OBAFEMI AWOLOWO UNIVERSITY

THE INVESTIGATION OF THE IMPACT OF LEACHATE FROM SOLOUS WASTE DUMPSITE, ISHERI, LAGOS, ON THE GROUNDWATER QUALITY.

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CERTIFICATION

This is to certify that the research work titled "THE INVESTIGATION OF THE IMPACT OF LEACHATE FROM SOLOUS WASTE DUMPSITE, ISHERI, LAGOS, ON THE GROUNDWATER QUALITY" was carried out by OJO-AWO Nicholas Adesina for the award of the degree of Master of Science in the Institute of Ecology and Environmental Studies, Faculty of Science, Obafemi Awolowo University, Ile-Ife, Nigeria.

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----- Prof. O. O. Awotoye Prof. I. F. Adeniyi

(Chief Examiner) (Supervisor)

DEDICATION

I humbly dedicate this project to the glory of God the father who in his infinite mercy gave us our saviour and redeemer Jesus Christ and the Holy Spirit who has been my helper in times of need.

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LIST OF ABREVIATIONS

ANOVA	-	Analysis of Variance
Bd	-	Before Dumpsite
BOD	-	Biological Oxygen Demand
CO_2	-	carbon (IV) oxide
COD	-	Chemical Oxygen Demand
DO	-	Dissolved Oxygen
Ds	-	Dump surrounding
Dv	-	Dump vicinity
et al	-	et alli (Latin) = and others
e.t.c	-	et cetera (Latin)
Fig	-	Figure
i.e	-	id est (Latin) that is
meq	-	milliequivalent
MSW	-	Municipal Solid Waste
PCA	-	Principal Component Analysis
pH	-	Potential of Hydrogen
p, pp	-	page,(s)
QA	-	Quality Assurance
QC	-	Quality Control
r	-	Correlation Coefficient
sem	-	Standard Error of Mean
TS	-	Total Solids
TDS	-	Total Dissolved Solids
TSS	-	Total Suspended Solids
USEPA	-	United States Environmental Protection Agency
WHO	-	World Health Organisation

Symbols

SO_4^{2-}	-	Sulphate
NO_2^{-1}	-	Nitrite
PO_4^{3-}	-	Phosphate
°C	-	Degree Celcius
µs	-	Microsiemens

ABSTRACT

This study investigated the physico-chemical properties of the groundwater surrounding the Solous Solid Waste Dumpsite at Isheri and determined the seasonal and spatial variations in the groundwater quality at selected distance intervals away from the dump site. This was with a view to determining the impact of percolating leachate from the dumpsite on the groundwater of the surrounding area.

Forty groundwater samples were collected from ten pre-determined sampling stations. Three sample stations were established before the dumpsite. Three other sample stations were located in the vicinity of the dump in the direction of the leachate plume while the remaining four sample stations situated further away acted as control. Sampling was carried out four times during the study period comprising of twice each in the rainy and dry seasons. Samples were collected from wells with the aid of the equipment used by the residents. The parameters measured *in-situ* were air and water samples (using mercury-in-glass bulb thermometer) and pH (using pH meter). Calcium and Magnesium were measured by complexometric titration using Ca-Mg indicator; Sodium was measured using flame emission spectrophotometry and Phosphate using flame photometry. The selected heavy metals (Copper, Iron, Lead, Cadmium, Zinc and Manganese) were measured with an Atomic Absorption Spectrometer. The oxygen parameters such as dissolved oxygen, biological oxygen demand, chemical oxygen demend and organic matter were determined titrimetrically. The data obtained were subjected to descriptive statistics, regression, analysis of variance (ANOVA), cluster analysis, and principal component analysis (PCA).

