Effects Of Refuse Dump On Ground Water Quality Within The Rivers State University Campus, Port Harcourt, Nigeria

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Abstract- Water remains one of the essential needs of man. Although, supply of fresh water is finite, availability of water is further threatened by contamination arising from man's use of space. Rivers State University has witnessed increase in its student and staff population. This increment has also resulted to huge wastes generation within the University campus. This study examined if there is any variation in physiochemical properties of borehole water at wastes dump sites and those away from the dumpsites. Out of a total of 174 boreholes and15 dumpsites within the Rivers State University campus, three bore holes located close to wastes dump sites and another three located 100 meters away from existing dumpsites were purposely selected for study. The result of investigation reveals that there exists variation in the Physiochemical properties of bore hole water found at dumpsites with those locate 100 meters away. Further analysis showed that most parameters examined for bore holes at the dumpsite fell below the WHO and Standard Organization of Nigeria minimum requirement for drinking water. The variation in these parameters was attributed to the effect of wastes dump close to this water source. The study recommends that the University management should as a matter of necessity install water treatment plants especially for wells around dumpsites before the distribution of water for consumption. There is also the need to put in place effective wastes disposal and management mechanism within the university campus as a desideratum for ensuring the protection of the health of students and staff of the University.

Index Terms- Ground water; contamination; dumpsite; wastes, Physio-chemical properties

I. Introduction

One of the challenges facing urban managers the world over is on how to effectively manage wastes such that they do not degrade the human environment. Man's interaction with his environment often times results in the degradation of the environment with attendant negative footprints.

According to Wilding and Zachars, (1991) anthropogenic activities are becoming of great concern to scientist as the chemical utilized in the course of agricultural, residential and industrial activities could impact greatly on the soil, ground water of surrounding environment resulting to potential threat to public health and human properties.

The 21st century has been characterized by very rapid growth in the number of urban centers. Unfortunately, increased population growth also transforms to increased wastes generation that may result in environmental degradation when not well handled. Increase volume of wastes generation impacts on biodiversity, and increase in global temperature as a result of the introduction of environmentally unfriendly gases on the environment.

Ground water constitute two third of the total fresh water reserve on the earth (Chitton, 1992).The world ground water reserve is estimated at about 5.0 x 10^{24}L accounting for over 2000 times the entire volume of water contained in all the rivers and creeks of the world and over 30 times the total fresh water contained in the world fresh water lakes (Buchanan, 1993).

In spite of the importance of water to man, its natural provision cannot be increased as less than 1 per cent of the earth's fresh is accessible to man and with increasing population, the demand for fresh water is expected to be one-third greater it is today (Melissa, 2018).

Ground water is mostly used for irrigation purposes accounting for over 50 percent of total irrigation water used and over 98 percent of domestic water usage in the rural areas (Todd, 2000). Although the quality of water found in ground water is very perfect as it satisfy the WHO drinking water requirement, anthropogenic activities such as manufacturing, agriculture could result in the pollution of ground water through the seepage of water from the surface of the earth to the ground water (Skinner, 2002).

Ground water can also be easily contaminated by the poor management of an open waste dump site, the use of latrine, mining activities, activities of manufacturing industries and other agricultural practices such as the utilization of pesticides and herbicides on the farm. The Rivers State University has witnessed increase in both student and staff population. Recent estimate has it that the school has a student population of 22,400 with a staff 3,000 which all together totaled 25,400 in 2017(Wikipedia, 2020) The import of increase population simply means more wastes generation with attendant management challenges..

In a bid to manage wastes within the campus, certain locations have been designated as wastes dumpsites. Poor waste management practice within and around the University campus may lead to the contamination of ground water through infiltration of leachates more so that unsafe water kills more people each year than war and all other forms of violence combined.

Poor wastes handing may further tasks the capacity of university management to supply adequate fresh water in both quantitative and qualitative terms giving the increasing population of students and staff. Our surmise is that indiscriminate allocation of wastes collection points may portent serious water quality challenges with attendant negative consequences on the socio-economic and health status of staff and students of the university. This work therefore seeks to examine the impact of open wastes dump on ground water quality within the Rivers state University campus.

II. Area of Study

Rivers State University Port Harcourt is located within the Diobu Area of Port Harcourt, Mile III, in Port Harcourt City Local Government Area of Rivers State.(Figure 1) The Rivers State University Port Harcourt has a population of about 3,000 civil force and 22,400,000 students in it making a total of 25,400 populations as at 2017. This figure does not include persons such as lecturer's children, staff children and of course some who make their living in and around University.

