Spatiotemporal Variability of the Effects of Leachates on Shallow Wells Water in Kano Metropolis

Hadiza Ado Suleiman & Isham Sani
Department of Geography
Sa'adatu Rimi College of Education Kumbotso, Kano

D.O.I: 10.56201/ijgem.v8.no2.2022.pg36.47

Abstract
Improper solid waste management in Kano Metropolis, Nigeria has become a serious threat to human health and ground water quality. Groundwater monitoring should be conducted to assess the groundwater contamination, especially originated from leachate generated from the dumpsites. Most of the dumpsites are located nearby water body that subsequently affecting the quality of the water for human purposes. This study aims to investigate the relationships between different physical-chemical and biological parameters during the two seasons (dry and wet seasons) in Kano Metropolis area as well as to identify the sources of variation during the two seasons. The level of some physical-chemical and biological parameters of the groundwater (wells) and dump sites were assessed (i.e. temperature, pH, conductivity, suspended solids, turbidity, hardness colour, e-coli and coliform). Mean concentration of some physical-chemical and biological parameters except that of temperature, colour, pH and total dissolved solids were found to be above the acceptable limit of the National and International standard of drinking water quality, NESREA and WHO. The sources and variations of the samples results were tested using statistical analysis. The water samples show a considerable level of pollution. The analysis of the groundwater and that of dump sites reveals no significant difference in the parameters measured. It is therefore recommended that the water from this source should be monitored and treated properly before consumption.

Keywords: *Water quality, Landfill, Groundwater pollution, Leachate.*

1. INTRODUCTION

Water is a major need for all forms of life with increase in population and industrial development, its demand and supply has become lopsided and quality deteriorated. The world water situation has grown from bad to worse and presently precarious especially in developing countries like Nigeria, the surge in population and unprecedented urbanization in the last quarter of the 20th century compounded the water situation in Nigeria.

Some other causes of water quality deterioration as outlined by Maigari (2002) are industrial activities, agricultural practices, municipal waste generation and mode of disposal, land erosion etc. However numerous experts and groups such as international organizations concerned with physical environment and human health such as (WHO 1992, 2000) have

since emphasized the need for water intended for human consumption to be free from organisms and from toxic concentration at levels that may be hazardous to health. Thus, monitoring, evaluation and protecting source of domestic water supplies in communities become necessary. Nevertheless, the task before policy makers in the first instance is through adequate planning. Planning in this regards as pointed out by Abdulkadir (2000) is high quality data dependant. Thus in turn depends on the contribution of many relevant fields of experience such as water engineering, environmental sociology, health, research and training government and its policy as well as individual and community groups.

It is in view of such precedence that, water quality criteria, standards and guidelines are established internationally primarily concerned with quality control and public health.

Meanwhile the water supply from pipe born in the last few years in Kano metropolis is in short supply. That is why some people within the metropolis opt for groundwater in place of pipe borne water, such as shallow wells and boreholes. The qualities of such water received attention at several point in time by different researchers Tanko (1997).

This research work also presents findings on the quality of water of some wells sited within and around Gyadi-Gyadi solid waste dumpsites to determine the effect of waste dumps on the quality of shallow open wells in the area. These wells serve as a source of drinking water and production of goods and services in the area. This source of water will be assessed using physical and biological parameters as indices.

2. MATERIALS AND METHODS

2.1 STUDY AREA

Gyadi-Gyadi quarters is located in Tarauni local government area (Fig 1) within Kano metropolis. The metropolitan Kano lies between latitudes $12^{0}03^{1}$N and $8^{0}31^{1}$E and longitudes $70^{0}3^{1}$N and $1^{0}35^{1}$E.

