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An assessment of water quality of boreholes around selected land fills in Kano Metropolis

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ABSTRACT: The quality of ground water in some selected land fill sites within Kano metropolis were assessed during the wet season for pH, turbidity, conductivity, total solids (TS) suspended solids (SS), total dissolved solids (TDS), Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), Dissolved oxygen (DO), chloride, sulphate nitrate, phosphate, Zinc, Lead, Nickel, Cadmium, Iron, Manganese, Copper, and chromium. The analysis revealed that some samples were acidic and some alkaline with a pH range of (6.80 – 7.75) and at the methogenic stage. All the samples have low BOD (28.5 – 46.0mg/dm^3) and COD (55.00 – 89.25mg/dm^3) values indicating that active methogenesis process is taking place at the sites. The suspended solids, total dissolved solid and turbidity results varied significantly between sites. All samples contained low concentration of nitrate and sulphate with phosphate, chloride, lead and manganese in high ranges when compared with the national regulatory standard (SON). Comparison of the water samples showed that the pollution potentials of Gyadi-gyadi and Ubagama samples are higher than those of Hajj camp and Maimalari. The study revealed the need to treat the ground water samples in these dump sites.

Keywords: Groundwater quality, Land fill, Metropolitan area.

Introduction

The quality of natural waters varies temporally and spatially, making it difficult to compare the quality across broad geographic region or time scale. The dissolved oxygen concentration, and impurity parameters for aquatic life vary inversely with temperature and so changes continuously with atmospheric temperature.

The quality of water varies depending on location, origin and the prevailing climate. One of the factors in assessing the overall quality of life is the availability of quality drinking water (Woying, 1993). Research over the years has shown that bacteria can be transported some distance through the ground by liquid leached from municipal solid wastes, land fill, latrine or septic tanks, and could thus contaminate drinking water supplies drawn from the ground (Pete and Caver, 1999).

The disposal of waste into land fill sites has caused concern and adverse health effects for populations living nearby, particularly where hazardous wastes are dumped (Vryheid, 2008). The presence of chemicals in ground drinking water is a factor in determining the risk posed by land fill sites (National Research Council, 1991). Over the years, there has been rapid growth in the awareness of environmental pollution problems and has become a national and international issue (Akinbiyi, 1992).

Land fill sites may be a source of surface, water, which may lead to direct contact or pollution for residents in the consumption of home grown vegetables and water for domestic use. Clark and Meyer (1982) and UNICEP, (2006) stated that achieving the millennium Development Goal and its 2015 targets of reducing by half the proportion of people without sustainable access to safe drinking water and sanitation are of vital relevance for children for improving nutrition, education and women status.

Drinking safe water is a matter of high priority to national agencies, environmentalists and medical practitioners. This study therefore, aims at assessing the quality of ground water around some selected land fill sites in Kano metropolis.

Materials and Methods

The study area

Kano metropolitan is located between latitude $12^0 25^{'}$N and $12^0\ 40^{'}$ and longitude $8.0^0 35^{'}$E and $8^0.0^0\ 45^{'}$E to the green-which meridian. It occupies an area of about 683km^2, with an aerial distance of 19km from east to west and about 15km from north to south. Kano metropolis is underlain by basement complex rock of Precambrian origin, which consists of undifferentiated ingenious and metamorphic rock. The soil is the tropical ferruginous type, rich in iron. The natural vegetation is that of the Sudan Savannah. The climate of the area is the tropical wet and dry type with wet season lasting for 4.5 months between May and September (Olofin and Tanko, 2002).

Description of the Dump Sites

The Gyadi-gyadi dump site is a large excavation ditch located in Hausawa Area of the metropolis the dump site covers about 6 hectares. It receives unsorted domestics industrial, institutional and clinical wastes.