The climate of Rivers State University Port Harcourt is not different from the entire climate of Port Harcourt where it is superimposed. The dry season is short lasting for just two months with very brief influence of the harmattan. Precipitation in the region last for about 10 months with the heaviest month in September averaging 367mm of rain. December on average is the driest month recording about 20mm, temperatures throughout the year in Rivers State University of Science and Technology are relatively constant. Average temperatures are typically between 250c – 270c on campus.

The Rivers State University is generally a lowland area with average elevation below 20 meters above sea level. The region is made up of sedimentary formation and the basement complex rock. Some areas of the university campus is still having its natural vegetation especially the slums. It comprises the raffia palms and light rainforest, this is due to high rainfall in and around the campus. Other vegetation includes home gardens and ornamentation that beautifies the campus.

The prevalence of sandy or sandy loam is paramount in the University Campus. The soil on the campus is always leached, and beneath it is an impervious pan layer. This is due to construction works that is always happening on campus.

There are 2 campuses, old site and the new site. Other places include the agric site, Faculty of Law site, Staff Quarters both at the old and new sites properly linked together. The ISS section and the Arena, the Staff Club around the Amphi Theatres and the Commercial Area. Hostels include hostel H, D, etc.

The school runs a private health-care retainership scheme of its own that renders medical assistance to both staff and students.

The University has a permanent water supply scheme incorporated in the Department of works, where mini tankers are used to make water available to users in hostels, classrooms and laboratories. But is has been enhanced in recent times when boreholes are sunk and connected to almost all buildings in Rivers State University making the water board of the Department of works functional. Figure 1 is the schema showing study area

