

**EVALUATION OF GROUND AND SURFACE WATER
CONTAMINATION BY KARADIYANA LANDFILL
LEACHATE AND ITS' TEMPORAL VARIATION**

by

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Thesis submitted to the University of Sri Jayewardenepura for the
award of the Degree of Doctor of Philosophy

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“The work described in this thesis was carried out by me under the supervision of Snr. Prof. Sudantha Liyanage and Dr. Asitha Cooray. This has not been submitted in whole or in part to any university or any other institution for another Degree/Diploma”.

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List of Abbreviations

BOD	Biochemical Oxygen Demand
CCME	Canadian Council of Ministers of the Environment
<i>C_f</i>	Contamination factor
CBSQGs	Consensus-based sediment quality guidelines
COD	Chemical Oxygen Demand (COD)
CFU	Coliform Counts
DMMC	Dehiwala and Mount Lavinia municipal council
DOM	Dissolved Organic Matter
DGGE	Denaturing Gradient Gel Electrophoresis
EEM	Excitation Emission Matrix
EIA	Environmental Impact Assessment
GNP	Gross National Product
GCMS	Gas Chromatography Mass Spectrometry
I _{geo}	Geo accumulation index
IEA	Initial Environmental Assessment
KUC	Kolonnawa Urban Council
LPI	Leachate Pollution Index
MSW	Municipal Solid Waste
MPI	Metal Pollution Index
MVDA	Multi Variate Data Analysis
MMC	Municipal Council of Moratuwa
PC	Principal Components
PLI	Pollution Loading Index

PCA	Principal component analysis
PEC	Probable Effect Concentration
USEPA	United States Environmental Protection Agency
WQI	Water Quality Index
SLSI	Sri Lanka Standards Institute
SQGs	Sediment Quality Guidelines
SJKMC	Municipal council of Sri Jayewardenepura Kotte
TDS	Total Dissolved Solids
TEC	Threshold Effect Concentration
WHO	World Health Organization
XOM	Xenobiotic Organic Matter

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**Evaluation of Ground and surface water contamination by
Karadiyana landfill leachate and its' temporal variation**

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ABSTRACT

Solid waste management using open dumpsites leads to contamination of ground and surface water due to the interaction of leachate with water sources. The specific objective of this study was to identify the major leachate flow paths through groundwater that leads to contamination of nearby Weras Ganga and Bolgoda Lake by leachate and to identify the spatiotemporal variation in Karadiyana landfill leachate and its impact on surface and groundwater bodies. Investigation of physiochemical parameters were carried out for leachate, surface water, groundwater and dug well water during the study period from October 2016 to June 2020. Sediment samples from nearby Meda Ela was assessed for its physiochemical parameters. Leachate characterization data shows that it falls under the methanogenic phase. Leachate samples showed average values of 10.30 ± 0.90 , 0.55 ± 0.15 , 1.63 ± 0.44 , 0.46 ± 0.10 mg/L for Fe, Cu, Zn, Mn respectively. Groundwater samples showed nitrate and ammonia values of 151.68 ± 47.73 , 346.4 ± 39.02 mg/L where surface waterbodies around site showed average values of 200.5 ± 16.0 , 2.66 ± 0.20 mg/L for nitrate and ammonia. Groundwater metal concentrations were 0.16 ± 0.03 , 7.81 ± 0.68 , 0.05 ± 0.01 , 0.23 ± 0.04 mg/L for Cu, Fe, Zn, Mn respectively. Leachate Pollution Index (LPI) of Karadiyana leachate has a value of 28.10 indicating it is contaminated. It suggests that mitigation methods should be carried out to control the leaching of pollutants to the surrounding body from the dumpsite. Only one out of ten dug wells located in a

radius of about a kilometer of the site has a Water Quality Index (WQI) value which can be classified as good water for drinking purposes though eight of ten are used for drinking during study period. All ten dug wells exceeded the recommended level for nitrate by WHO standards for drinking water 2011, showing the possible contamination by the dumpsite leachate. The comprehensive index value for surface water was 6.98. Surface water is under moderate pollution according to single pollution index. Pollution Loading Index (PLI) of the sediment was calculated as 0.87 which falls into class of $PLI < 1$ which is no pollution category. The concentration of studied metals in sediments varies as $Cu < Mn < Zn < Fe$. Semi-volatile compounds including aromatic compounds, long-chain hydrocarbons and halo hydrocarbons were identified in the extracted leachates concluding Karadiayana leachate falls majorly into stabilized category though it receives fresh waste daily. The use of spectroscopic methods in identifying dissolved organic matter in Karadiyana leachate was useful in recognizing four major groups as tryptophan and tyrosine protein fractions, fulvic and humic fractions. The presence of high molecular weight and aromatic compounds, which is significant for humic acids and carbons substituted by functional groups including nitrogen, and oxygen atoms concluding its humic, fulvic nature. BOD/COD ratio of leachate in present study varies in between 0.39-0.49 which categorizes leachate into the age of intermediate where biodegradability is medium and further proven by average of $pH 6.81 \pm 0.08$ and average of $COD 2,221 \pm 45$ mg/L. Use of florescence for tracing leachate pollution was concluded as a productive method.

Keywords: groundwater, leachate, open dumpsite, surface water