Impact Of Gyadi–Gyadi Solid Waste Dumping Site On The Quality Of Ground Water Of The Neighbouring Environment

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Abstract: This work examines the effects of an open dumpsite on the quality of shallow underground water in Gyadi-Gyadi ward of Tarauni Local Government area of Kano State, Nigeria. Analysis of the physical and chemical parameters of raw water from four wells located at various distances (100-500m) from the dumping site shows that the concentrations of nitrate and phosphate in the analyzed water samples were below detectable limits. Whereas, the pH of the ground water is slightly acidic, this could be attributed to acidic leachates from the decomposing waste. However, most of the water parameters tested fall within the standards of the World Health Organization (WHO) and the National Standard for Drinking Water Quality (NSDWQ). The overburden of the soil underlying the open dumpsite most likely acts as an impervious protective layer that prevents leachates from the waste materials to enter the underground water.

Keyword: dumpsite, underground water, wells, quality, Gyadi-Gyadi

1 Introduction

Supply of pipe borne water in big cities of most developing countries is often grossly inadequate because of rapid urbanization and poor planning. Most people in these countries use untreated underground water from unprotected shallow hand-dug wells and bore-holes for domestic and other purposes. Ground water is also widely used for industrial water supply in these countries (Akujieze et al., 2003; Fecham et al., 1986). The quality of ground water in aquifers can be affected by natural and human activities. In aquifers unaffected by human activity, the quality of ground water is dependent on geochemical interactions between the water and rocks as the water moves along flow paths from areas of recharge to areas of discharge. These interactions depend on the hydrogeological and climatic conditions (Punmia and Jain, 1998). Due to improper town planning, dumping sites and soak ways are indiscriminately located in the rural and urban areas of most developing countries. Ground water contamination by waste materials is primarily determined by the nature of the contaminants contained in the waste, hydrogeological and climatic conditions, as well as the effectiveness of regulatory action (Obasi and Balogun, 2001).

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One of the common means of waste disposal is by sanitary landfills where waste materials are spread on land, compressed and covered with soil. When precipitation occurs the percolating water dissolve many organic and inorganic salts which may be transported to nearby aquifers. Similarly gases such as methane, carbon dioxide, and hydrogen sulfide produced on site may be transported by gaseous diffusion through unsaturated media to adjacent terrains (Badmus et al., 2001). According to the 2006 national census, Kano State is the most populous State in Nigeria with a population of 9,401,288 inhabitants spread over forty four local government areas. Kano city is one of fastest growing cities in the world due to rapid uncontrolled rural urban migration. Pipe borne water in the last few years in Kano metropolis is in short supply. Most of the developing areas of the metropolis are not connected to pipe borne water network. Therefore, majority of Kano inhabitants, regardless of social status, depend on hand-dug wells and bore-holes for their daily water supply needs. The quality of ground water has received much attention at several points in time by different researchers as poor quality water has huge health and economic implications (Tanko, 2002). Present work focuses on the quality of ground water from some hand dug wells sited in the vicinity of Gyadi-Gyadi solid waste dumping site in order to determine the effects of solid waste leaching on the quality of the underground water. The waste dumping site at Gyadi-Gyadi area is one of the largest dumping sites in Kano Metropolis. The site is surrounded by densely populated residential areas and Aminu Kano Teaching Hospital – the largest health institution in Kano State. The solid waste dumping site is located in Gyadi-Gyadi ward of Tarauni Local Government area along Court road within Kano Metropolis. Tarauni Local Government area is located at the latitude of 11058.15N and longitude of 08032.55E. The Local Government area has a total area of 28km2 and a population of 221,367 according to the 2006 national census. The ground water serves as the major source of drinking water in the area. The levels of some physical and chemical water quality parameters in selected hand dug wells located at various distances from Gyadi-Gyadi waste dumping site were evaluated. The effects of proximity to the dumping site on the level of some water quality parameters were also investigated. The results were then compared with the World Health Organization (WHO) and the Nigeria's National Standard for Drinking Water Quality (NSDWQ) standards for

drinking water (WHO, 1998; NSDQW, 2007).