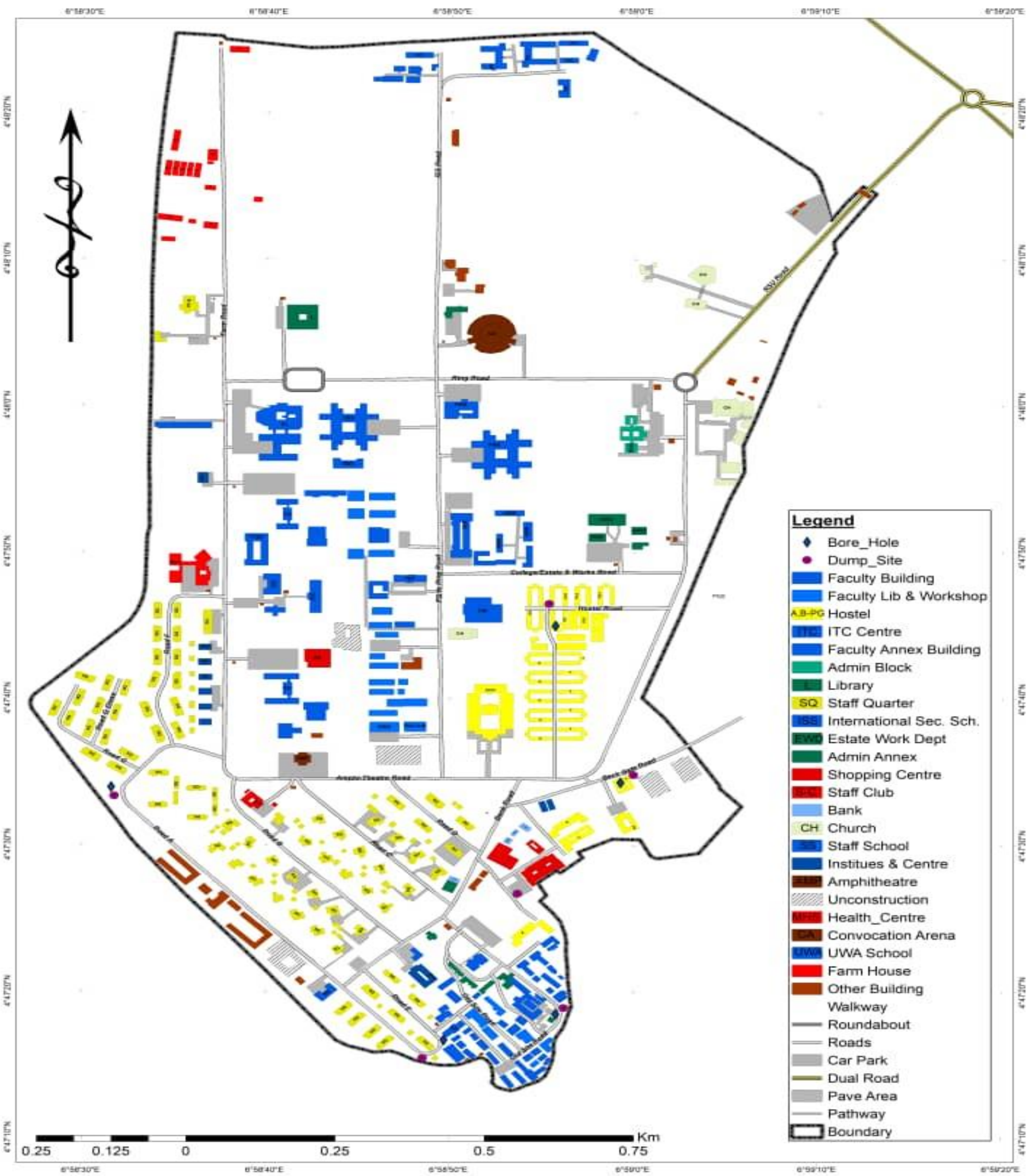


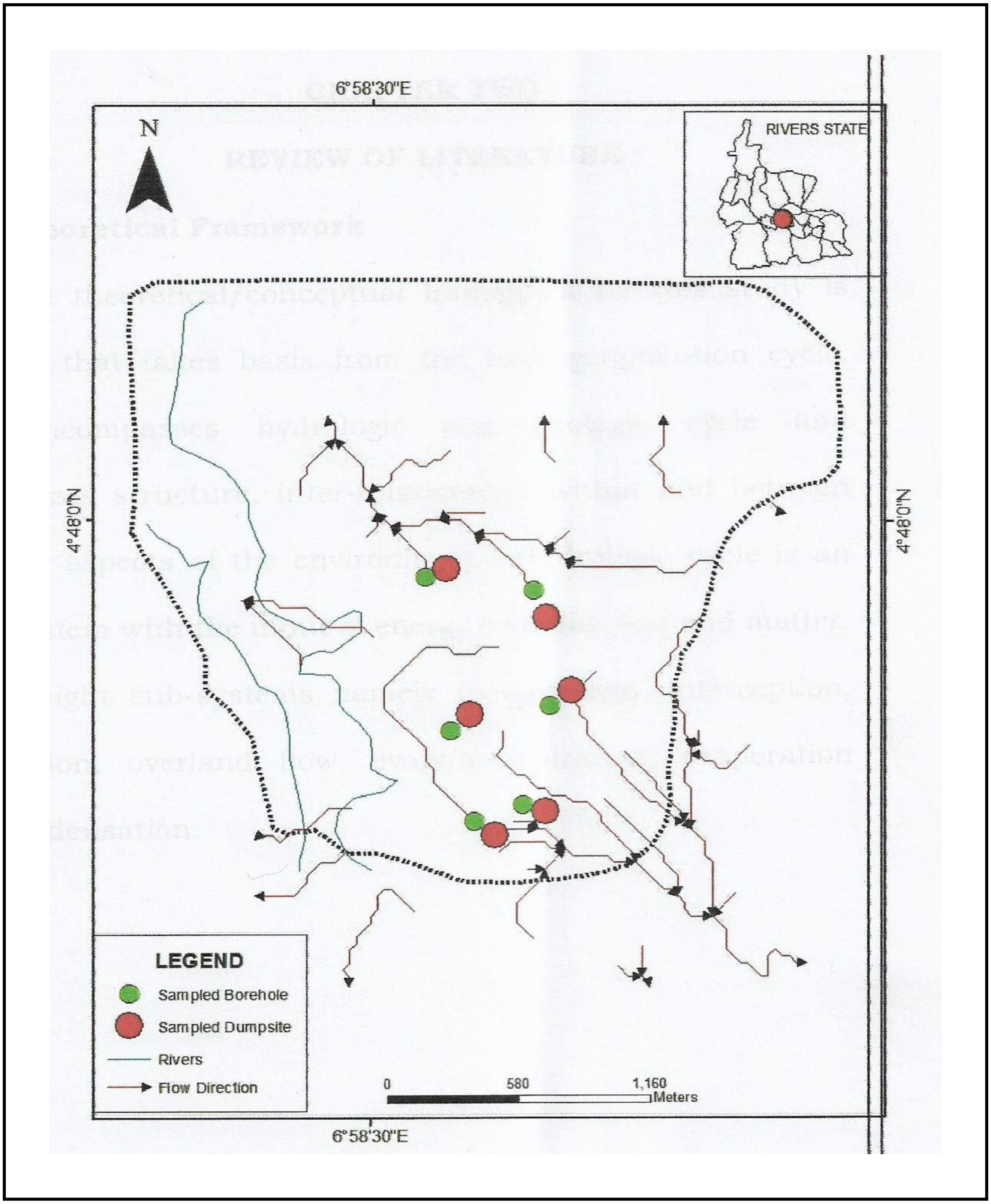
Figure 1:Rivers State University showing bore hole and waste dump sites

III. METHODS AND MATERIALS

The research employed experimental research design since the study intends to show if there is any statistically significant relationship between quality of bore whole water at wastes dump sites and those away from dumpsites. The objective is to determine if the variation in physio-chemical properties of borehole water at waste dumpsites varies with those located 100 meters away. This research design allows the investigation of cause and effect relationship as observed among the study parameters.