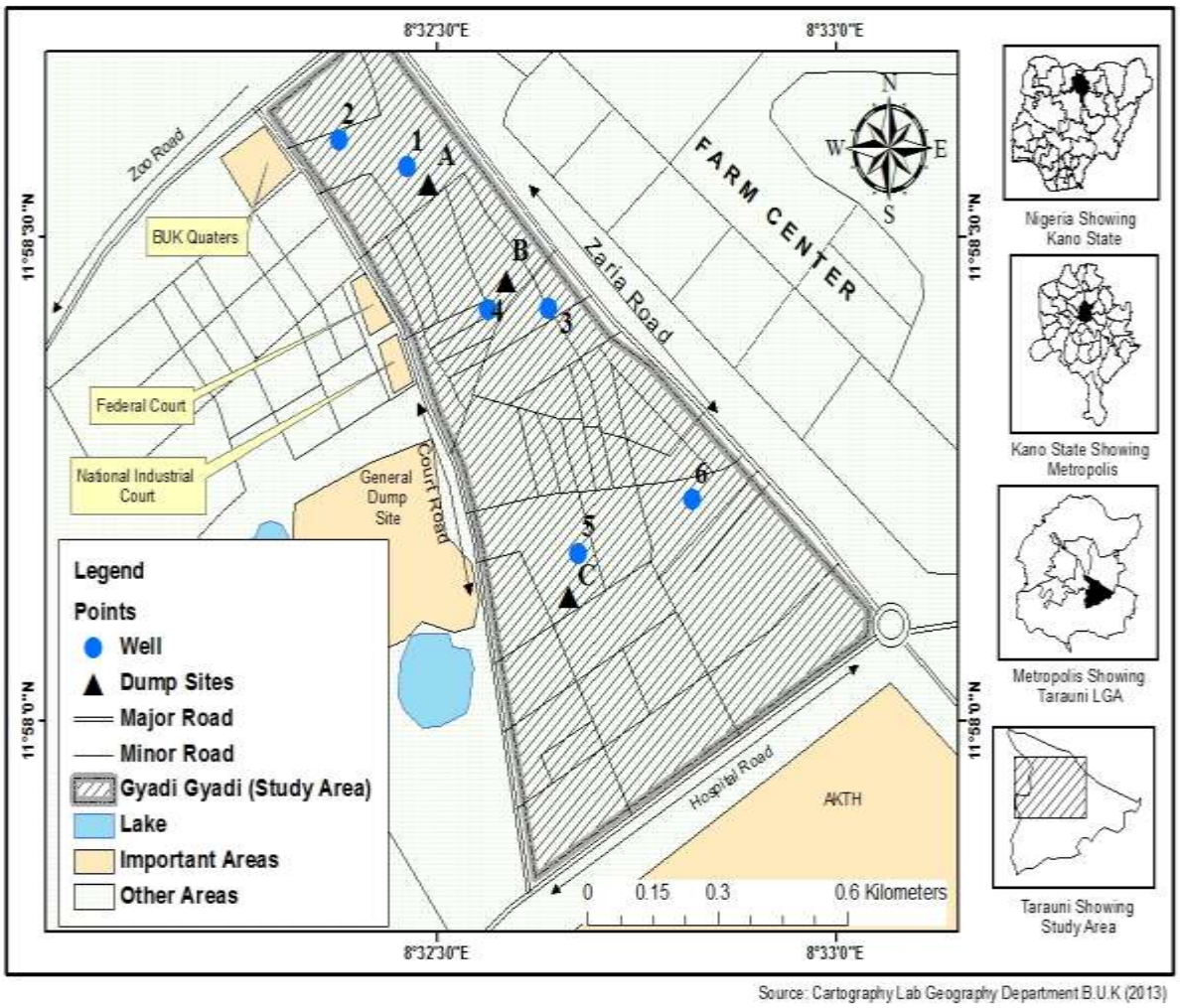


Figure 1: Map of Gyadi Gyadi Showing the sampling points

The study area is among the seven local government areas that compose the metropolis city which has a lot of infrastructural facilities, utilities and services. It is well accessible from every angle in Kano metropolis because most of its wards are along Kano –Zaria expressway.

The local government has ten wards and the area under study lies within the wards. Gyadi-Gyadi lies between latitudes $12^{0}02$N and $11^{0}58.15$E and longitudes $8^{0}30^{1}$N and $8^{0}32.55$E.

The climate of the area could be regarded or categorized as AW under Koppens classification which is wet and dry, although climatic changes are believed to have occurred in the past. The climatic characteristics are typical of West African savanna. Temperature in the region is generally high throughout the year. These consist of warm rainy season from June to September, a cool dry season from October to May. The warm rainy season is traditionally the farming period. Rainfall is highest in July and August during which precipitation exceed potential evapo transpiration in the years.

2.2 SAMPLING TECHNIQUES

For the purpose of this research stratified random sampling technique was used. The selection was made of the open wells in the three selected location of the study area.

To ensure statistical validity of the result two wells and one dump site were selected in each of the three locations of the study area based on 5-15 meter radius from the open well to the dump site in order to assess how much the influence dies at some interval.

2.3 DETAILED FIELD WORK

The detailed filed work was conducted in the following way; direct observation was undertaken were the six selected open wells and three selected dumpsites were visited for identification and collection.

The water samples were collected using 2 litre plastic and screw-capped bottles that have been sterilized to avoid contamination by any physical, chemical or microbial means. Temperature of the collected water samples were immediately taken before they were placed in the ice cooler for transportation to the laboratory. All the water samples were obtained in the morning of two different seasons respectively. The seasons are dry and wet in the months of April, May, and June for the dry seasons and the months of July, August and September for the wet season of the year 2022.

2.4 LABORATORY TECHNIQUES

The methods described herein are adopted in accordance with the chosen parameters analyses. Ten important parameters were tested for to ascertain the portability of all water samples from the six different sources. The water physical and biological analyses were done using standard analytical method of water analysis, each sample was analyzed in duplicate and the averages of the result were reported. Generally laboratory quality assurance measures were also observed to prevent sample contamination and instrumental error.