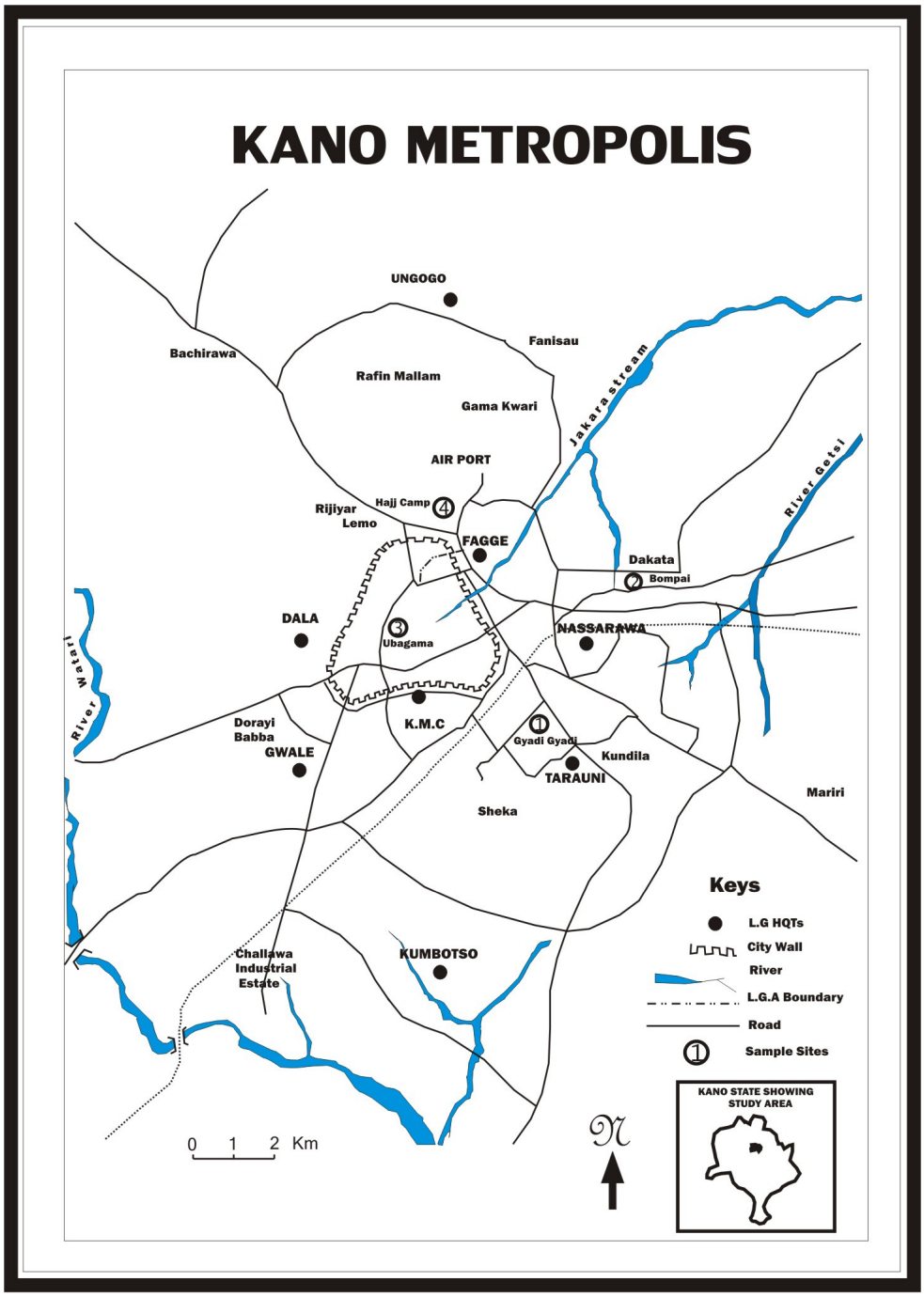
The Hajj camp dumpsite is also an excavation ditch located along Katsina road. It covers about 4 hectares of land and receives mainly domestic wastes. The Ubagama dumpsites is an excavation ditch, located in Dala area, it covers 4 hectares and receives unsorted domestic wastes. Maimalari dump site is an excavation ditch, located in Bompai industrial estate. It covers about 6 hectares; it receives unsorted domestic and industrial waste (Fig 1).