There are a total of 174 boreholes and15 dumpsites within the Rivers State University campus (figure.2). The choice of the number of boreholes was based on their proximity to wastes dump sites. Six boreholes three located close to wastes dumps and another three located 100 meters away from dumpsites were also selected for study. The direction of flow within the campus was a major yardstick for selection of borehole for study (figure 2).

Two sets of samples were collected for this study. Samples were collected from boreholes at selected dumpsites (Hostel F& G, staff Quarters and Old site}spots and a second sample that acted as control were also collected from boreholes at 100 meters away from dump sites. The water parameters of interest are Ph, Chlorine (Cl), Sulphur dioxide, SO3), Nitrogen dioxide (No3), Total Dissolved Substance, Turbidity, Ammonium (NH4), Iron (Iron),



Lead (Pb), Potassium (k), Calcium (Ca), Magnesium (Mg), Sodium (Na).

The water samples were collected using a 2-liter hand plastic and screw-capped bottles that have been sterilized to avoid contamination by any physical, chemical or microbial means. The collected well water samples were aseptically transferred into sterile 2 plastic containers.

Figure 2: Sampled Borehole and Dumpsite in relation to Flow Direction within Rivers State University campus
Source: Author's field work, (2020)

After collection, the samples were immediately placed in ice coolers for transportation to the laboratory and stored in refrigerator. The result of experiment was placed side by side with the WHO standards for water quality to ascertain if the physiochemical properties of the sampled wells are within the minimum allowable limit. The results of this work are presented in form and of tables and charts to enhance comprehension.

IV. Theoretical Framework and Literature Review

The theoretical framework for this study is the hydro-geopollution cycle. (Figure 3).This encompasses hydrologic and geologic cycle and emphasizes structure, inter-relationship within and between different aspects of the environment. Hydrologic cycle is an open system with the input of energy from the sum and matter. It has eight sub-systems namely precipitation, interception, percolation, overland flow, evapotranspiration, evaporation and condensation.

The entrance of pollutants into the hydrological cycle is subject to the failure of proper management of the system. The entrance is via percolation from the geological cycle and atmospheric precipitation of acidic rain and other forms of atmospheric pollutants. The cycle here refers to the movement of water from the atmosphere to the earth and back to the atmosphere induced by the energy of the sun. Some infiltrates into the soil and later peculates to become groundwater. Groundwater is subsurface water that fills voids in geologic formations

At any stage of the hydrological cycle, pollutants and contaminants may be introduced and cyclically dispersed from one point to another, as pollutant could be either from a point or nonpoint source.