2.5 STATISTICAL ANALYSIS

To ensure statistical validity of the result, means, correlation coefficient and ANOVA were employed in the analysis of data. The means of physical and biological parameters in each water sample was compared with national and international standards of drinking water in order to ascertain whether they are within the acceptable limit or not.

Student's 't' test was also employed to compare the wells water quality to assess whether there is relationship between the wells water and the dumpsites in the area.

The comparison was made between the seasonal variability in water quality, spatial variability in water quality and the relationship between proximity to dump sites and the water quality.

.:

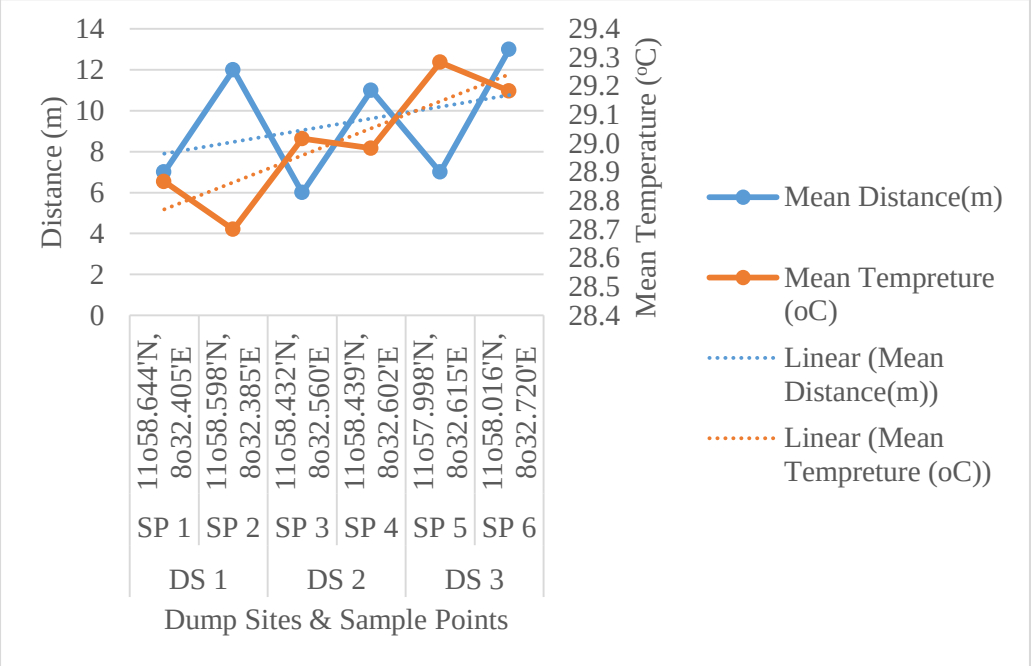
3. RESULTS AND DICUSSIONS

Open dumping thus present an environmental and health threat through water and soil contamination, disease transmission, fire danger and injury to site salvagers. One of the

severe problems associated with the open dumps is infiltration of leach ate into the surrounding environment and subsequent contamination of water. In dump sites leach ate forms as water percolates intermittently through the refuse pile, and can contain high levels of nutrients, heavy metals, toxins etc.

A correlation coefficient was employed to find out the relationship between the distance from dump sites and the water quality.

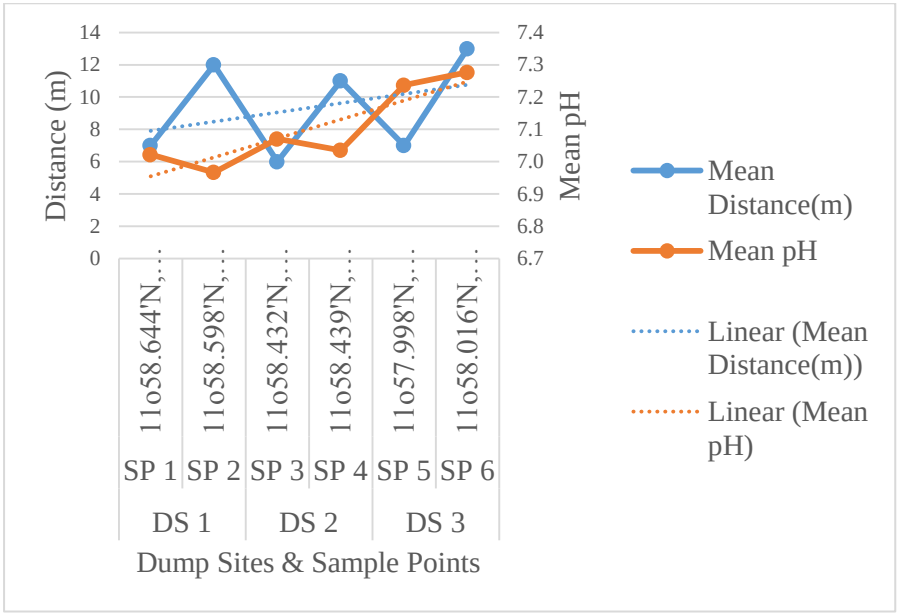
This is similar to the work of oluseyi etal (2014) on the comparative assessment of the impact of a functional and abandoned waste dump site on the quality of neighbouring ground water in Lagos Nigeria where the levels of some physico-chemical, microbial and heavy metals of two soil samples obtained from dumpsites and nine hand-dug wells at different proximities were tested where the values of physico-chemical parameters were within the acceptable limit of who and NSDQW while the microbial parmeters exceeded the regulatory limit.