The study revealed that more parameters had higher values in the dry season than in the rainy season. Temperature (27.75±0.95°C), alkalinity (211.37±82.78 mg/L$CaCO_3$), phosphate (0.30±0.07 mg/L) and sulphate (2.78±0.35 mg/L), sodium ion (41.95±18.86 mg/L), dissolved oxygen (2.98±0.57 mg/L) and COD (33.54±4.50 mg/L) had higher mean values in the dry season than in the rainy season. On the other hand the mean values of electrical conductivity (1224.85±370.63), nitrate (0.01±0.003 mg/L), chloride (98.76±21.58 mg/L), calcium ion (5.38±0.68 mg/L), Magnesium ion (3.05±0.05 mg/L), BOD (22.37±2.20 mg/L) and pH (6.31±0.18) were higher in the rainy season than in the dry season. The heavy metals (Iron 1.10±0.05 mg/L, Lead 0.12±0.07 mg/L, Manganese 0.01±0.004 mg/L, Copper 0.15±0.003 mg/L, Zinc 0.07±0.004 mg/L and Cadmium 0.02±0.02 mg/L) were fairly uniform all year round. There was also a marked decline in values as one moved away from the dumpsite. The differences in seasonal variations of measured parameters were not significant at $p > 0.05$

The study concluded that the leachate percolating from the Solous solid waste dumpsite at Isheri, Lagos, had negatively impacted the groundwater quality of the surrounding study area.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Whilethere exists a water corporation board in almost all the states in Nigeria, the main source of water supply for house hold applications in the country todayis harnessing of groundwater mainly from individual household hand dug wells or by boreholes by the fewwho can afford the cost of a borehole. This is because public pipe borne water supply by the government at all levels is grosslyinadequate and in most places the available resources are not functioning. The other sources of water supply in most communities includesolar powered public boreholes, ponds, rivers and streams. In Nigeria, there has always been and there is still a great dependence on groundwater for domestic uses.

Groundwater is defined as water that accumulates in the pore spaces and cracks beneath the surface of the earth(Kemp 1998). It is an important component of the water cycle. Groundwater is thus recharged from surface water flows and atmospheric precipitation (mainly in the form of rain, hail and snow) percolating down into subsurface aquifers (fig.1.1). Groundwater can flow to the surface naturally as springs or harnessed though boreholes and wells.

Hydrological statistics (Chorley, 1969;Rosenberg, 2008) shows that 71% surface area of the planet earth is covered by five oceans (Atlantic, Arctic, Indian, Pacific, and Southern oceans) which altogetheraccount 97% of the total water volume on earth. Thus it is only about 3% of the water on earth that is non-atmosphere system as oceans (97.08%), ice sheet and glaciers

(1.99%), beneath the surface as groundwater (0.62%), atmosphere (0.29%), fresh water lakes (1%), (Rosenberg, 2008).