Sample Collection and Analysis

Water samples were collected twice a mouth, during the wet season (June to September). Borehole located at distances of 100 – 200m away from land fills were used as the sampling points. To determine the physical and chemical characteristics of the water samples integrated samples (a mixture of grab samples collected from different points simultaneously) were taken and labeled for easy identification and analysis the methods used were according to the American Public Health Association Standard Method for Examination of water and waste water (1985).

Digital pH Meter was used for determining pH of samples. Conductivity was determined by using the conductivity cell containing platinized electrodes. The COD was determined by dichromate reflux method. DO was determine by azide modification of winkler's method (APHA, 1985).

Suspended solid and turbidity were determined by spectrophotometric method. The Nessler's method was used to determine ammonia. Nitrates were determined by the phenoldisusphoric acid method. The colorimetric method using molybdate was used for determining phosphate and atomic absorption spectrometer was used for the metal analyses.



Source; Cartography & Remote sensing unit Dept. Of Geography Bayero University Kano (M.Ahmed 2009)

Fig. 1: Map of Kano Metropolis showing the dump sites.

Results and Discussion

The physico-chemical characteristic of water samples from the four landfills are as presented in tables 1 and 2. Samples from these sites varied from slight acidity to alkaline with a pH range of 6.80 – 7.75. This pH value indicate that, the mean values is ideal to support aquatic life, good for human consumption (Boyd and Linchkoppler, 1997). Extreme pH value for waters are not suitable for human consumption and can cause stress to aquatic life (Stiring, 1985). Also all the samples are within the SON pH 5 standard of 6.5 – 8. (SON, 2007).

The mean conductively values showed a significant variation within the sites ie 1600-495.5 ms/cm with all samples appearing to be above the SON permissible limits. All the water samples were low in BOD (28.5 – 46.0mg/dm^3) and COD (55.08 – 89.25mg/dm^3) values indicating that active methogensis is taking place at the sites (Johansen *et al.,* 1976), Chain *et al.,* 1977). The suspended solids of the sample ranged from 52.25 – 315.00mg/dm^3) and the turbidity ranged from 8.75 – 15.25 FTU. The suspended solid and turbidity values indicate the presence of organic and inorganic solids which can provide absorptive site for certain chemical and biological agents (Chain *et al.,* 1977)

The dissolved oxygen of all the samples is low (Table 1) indicating that the samples may not support aerobic organism. All water samples contain low nitrate and phosphates concentrations except the Gyadi Gyadi site with phosphates value of 16.8mg/l which may be due to fact that it receives domestic, industrial, institutional and clinical wastes that could contain traces of phosphates at different concentrations. The sulphate mean values of 0.00mg/l for all the four sites indicates that all the sites are free of sulphate contamination. Chloride content in the samples were found to be higher than the permissible limits of SON in two sites studied ie Gyadi Gyadi and Hajj camp sites with values of 321.00 and 295.75mg/l respectively.

There was high concentration of lead, Nickel, Copper, and Chromium, above the regulatory standard of SON. These could be hazardous to the ecosystem and public health, since metals are cumulative toxicants posing danger to organisms near the top of the food chain. It could also lead to bio accumulation and bio – concentration of the metals.

A comparison of the quality of the water sample in the four dumpsites showed that the pollution potential samples at Gyadi-gyadi and Maimalari are higher than the other two. This may be due to the fact that these sites are receiving both industrial and domestic wastes.

Table 1: Mean Physical Characteristics of Water Samples from Four Dump Sites in Kano.