Source : Field work and Laboratory Analysis (2022)

Figure 2: Relationship of Ground Water Temperature to Distance from Dumpsite

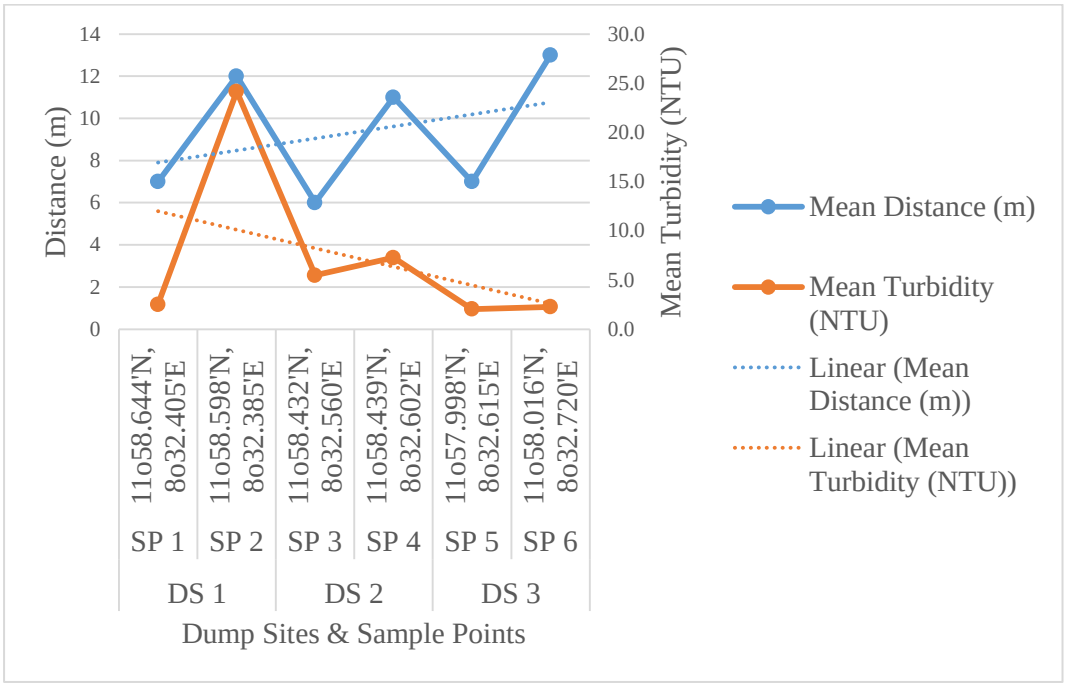
The correlation coefficient of the Temperature ground water samples shows a positive weak relationship between the ground water samples and the dump sites.



Source : Field work and Laboratory Analysis (2022)

Figure 3: Relationship of Ground Water pH To Distance from Dumpsite

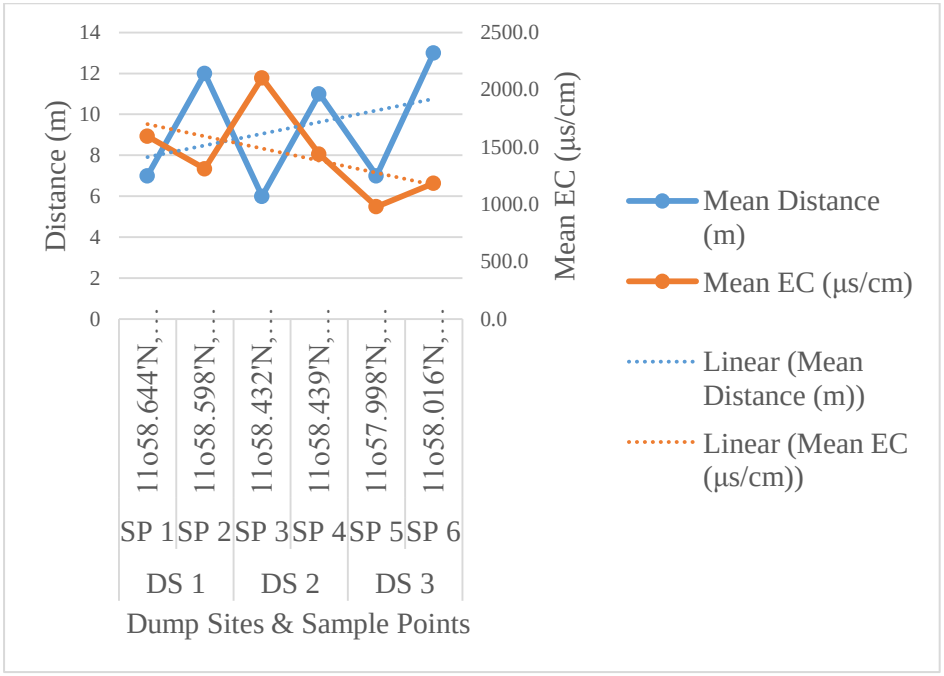
The correlation coefficient of the pH ground water samples shows a positive weak relationship between the ground water samples and the dump sites.