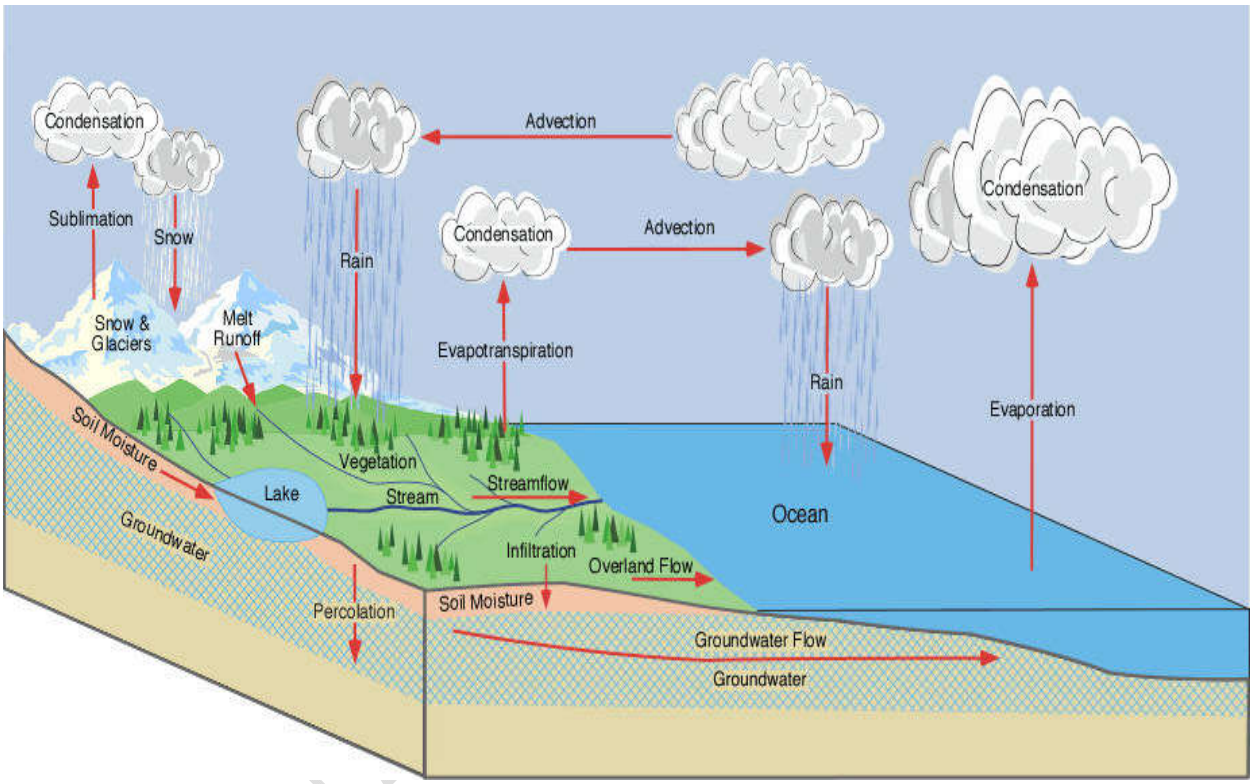

Fig 1.1 Hydrological Cycle. (Source: Australian and New Zealand Environment and Conservation Council, 2000)

From the surface, water percolates beneath the earths' surface and accumulates in soil pores, spaces and in the fractures of rock formations ranging in depth from one place to the other depending on a couple of factors which include the type and nature of the parent rock material, soil properties, ground elevation, sea level etc. A unit of water bearing rock or an unconsolidated deposit bearing water is called an aquifer when it can yield a considerable amount of water (Todd, 1980). In most instances groundwater in such an aquifer is harnessed either from wells in the rural areas and by hand pumped boreholes or by an electric pump installed to push the water out via taps in the urban centers.

Waste can be defined as anything that is unwanted, useless and worthless or in excess of the amount that is required.Wastes are mainly byproducts of mans' existence and activities and their disposal is of paramount importance as they could be harmful and injurious to human health and well being if not quickly and properly disposed off. Waste can also be injurious to human aesthetics as the sight tends to be repulsive while they smell offensively. Waste can take various forms; environmental wastes, nuclear wastes, hazardous wastes, etc and can occur in the three states of matter i.e. solid, liquid and gaseous wastes. Wastes can also be classified into such classes as: garbage (decomposable waste from food), rubbish (non decomposable wastes which could either be combustible or incombustible e.g. paper, wood, cloth, metal, glass and ceramics), ashes (residues of the combustion of solid fuels), sewage treatment solids (materials retained in sewage treatment screens, settled solids and biomass sludge), industrial wastes (such materials as chemicals and paints) and agricultural wastes (farm animal manure and plant residues) EPA (2004).

Sanitary landfill (a dump where dirt is used to cover the garbage so as to prevent it from being blown away and to keep associated odors down) is the most common shelter of solid waste

treatment. As much as 66% of solid waste in the United States ends up in waste dumps while in Canada the amount is 82% of the total solid wastes. The equivalent figures

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