higher concentration of EC and TDS during the wet season proposes that the leachate have more contamination probability during wet season. DO of ground water ranged between 3.8 mg/l to 6.2 mg/l and 2.1 to 6.2 mg/lin dry and wet, respectively. The water quality in terms of DO concentration is always of primary importance, because at the waste discharge points, the DO is obligatory for aerobic oxidation of the wastes. Also DO levels are important in the natural self-purification capacity of water. A better level of DO in sampling sites specified a high re-aeration degree and speedy aerobic oxidation of biological substances.

Table-4
Physio-Chemical Characteristics of Surface water Samples (Dry Period)

Parameters	Wet			Desirable Limit WHO/SLS
	Min	Max	Mean	
pH	8.08	8.81	8.24	6.5 – 8.5
EC	289.80	2005.00	778.36	750
TDS	270.40	1870.80	726.11	1000
Turbidity	6.20	23.30	15.92	5
Nitrate	0.11	8.89	2.22	50
Phosphates	0.0044	0.0150	0.2954	2
Fluoride	0.06	0.66	0.19	1.5
TSS	26.80	282.20	130.22	500
TS	159.00	804.00	355.22	-
DO	0.30	6.80	3.69	6

Source: Survey data, 2017

Table-5
Physio-Chemical Characteristics of Surface water Samples (Wet Period)

Parameters	Wet			Desirable Limit WHO/SLS
	Min	Max	Mean	
pH	8.08	8.81	8.24	6.5 – 8.5
EC	289.80	2005.00	778.36	750
TDS	270.40	1870.80	726.11	1000
Turbidity	6.20	23.30	15.92	5
Nitrate	0.11	8.89	2.22	50
Phosphates	0.0044	0.0150	0.2954	2
Fluoride	0.06	0.66	0.19	1.5
TSS	26.80	282.20	130.22	500
TS	159.00	804.00	355.22	-
DO	0.30	6.80	3.69	6

Source: Survey data, 2017

The physio-chemical composition of surface water samples in the dry season and wet season were statistically analyzed and the results provided in Table 04 and 05. 90% of the samples were alkaline in nature; and the pH of the water samples differed from 8.69 to 9.28 and 8.08 to 8.81 in the dry and wet seasons respectively. The comparatively high rate of EC and dissolved solids in the samples signposted the incidence of inorganic particles in both seasons. The uppermost dissolved solids compound was noticed in the samples taken adjacent to the landfill site, representing that free ions from the waste is being leaching in to the surface water (Dharmarathne, Gunatilake, 2013). From the gathered samples, 30% had high dissolved solid amounts than the prescribed boundary levels by the CEA Inland surface water standards. The higher concentration of dissolved solids throughout the wet season indicates that the leachate comprised with more potential contaminating possibility during wet season.

5. Statistical Interpretations

5.1. Multivariate Statistical Methods

The collected data was analyzed utilizing one-way analysis of variance (ANOVA) at 0.05% level of significance with the objective of examining the significant deviations among all water quality variables. All statistical analyses were completed by utilizing the SPSS (v. 16) and MS Excel software applications. Statistical conclusions and tests were completed based on ten water quality parameters. To assess the influence of the dumping site and spatial-temporal variations on physicochemical characteristics of surface and ground water, it have used Correlation, -test and ANOVA.

In statistical analyzing the analyzed were based on multivariate analysis under inferential statistics. One-way ANOVA, Bi Variate Correlation, T- test were used to identify the relationship within variables and data analyzed utilizing MS Excel and SPSS.