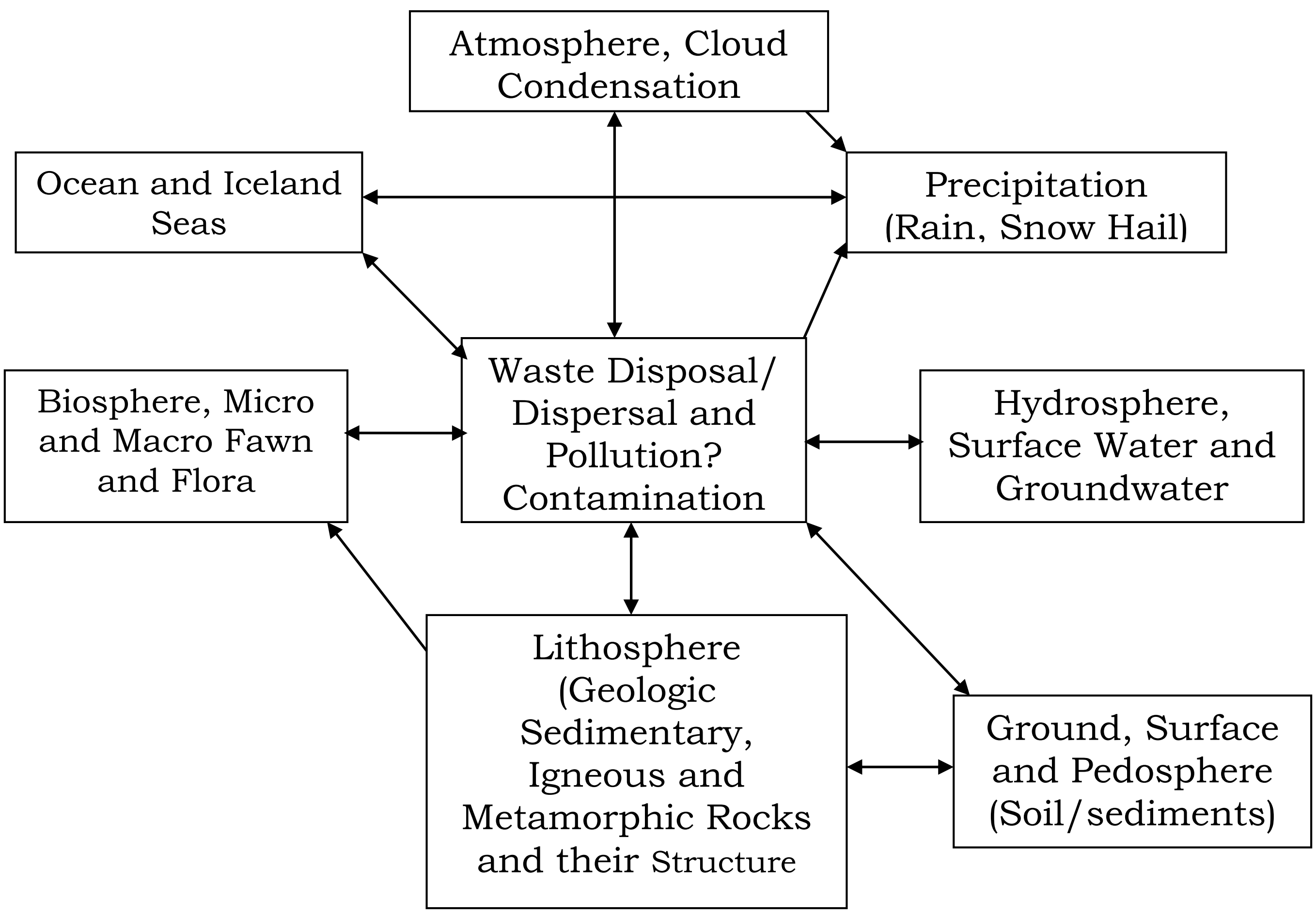


Fig 3: The Hydrogeopollution cycle Source: Egboka et al (1998)

2.2 Literature Review

Waste refers anything that has no use value. NISP (2003) described wastes as material from the production process that can no longer be put to use. Waste can be in diverse forms which are, solid, liquid or gaseous state. Waste in the solid state are waste generated in the form of broken bricks, bottles and so on while waste generated in the liquid form are waste such as effluent and finally waste generated in the gaseous state are waste in the form released from industrial stacks making for particulate matter in the air (Adedibu, 1992).

The growth of population and the pace of urban development have resulted in the generation of large volumes of wastes outpacing the level of sanitation in the cities making life difficult for the urban poor who live with no sanitation in most of their environment. This situation has resulted to poor access to sanitation by over 2.4 billion people globally distributed at the tune of 80 to 13 percent in Asian and Africa respectively. Though, the situation is different in the urban centers but still with poor presence of sanitation awareness in the urban area though significantly better than the rural areas.

Water governs the survival of all living things on the planet earth. Though the essence of water and the scarce availability of fresh water is also complicated by man industrial activities by the introduction of pollutants via sewage into the scarce available fresh water system affecting the physical, chemical and biological processes of the environment to include plant and animal life. Lee and Jonelee, (1996) while considering the impact of wastes on ground water quality argued that little amount of land fill leachate can contaminate huge amount of ground water expose the reserve unsuitable for household and lots of additional function.