Source : Field work and Laboratory Analysis (2022)

Figure 4: Relationship of Ground Water Turbidity to Distance from Dumpsite

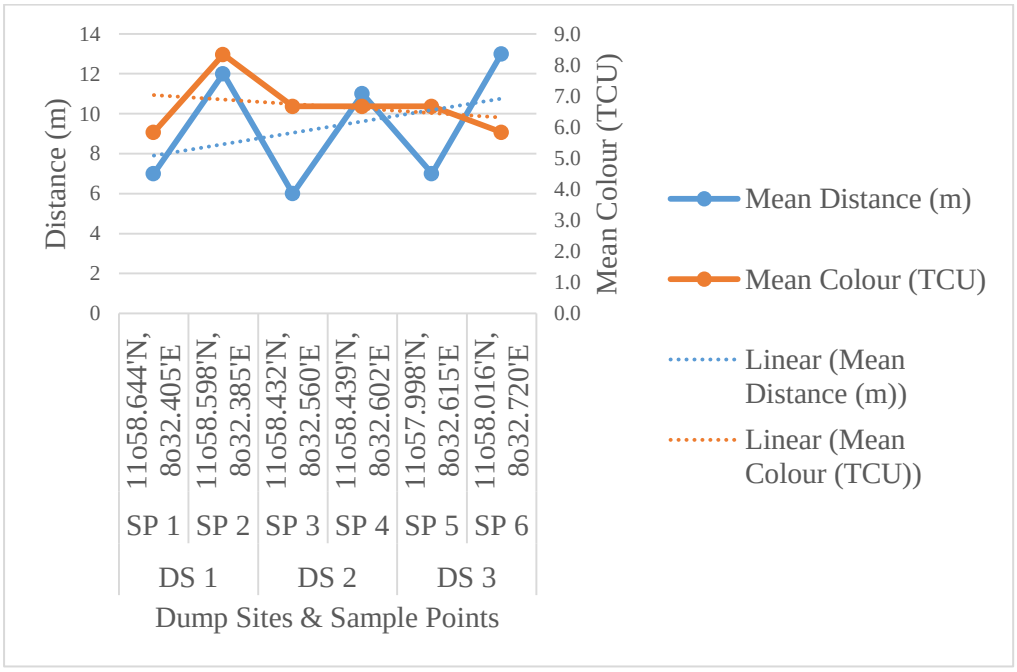
The correlation coefficient of the ground water turbidity shows a positive weak relationship.



Source : Field work and Laboratory Analysis (2022)

Figure 5: Relationship of Ground Water Electrical Conductivity to Distance From Dumpsite.

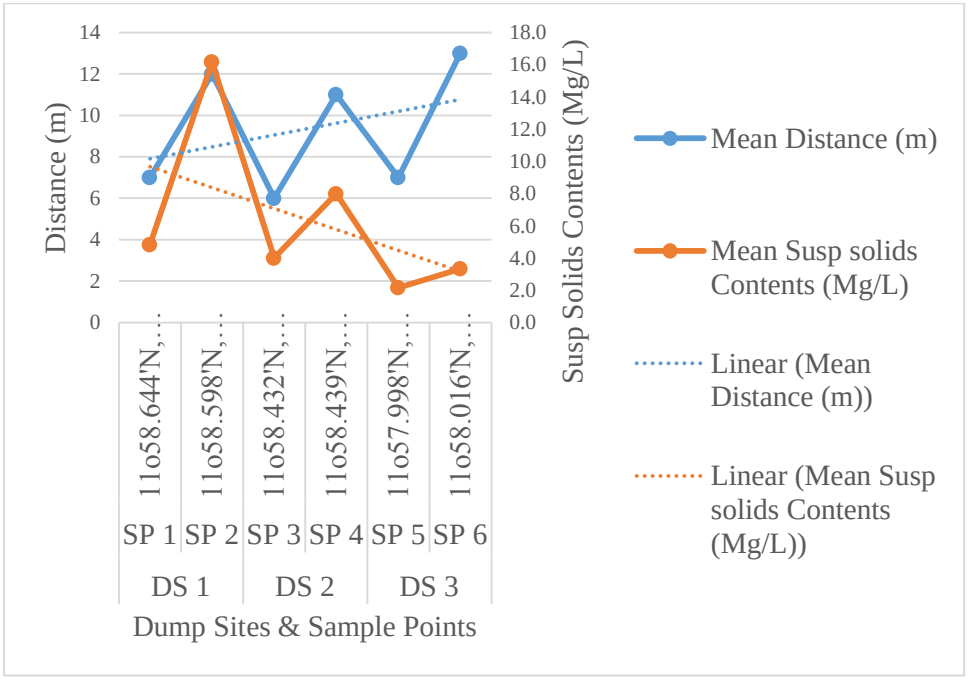
This shows that there is negative moderate relationship of electrical conductivity between the ground water and the dump site.