Parameter	**Gyadi-gyadi**	**Hajj camp**	**UBA Gama**	**Maimalari**	**SON STDS**
pH	7.7	6.9	7.7	6.82	6 – 8
Turbidity (FTU)	15.25	11.75	12.52	8.75	5.0
Conductivity(ms/cm	1600	782.50	562.50	495	1000
Alkalinity (mg/dm^3)	90.00	53.00	71.75	43.00	-
Total solid (mg/dm^3)	1695	235.50	71.75	200.00	500.0
Susp.solid (mg/dm^3)	315.00	57.75	60.00	52.25	30.0
Total diss. solid (mg/dm^3)	731.75	122.25	145.00	147.38	50.0
DO (mg/dm^3)	7.25	1.125	6.75	7.175	-
COD (mg/dm^3)	87.25	89.25	86.50	55.00	-
BOD (mg/dm^3)	44.25	46.00	44.50	28.50	50.0

Source: 2009 field work

Conclusion and Recommendations

The effects of consumption and usage of contaminated, water cannot be overemphasized; the problems associated with land fill sites are the generation of leachates and gasses which are sources of environmental pollution, (Al – Yousifi, 2006).

The results from this study showed that mean values of some heavy metals (Pb, Fe, Mn and Cu) are above the SON permissible threshold for drinking water. This makes the water from the sampling sites unsuitable for drinking and for household activities.

The detection of high mean values of (Pb, Fe, Mn and Cu) in all the sites studied suggest intake of the metals from the water even when statistical analysis has shown no significant variation in the content of the metals between the sites, exposure to high level of Mn, Pb, Fe, and Cu may result in the manifestation of metals in the systems of the residents of the areas neighboring the land fill sites. It is recommended that uncontrolled dumping of wastes into the local and other solid waste treatment and disposal methods should be discouraged or totally stopped. It is important to consider the quality of water sources found around land fill sites with a view to avoiding contamination due to seepage and leachates production (Aguwamba, 2001).

References

Agunwanba, J.C (2001). Waste engineer and management tools. Immaculate Publications United, Enugu, Nigeria, pp. 352 – 380.

Akinbiyi, R. (1992). Improving the urban environment. African Health, Vol. 15 No. 1 Pp 26.

Al-Yousifi, A.B (2006). Sound Environmental management of solid waste the land fill Bioreactor. UNEP publication 2006.

APHA (1985); Standard methods for the examination water and waste water. American water works, association and water pollution control Federation sd (16) 1076, American public Health Association Washington DC.

Boyd, C.C and Linch Koppler, F. (1997): Water Quality Management in pond fish culture. International center by Agriculture experimental section Auburn University U.S.A

Chain E S K and Dewalle, F B (1977); Evaluation of leachetes Treatment, Biological and physical-chemical Treatment processes. Vol, ii USEPA.

Clark, C.S Meyer, C.R and Garside P.S (1982). An environmental Health survey of drinking water contamination by leachate pesticide waste dump in Hardenan country, Tenessee. Arch. environ. Health 37: 9 – 18.

Johansen *O J and Carlson D A,* (1976) Characterization of sanitary land fill leachetes water Resources 10,and 11.

Murtala M.R. (2006). An assessment of water quality for irrigation in Ajiwa Dam. Katsina State/. An unpublished M.S./C Land Resources thesis submitted to the Department of Geography Bayero University Kano

N R C (1991) Environmenral epidemiology Vol. 1: Public Health and Hazardous waste. Washington DC: National Academic Press Pp (23-31).

Olofin E A and Tanko A. I(2002).Laboratory of Areal Differenciation; Metropolitan Kano in Geographic Perspective.Adamu joji publishers.

Pete, K. and Lave B. (1999). Ground water, latrines and Health. London School of Hygienic and tropical medicine, U.K.

Stirring, P.(1915).Chemical and Biological methods of water analysis for aquaculturist first edition. Institute of agriculture experimental section, Auburn University USA 20 Pp (11-17)

SON (2007)Nigerian Standard For Drinking Water Quality. Approved by Standard Organisation of Nigeria Governing Council(2007)

UNICEF,(2006).United Nation Children emergency fund Report.

Vryheid (2000). Health effect of Residence near Hazardous waste land fill sites. A review of epidemiological literature 8:101-112.

WHO, (1993).“Guidance for drinking water quality “ WHO Geneva. Switzerland.

Woying, (1993). Retrieved from fils://E:/woyingepartment of environmental quality_ water quality htm 2009.