A cloud of contaminant is frequently in attendance downward slope from landfill sites. This cloud can be recognized by high chemical apparatus in the ground water, which have been consequential from the sequential collapse and leachate of the waste (Akan, et.al 2007) Natural concentration and micro-biological distinctiveness of the waste matter are capable of causing physiochemical change in soil, as a consequence of the nutrient and pathogen level in the ground (Dawes and Goonetilleke, 2001;. Wetherill, 2001) observed that the financial side of landfill in municipal Australia do not pull through the spending cost, and regulator be supposed to think about burning amenities. The core difficulty is that current occurs from beginning to end of jagged rock fractures that are mainly responsible for the conveyance of leachate (Lee and Jones Lee op cit). Although there is high level awareness' on the negative impact of wastes on water resources among residents in the study area, there is need to scientifically ascertain the impact of open wastes dump site on physiochemical properties of water within the Rivers State University campus

V. RESULTS AND DISCUSSION

Analysis of the physio-chemical parameters of bore hole water within the dumpsite areas and those 100 meters away from the dumpsites (table 1, figure 2) reveals that the parameters varied for all the water parameters investigated. From the results, the pH value of the samples collected at the different dumpsites located at F& G Hostel, Staff Quarter and Old site fell short of the WHO standards with values of 6.1, 5.9 and 5.7 respectively compared to the PH of bore hole water found 100 meters away from the dumpsites that were within the minimum WHO standards (6.5-8.5).

for Lead (Pb), the results of water analysis shows that here is no trace of Pb for boreholes 100 meters away from the dumpsites while at dumpsites Lead was detected with values ranging from 0.105, 0.87 and 0.094 for F& G Hostels, Staff quarters and Old site respectively (table 1). According to the Standard Organization of Nigeria (2007), the high lead value of these environment if it percolates into the groundwater is capable of causing cancer, interference with vitamin D metabolism, affect mental development in infants, toxic to the central and peripheral nervous system. Figures 5and 6 shows the lead values vis-a-vis the SON's range

Table 1: Physio-chemical properties of Bore hole water at different dumpsites in RSU Campus

	Pysio-chemical properties of Bore hole water at different dumpsites in RSU Campus			**Physio-chemical properties of Bore hole water 100 meters away from dumpsites in RSU Campus**			**WHO Minimum Standard**
Parameters	**F & G Dumpsite**	**Staff Qts Dumpsite**	**Old Site Dumpsite**	**F & G Borehole**	**Staff Qts Borehole**	**Old Site Borehole**	
pH	6.1	5.9	5.7	7	6.9	6.8	7.0 – 8.5
CI	5.92	5.94	14.32	4.94	4.43	3.45	250 mg/l
SO2	4	2	3	1	1	1.12	200 mg/l
NO3	4.04	1.08	1.03	0.01	0.03	0.03	4.5 mg/l
TDS	87	63.7	153	1	4	2	200 mg/l
Turbidity	20.04	20.11	18.34	0.01	0.04	0.02	5 NTU
Nh4	1.05	0.88	0.06	0.06	0.06	0.05	0.2mg/l
Fe	5.721	3.2	4.201	0	0	0	0.3 mg/l
Pb	0.105	0.87	0.094	0	0	0	1.5mg/l
K	16.71	20.44	21.42	0.01	0.001	0.002	200mg/l
Ca	4.6	3.07	9.21	1.53	1.53	2.3	75mg/l
Mg+	0.93	1.01	1.4	0.46	0.93	0.093	10mg/l

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Na	5.196	4.147	5.181	2.91	4.03	2.557	200mg/l

Source: Author's field work, (2020)