Source : Field work and Laboratory Analysis (2022)

Figure 6: Relationship of Ground Water colour to Distance from Dumpsite

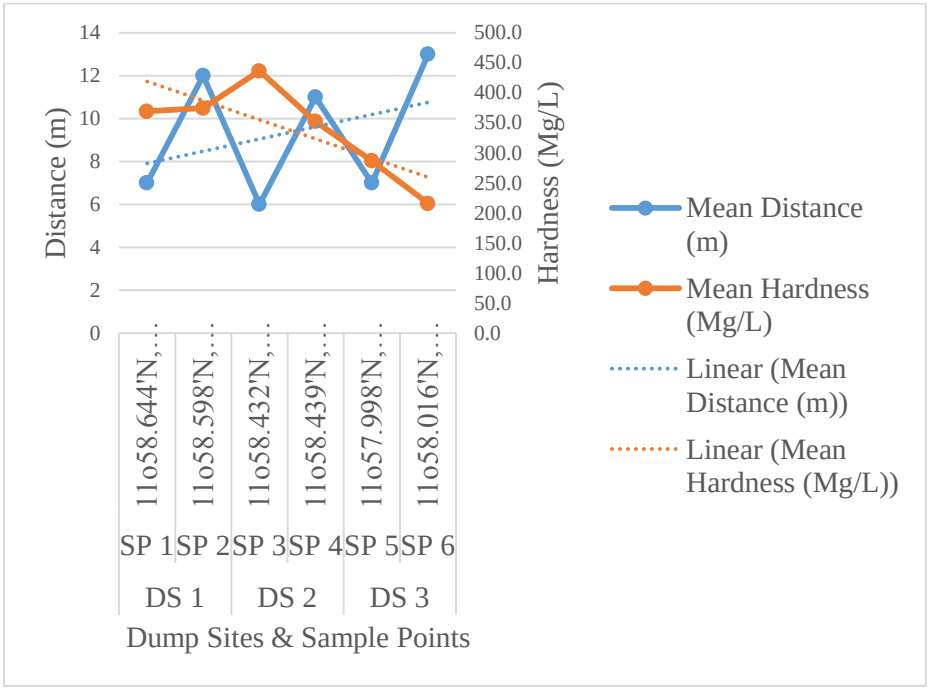
This shows a positive weak relationship between the ground water and the dump sites



Source : Field work and Laboratory Analysis (2022)

Figure 7: Relationship of ground water suspended solids contents to distance from dumpsite.

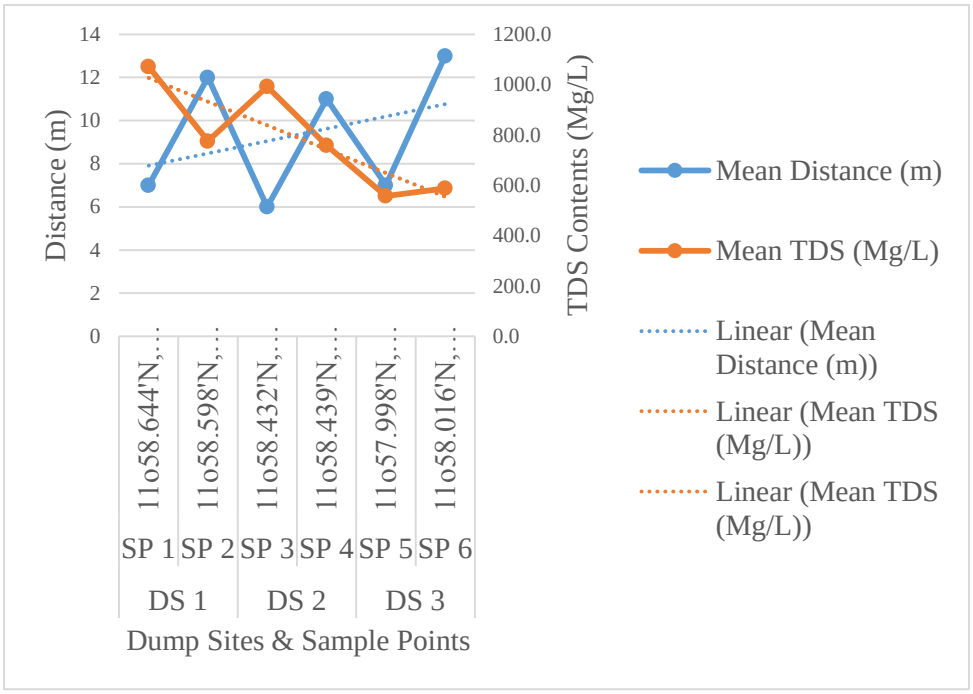
The correlation coefficient shows a positive moderate relationship of suspended solids between the ground water and the dump sites