2 METHODOLOGY

Water samples were taken using cleaned and sterilized containers at different hand dug wells located at various distances from Gyadi-Gyadi waste dumping site as summarized in Table 1. Physicochemical analyses of underground water samples were performed using standard analytical methods of water analysis in accordance with the American Public Health Association recommendations (APHA, 1998). Each sample was analyzed in duplicate and the averages of the results were reported. Generally, laboratory quality assurance measures were observed in order to prevent sample contamination and instrumental error. The laboratory water used in the analyses was doubly distilled before it was deionized. Wavelengths settings of the spectrometer were carried out using the standard instrument procedure and all others equipment used were also calibrated against reference standards. The analyzed ions are: sulphate, nitrate, chloride, phosphate, iron and manganese. Temperatures of the samples were determined at the field using an alcohol thermometer. The pH of the samples was measured with a Suntex pH meter that has been calibrated with a buffer solution. Dissolve Oxygen of the samples were measured with a dissolve oxygen meter (Jenway 9071). For hardness measurements, 50ml of samples was mixed with 0.005N volume of hydrochloric acid in a conical flask. The solution was boiled and allowed to cool to about 50oC. 2ml of buffer solution was added, and then titrated with NaOH solution till faint pink end point was observed. The volume of titrate used was recorded.

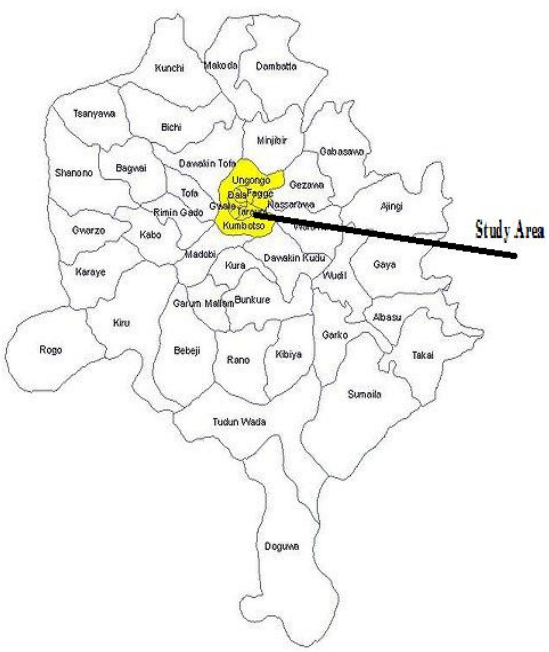

Fig. 1. Map of Kano State showing the study area

3 RESULTS AND DISCUSSION

Table 1 Labeling of the sampling sites and their distances from Gyadi-Gyadi waste dumping site

Sample labeling	Distance from site (m)
A	500
B	350
C	200
D	100

The average values of the measured water quality parameters of groundwater obtained from four wells located at various distances from the dumpsite are listed in Tables 2. From the result obtained, the groundwater is clear, colorless and odorless. The temperature of the groundwater in the study area is virtually constant throughout (26°C). This temperature depends on the environmental condition at the time of collection of the samples. Generally, increase in temperature leads to low dissolve oxygen content of water. Some of the physical properties of the ground water such as appearance, colour, temperature and taste were found to be independent of the distance from the dumpsite.