5.2. T-test to identify the relationship of sample locations and the season

The mean values, the standard deviation and the P- value of physicochemical parameters at different sampling locations and the seasonal variation during the period of 2 months (August 2017- test Results in Dry and Wet seasons)

Table-6
Results of the T-test (Dry Period)

T-Test	**August (Dry)**		P value
	Mean	**SD**	
pH	8.8	0.42	0.00005
EC	762.67	537.79	0.12229
TDS	726.81	486.14	0.12006
Resistivity	1064.26	495.34	0.07212
Turbidity	12.09	8.39	0.48736
Nitrate	1.78	2.83	0.33907
Phosphate	0.21	0.22	0.23594
Fluoride	0.16	0.16	0.00104
TSS	117	62.05	0.02424
TS	117	62.05	0.02424
DO	2.36	1.79	0.0143

Source: Survey Data, 2017

Table-7
Results of the T-test (Wet Period)

T-Test	**October (Wet)**		**P value**
	Mean	**SD**	
pH	8.21	0.43	0.00005
EC	892.2	700.17	0.12229
TDS	848.78	637.59	0.12006
Resistivity	1113.79	484.98	0.07212
Turbidity	12.09	8.43	0.48736
Nitrate	1.83	2.95	0.33907
Phosphate	0.29	0.47	0.23594
Fluoride	0.18	0.16	0.00104

TSS	128.35	75.3	0.02424
TS	128.35	75.3	0.02424
DO	3.97	2.19	0.0143

Source: Survey Data, 2017

Among the all parameters (n=11) pH, Fluoride, TSS, TS, DO values shows a statistically noteworthy variance between the dry and wet seasons because the P value is less than 0.05. All the other value shows there was no any statistically important change between the dry and wet seasons because the P value is greater than 0.05. When Comparing the means of all the parameters, in dry season the pH, Resistivity and Turbidity obtained a high value and EC, TDS, Nitrate, Phosphate, Fluoride, TSS, TS, DO obtained a high value in wet season. This is because of the rainfall variations and leachate accumulations.

5.3. AOVA to identify the relationship of sample locations and areas – August

The average and the P- value of physicochemical parameters at four different sampling areas around the dump site together with both surface and ground water and the sample locations. The seasonal variation shows separately during the period of 2 months (August 2017- Dry), (October 2017 - Wet) are presented in Table 08 (Annex 01).

Among the all parameters (n=11) Turbidity, TSS and DO values shows a statistically significant variation among each of the four sampling areas because the P value is less than 0.05. All the other value shows there wasn't any statistically noteworthy variance among each of the four sampling areas and the surface water bodies' locations because the P value is greater than 0.05.

When considering the locations of sampling, pH, Nitrate, TSS levels are high and the resistivity is low in the 2nd location of three surface water bodies and ground water samples because the dumping site is directly opposite to those locations. The EC, TDS, Turbidity, Phosphate and fluoride concentrations are high in the 3rd location of three surfaces and ground water samples because with the slope the pollutants area accumulated at lower areas.

When considering the areas of sampling EC, TDS are high and the resistivity is low in ground water. pH, Turbidity, phosphate, Fluoride, TS concentrations are high and the DO level is low at Meda ela because the it is in between two main dumping sites called A and B. The Nitrate level is very high at Weras gaga because there are many invasive alien species at the water body such as algea, Japan Jabara.

5.4 AOVA to identify the relationship of sample locations and areas – October

Among the all parameters (n=11) Turbidity and TSS values shows a statistically noteworthy difference among each of the four sampling areas because the P value is less than 0.05. All the other values do not indicate any variance with statistically significance among each of the four sampling areas and the locations of surface water bodies because the P value is greater than 0.05. (Table 09; Annex 02).

When considering the locations of sampling the 3rd location of all 4 areas polluted with the increase of EC, TDS, Turbidity, Phosphate, Fluoride and decrease of DO level. This may be because with the rainfall the leachate flows through the drains and with the slope the pollutants are accumulated at lower areas.

pH, Nitrate, TSS concentration is high and the Resistivity is low at the 2nd location of 4 areas because the leachate drains are directly open to the Meda ela and New canal which is the boundaries of site A and site B.

When considering the areas of sampling EC, TDS are very high in ground water relatively to the other water bodies. The mean level of ground water is exceed its standard value and not suitable for drinking water. Turbidity, Phosphate, Fluoride, TS levels are high and Resistivity and Do are low at the Meda ela while pH, Nitrate and TSS are high at Weras gaga. During the rainy season the Total Suspended Solids at Weras gaga is high with algae and other aquatic plants and also the sediments are high.