Source : Field work and Laboratory Analysis (2022)

Figure 8: Relationship of Ground Water Hardness to Distance from dump site.

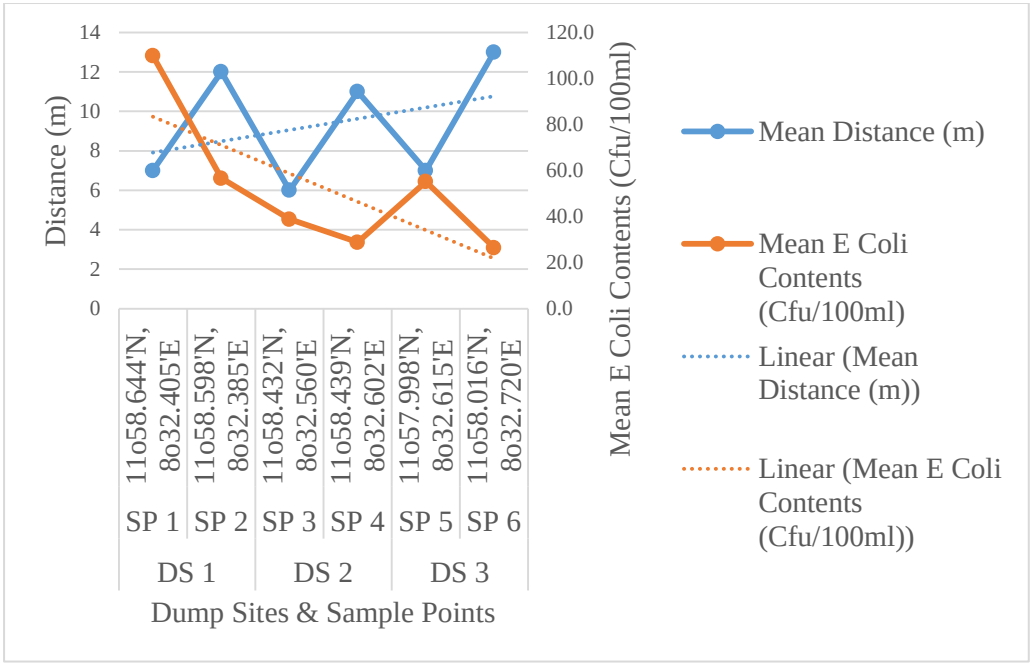
This shows a negative moderate relationship of hardness between the ground water and the dump sites.



Source : Field Work and Laboratory Analysis (2022)

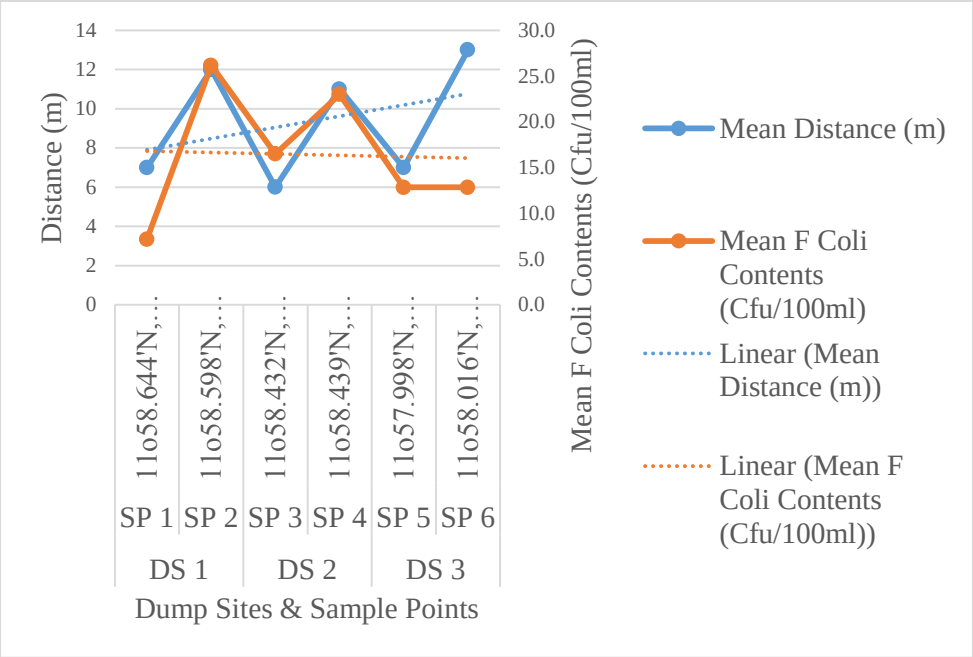
Figure 9: Relationship of Ground Water Total Dissolved Solids to Distance From Dump sites.