Table 2 Average values of the water quality parameters of the wells under investigations

Parameters	Sample			
	A	B	C	D
Appearance	Clear and colorless	Clear and colorless	Clear and colorless	Clear and colorless
Temperature (°C)	26	26	26	26
pH	6.5	7.0	6.2	6.2
Total Hardness (mg/l)	32.04	28.48	28.4	21.36
Iron (mg/l)	0	0.1	0.3	0.25
Manganese (mg/l)	0.007	0.008	0.024	0.12
Sulphate (mg/l)	NIL	NIL	NIL	NIL
Nitrate (mg/l)	NIL	NIL	NIL	NIL
Chloride (mg/l)	10.64	10.69	31.91	17.73
Phosphate (mg/l)	0.1	0.1	0.1	0.1
DO (mg/l)	5	5.6	6.5	6

Iron is often present in groundwater because iron is commonly found in many aquifers and is found in trace amounts in practically all sediments and rock formations. The iron content of groundwater is important, because small amount of iron seriously affect water quality. Iron stains plumbing fixtures, stains cloth during laundry and clog pipes. The World Health Organization recommends that the iron content of drinking water should not be greater than 0.1mg/l, while the NSDWQ set a value of 0.3mg/l as the permissible limit. The concentration of iron in all the wells analyzed around Gyadi-Gyadi dumping site falls within the acceptable range. Manganese occurrence in groundwater is less common than that of iron. Manganese occurs as soluble manganese bicarbonate which changes to insoluble manganese hydroxide when it reacts with atmospheric oxygen. The WHO and the

NSDWQ set a maximum acceptable value of 0.05mg/l and 0.02mg/l, respectively, as the permissible limits of manganese in drinking water. The levels of manganese in the analyzed wells are found to be within the recommended values set by the WHO and the NSDWQ except that of samples C and D. The concentration of sulphate and nitrate in the water samples analyzed is very low to the extent that they could not be detected with the analytical techniques employed. This observation can be attributed to the fact that most of the waste in the site does not contain nitrogen and sulphur containing compounds. Nitrogen mostly enters ground water from agricultural activities using nitrogenous fertilizers and also from legumes, which fix atmospheric nitrogen and transfer it to the soil where it is used by plants. Nitrogen may also enter ground water from sewage discharge on land (Groen et al., 1988). The safe concentration of nitrate for domestic water set by the NSDWQ is 50mg/l. Nitrate concentration above the recommended value of is dangerous to pregnant women and poses a serious health threat to infants because of its ability to cause blue baby syndrome in which blood loses its ability to carry sufficient oxygen (Groen et al., 1988). Phosphates occur naturally in underground water. High phosphate in water cause serious problems of water pollution. The WHO maximum permissible limit of phosphate in drinking water is 10mg/l. All the wells analyzed show very small amount of phosphate (0.1mg/l). Traces of phosphates increase the tendency of algae to grow in the water (Ikem et al., 2002). Chloride ions enter the groundwater aquifers from solid waste when it comes in contact with rain water and then gain entrance into aquifers. High chloride content may corrode metallic pipes. Water that contain less than 150mg/l chloride is satisfactory for most purposes. A chloride content of more than 250mg/l is generally objectionable for municipal uses (Sridhar, 2000). Dissolve oxygen is the amount of oxygen found in water. Dissolve oxygen sustain life of aquatic organisms. Very low dissolve oxygen may result in anaerobic conditions that cause bad odors. The NSDWQ limit for dissolve oxygen in drinking water is 7.5mg/l. The amount of dissolve oxygen of the wells analyzed ranges from 5.0-6.5mg/l. These values suggest that the water can be used for household and industrial applications.

4 CONCLUSIONS

The levels of some physical and chemical water quality parameters in selected hand dug wells located at various distances from Gyadi-Gyadi waste dumping site were evaluated. The appearance, colour, temperature and taste of the analyzed water samples were found to be independent of the distance from the dumpsite. The level phosphate in the wells was also the same for the four wells located at various distances from the dumping site. Whereas the pH of the ground water is slightly acidic, this could be attributed to acidic leachates from the decomposing waste. However, most of the water parameters tested fall within the standard of the World Health Organization (WHO) and the National Standard for Drinking Water Quality (NSDWQ). The overburden of the soil underlying the open dumpsite most likely acts as an impervious protective layer that prevents leachates from the waste materials to enter the underground water.

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