When we comparing the variation in between month August and October in pH, EC, TDS, Resistivity, Turbidity, Nitrate, Phosphate, Fluoride, TSS and TS there is no a highlighted variation of amount of pollutants and the degree of pollution but the DO value is change somehow. But the pH and the resistivity values are change its areas with the month.

5.5. Co-relation to identify the relationship of parameters – August

When take a look at the table 10 (Annex 03) in the output file of Correlations between parameters of August. The parameters are the variables and named in eleven rows and eleven columns as pH, EC, TDS, Resistivity, Turbidity, Nitrate, Phosphate, Fluoride, TSS, TS, and DO. The boxes all contained numbers that represent parameter's crossings. In these boxes, it contained value for Pearson's r, a Significance (2-tailed) value and a number (N) value.

The one star (*) indicated that there is a noteworthy statistical correlation at 0.01 level and two stars (**) indicated that there is a significant correlation at 0.05 level. The correlation between Turbidity and pH, Phosphate and pH, TSS and Nitrate show a significant correlation at 0.01 level. The Pearson's r for the correlation among those parameters are 0.658, 0.583 and 0.685 separately. This indicates that there is a slight relationship between each two parameters. This proposes that differences in turbidity slightly correlated with variances in the pH, Phosphate slightly correlated with changes in pH and TSS slightly correlated with differences in nitrate. The value is much close to 1. For this cause, it can determine that there is a slight relationship between each pair of parameter.

In all these the Pearson's r value was positive. This designates that as one variable surges in value, the value of second variable also increases. Similarly, as one variable reduces in value, the value of the second variable also. This is named as a 'positive correlation'. Since all the Pearson's r was positive, it can determine that when the first parameters slightly increase the second parameters also slightly increase. As an example when the Turbidity is increases the pH level also high.

The correlation between DO and Turbidity shows a significant correlation at 0.01 level. The Pearson's r for the correlation between this pair of parameter is – 0.629. This indicates that there is a slight negative relationship between DO and Turbidity. It specifies that as one variable grows in value, the second variable reduces in value. When the DO increased in value the Turbidity decreased in value.

The correlation between TDS and EC, Fluoride and Phosphate, show a significant correlation at 0.05 level. The Pearson's r for the correlation between those parameters are 0.995 and 0.740 separately demonstrating a strong relationship between each two parameters. This means that deviations in TDS strongly correlated with deviations in the EC and Fluoride slightly correlated with changes in Phosphate. The value is very close to 1. For this reason, it can conclude that there is a strong relationship between each pair of parameter.

In all these the Pearson's r value was positive. This notes that when one variable increases in value, the second variable also increase in value. Since all the Pearson's r was positive, it can determine that when the first parameters slightly increase the second parameters also slightly increase. As an example when the Turbidity is increases the pH level also increases.

5.6 Co-relation to identify the relationship of parameters – October

When take a look at the table 08 in the output file of Correlations between parameters of August. Same as the table 11(Annex 04) named in eleven rows and eleven columns as pH, EC, TDS, Resistivity, Turbidity, Nitrate, Phosphate, Fluoride, TSS, TS, and DO. The boxes all contained numbers that represent parameter's crossings. In these boxes, it contained value for Pearson's r, a Significance (2-tailed) value and a number (N) value.

Same as the one star (*) indicated that there is a statistically significant correlation at 0.01 level and two stars (**) indicated that there is a significant correlation at 0.05 level.

The correlation between DO and Fluoride, TS and TSS show a significant correlation at 0.01 levels. The Pearson's r for the correlation among the parameters is -0.547 and 0.530 separately. This denotes that there is a slight relationship between each two parameters. This means that deviations in DO slightly connected with changes in the Fluoride and TS slightly correlated with changes in TSS. The values are moderate between 1 and 0. For this reason, it can determine that there is a slight relationship between each pair of parameter.