This shows a negative moderate relationship of total dissolved solids between the ground water and the dump sites



Source : Field work and Laboratory Analysis (2022)

Figure 10: Relationship of Ground Water E coli Contents to Distance From Dump site. The correlation coefficient shows a negative moderate relationship



Source : Field Work and Laboratory Analysis (2022)

Figure 11: Relationship of Ground Water F coli Contents to distance from dump site.

This shows a positive moderate relationship in the f coli content between the ground water and the dump sites.

4. CONCLUSION

The study has been carried out to assess the effects of waste dump on the quality of well water in Gyadi Gyadi area of Kano metropolis. The principal aim of monitoring drinking water is to prevent the spread of water borne diseases and to protect the health of the community. The importance of access to good quality water cannot be over emphasized. Increase in population in Gyadi Gyadi coupled with the rise in human activity pose a great pressure on provision of safe drinking water. This necessitates large number of people to consume water from shallow open wells which constitute a major health problem due to close proximity of wells to dump sites. This study recorded a high number of coliform counts in water samples analyzed, thus making it unsafe for drinking which requires further treatment.

This work has revealed that the wells water samples obtained within three (3) locations from six (6) different wells in the dry and wet seasons in the study are did not meet both the national and international standard of drinking water quality and therefore not fit for human consumption. This work corroborates the assertion of Fosunwon et al (2008) credited to the conclusion of joint UNICEF/WHO (2005) report on rapid assessment of drinking water quality in Nigeria. They stated that more than 70% of water sources in Nigeria are contaminated and constitute risk to human health. The data revealed that there were considerable variations in the examined samples as far as parameters like hardness, conductivity, turbidity, e coli and f coli are concerned only the colour, pH, TDS and the temperature falls within the acceptable limit. The presence of these physical and biological parameters at high level in the water rendered it to be poor quality. It was also observed that distance from the dump site has no effect on the wells water because pollution was recorded in all the wells water analyzed, therefore this may be due to lack of proper cover on the wells or it may be due to the attitude of the inhabitants of the area like improper waste disposal that may lead to the pollution of the wells water.

5. RECOMMENDATIONS

With particular reference to the findings of this research, the following recommendations are made:

1. Public health education on water sanitation is required, especially with routine monitoring of human activities in the area, pertaining all sources of water supply.
2. It is recommended that people should device the means of treating water locally to reduce the hazards of biological parameters which are the most dangerous through boiling, addition of alum and local chlorination especially those suspected to contain high concentration of coliform bacteria, and this should be done by coordination.
3. The local communities should be mobilized to undertake regular maintenances and sanitation, and the government should monitor the way and manner waste is being disposed in the area.

4. FEPA quality laws should be viewed and reinforced by state water agencies.
5. Local Government Councils should establish water laboratory units that will be testing any suspected sources of water contamination in the area and advising appropriate authority.

REFERENCES:

Abdulkadir A. (2000): *An Appraisal of the planning and management of large scale Irrigation development in northern Nigeria.* Ed. Paper from issue in land administration and development in northern Nigeria No. 24 pg 271 Dept of geography BUK Kano.

Maigari A. I (2002): *Introduction to environmental problem and management*, wadallah environmental consult (WADEC) Kano Nigeria.

Oluseyi.T. Adetunde,O. and Amad.E.(2014): *Impact assessment of dumpsites on quality of near-by soil and underground water*. A case study of an abandoned and a functional dumpsite in Lagos Nigeria. International journal of science, environment and technology 3(3): 1004-1015.

Tanko A. I (1997): *Industrial waste water pollution and its effects on shallow groundwater sources in the metropolitan Kano*. Paper presented at the 4th annual conference of Nigerian Geographers Associaton (NGA).BUK.

UNICEF/WHO (2005): Joint water supply, sanitation monitoring programme world health organization.

WHO (2000*): Guideline for drinking water quality Surveillance and control of community supplies* 2nd edition vol. 3 WHO Geneva.

WHO (1992): *Guideline for drinking water quality* Vol. 3 second edition surveillance and control of community supplies