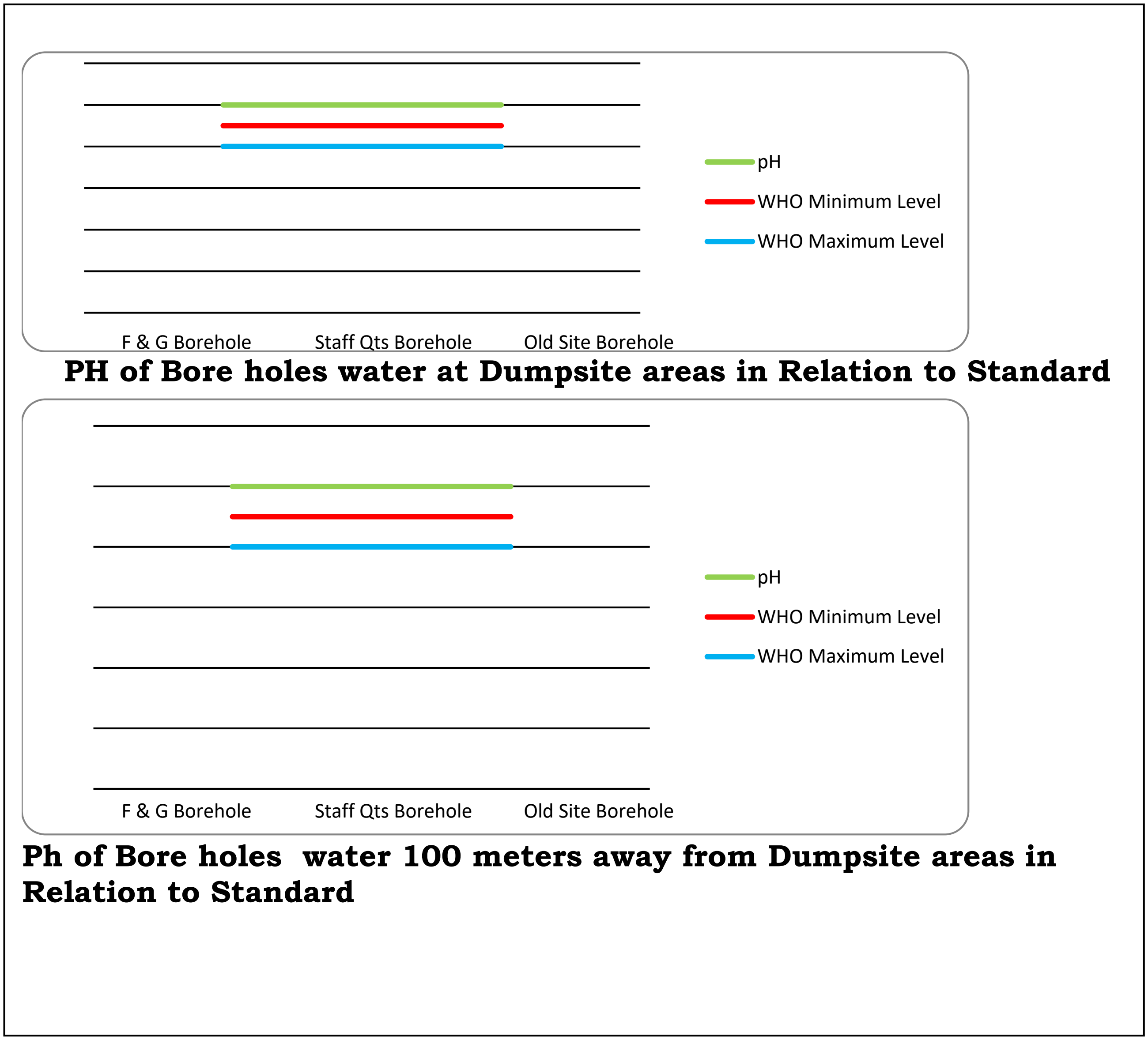
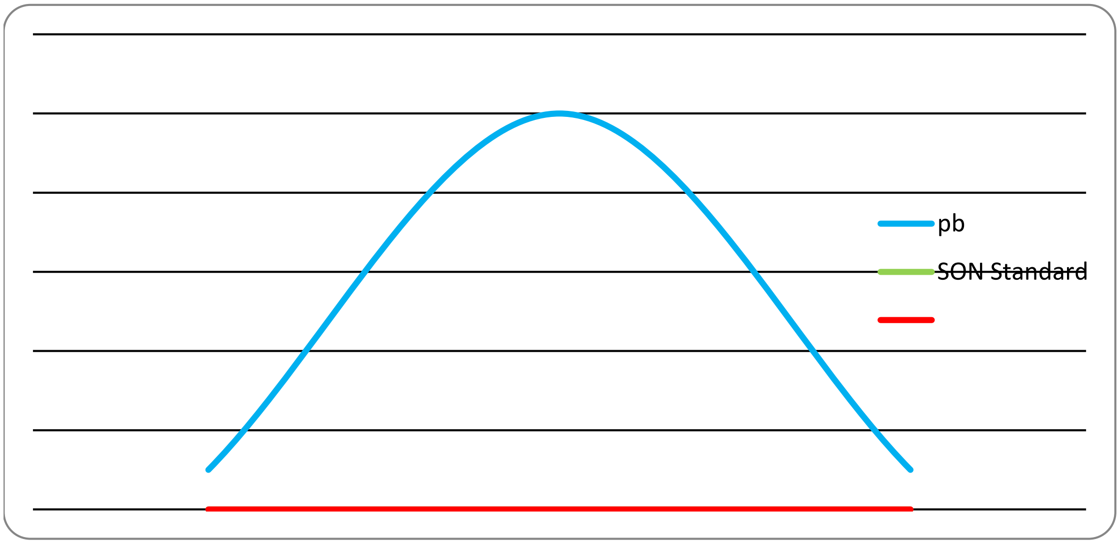
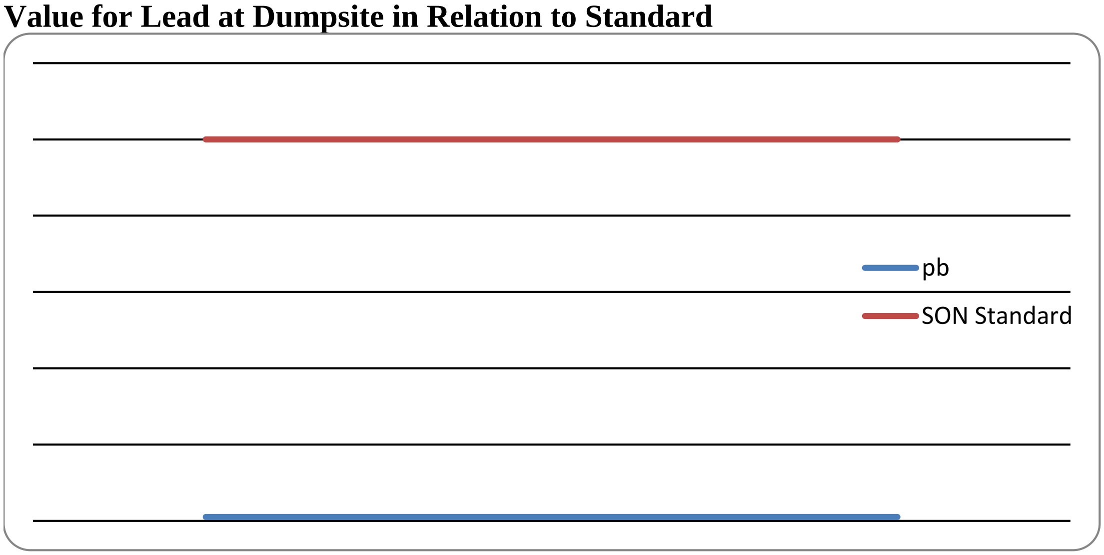