The Pearson's r value was negative between DO and Fluoride where one variable surges in value, the second variable decreases in value. The Pearson's r value was positive between TS and TSS indicating that while one variable rises in value, the value of the second variable also increases. Similarly, as one variable decreases in value, the second variable also decreases in value. Since all the Pearson's r was positive, it can conclude that when the first parameters slightly increase the second parameters also slightly increase. As an example when the TSS was increases the TS level also increased.

The correlation between TSS and Nitrate, Fluoride and Phosphate show a significant correlation at 0.05 level. The Pearson's r for the connection among the parameters are 0.741 and 0.861 separately. This indicates that there is a solid relationship between each two parameters. This means that diverges in TSS strongly associated with changes in the Nitrate and Fluoride strongly correlated with changes in Phosphate. The value is very close to 1. For this cause, it can determine that there is a solid relationship amongst each pair of parameter.

6. Conclusion

The research study revealed that the Karadiyana dumping site is found susceptible to the surface and ground water pollution through leaching action. All the pollutants are detected within 500m from the pollution source. Proximity to the waste sites and the changes in season from dry to wet period influences the concentration of water quality parameters. The concentration of various physic-chemical parameters in surface water viz. electrical conductivity, total dissolved solids, nitrate, phosphate, fluoride, are recorded higher at all the sampling locations which were closed to dump site and DO is recorded lower at same locations, where the injudicious discharge of untreated landfill leachate is directly impact on surface water bodies which might affect the sustainability of the aquatic life. The concentration of parameters in ground water such as the Electric Conductivity and TDS levels are above the SLS 614:2013 the samples which are located back to the dump site at low level and exceeding the water quality standards. Through the statistical analyzes it is significantly proved that the Meda ela which flows in between the dump site A and B are mostly polluted than the other water bodies and the locations which are closer to the leachate drains are mostly polluted than the others. Therefore it can be conclude that there is a directly impact on surface water through untreated leachate drains.

References

1. Akinbile, C.O. and Yusoff, M.S. (2011) Environmental Impact of Leachate Pollution on Groundwater Supplies in Akure, Nigeria, International Journal of Environmental Science and Development, 2, 81-86. http://dx.doi.org/10.7763/ijesd.2011.v2.101
2. APHA, AWWA, WEF (2012) Standard Methods for Examination of Water and Waste Water. 22nd Edition, American Public Health Association, Washington DC.
3. BIS (2012) Indian Standard Drinking Water Specification. Bureau of Indian Standards, New Delhi.
4. Dharmarathne, N. and Gunatilake, J. (2013) Leachate Characterization and Surface-Groundwater Pollution at Municipal Solid Waste Landfill of Gohagoda, Sri Lanka. International Journal of Scientific Research, 3, 1-7.
5. Gupta, N. (2014) Groundwater Vulnerability Assessment Using DRASTIC Method in Jabalpur District of Madhya

Pradesh. International Journal of Recent Technology and Engineering, 3, 36-43.
6. Jhamnani, B. and Singh, S.K. (2009) Groundwater Contamination Due to Bhalaswa Landfill Site in New Delhi. International Journal of Civil and Environmental Engineering, 1, 121-125.
7. Kanmani, S. and Gandhimathi, R. (2013) Assessment of Heavy Metal Contamination in Soil Due to Leachate Migration from an Open Dumping Site. Applied Water Science, 3, 193-205. http://dx.doi.org/10.1007/s13201-012-0072-z
8. Jhamnani, B. and Singh, S.K. (2009) Groundwater Contamination Due to Bhalaswa Landfill Site in New Delhi. International Journal of Civil and Environmental Engineering
9. Wijesekara, S.S.R.M.D.H.R., Mayakaduwa, S.S., Siriwardana, A.R., de Silva, N., Basnayake, B.F.A., Kawamoto, K. and Vithanage, M. (2014) Fate and Transport of Pollutants through a Municipal Solid Waste Landfill Leachate in Sri Lanka. Environmental Earth Sciences, 72, 1707-1719. http://dx.doi.org/10.1007/s12665-014-3075-2
10. www.leachate.co.uk/main/what-is-leachate/
11. www.das-ee.com/en/wastewater-treatment