Figure 4: Values of boreholes at dumpsites and boreholes 100meters away from Dumpsite in Relation to Standard
Source: Authors field work, (2020).



Value for Lead at Dumpsite in Relation to Standard



Value for Lead 100 meters away from Dumpsite in Relation to Standard

Figure 5: Values of boreholes at dumpsites and boreholes 100meters away from Dumpsite in Relation to Standard

Source: Authors field work, (2020).

Analysis of Magnesium however showed that they are below WHO acceptable limit for borehole water at dumpsite and those 100 meters away. The values range from 0.93- 1.4mg/l for bore holes at the dump site to 0.4-, 0.093 for bore holes 100 meters away.

Further analysis indicated that values for iron (Fe^{+2}) for borehole water at the dump sites were all higher than WHO limit of 0.3mg/l. the values measured at different points were 5.72mg/l for F&G hostel, Staff quarter, 3.2mg/l and Old site 4.2mg/l. This is in contradistinction with values of boreholes 100 meters away from dumpsites where there were there was no detection of iron

While a low level of iron isn't harmful in and of itself, iron in drinking water is classified as a secondary contaminant. This is because iron often carries with it bacteria that feed off the iron to survive. These small organisms can be harmful when digested. Excessive iron levels may lead to gene mutation. More so, Water with iron has a metallic taste to it, which makes it very unpleasant to drink. While water with high levels of iron is not recommended for cooking needs. Vegetables and other foods cooked in such water will blacken and absorb bad tastes.

For other water parameters such as Chorine, Sulphur dioxide (So2), Nitrogen dioxide (No3), Total Dissolved Substance (TDS), potassium (k) and calcium (Ca) were all within allowable WHO limit for bore boles waters at dumpsites and those 100 meters away from dumpsites.

One implication of the findings of this study is to the fact that borehole waters close to dumpsites around the F&G Hostels, Staff quarters and old sites are not good for drinking in line with microbial standard. Their quality therefore needs to be improved with adequate treatment.

VI. Conclusion and Recommendation

This work looked at the impact of waste dump site on the physio-chemical characteristics of borehole water within the Rivers State University campus. Water samples were taken from borehole located at dumpsites and another sample from boreholes 100 meters away from dump sites. It was observed that the there are some levels of contamination of the ground water within the waste dump site as against those located 100 meters away from the dump sites.

The import of this is that borehole waters at dumpsites around the F&G Hostels, Staff quarters and old sites of Rivers state University campus are not good for drinking as they have been contaminated by leachates from wastes. The quality of water located close to wastes dumps in the university campus needs to be improved with adequate treatment before they are eventually consumed. Putting in place effective wastes disposal and management mechanism within the university campus is a desideratum for ensuring the protection of the health of students and staff of the university.

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