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International Journal of Current Research
Vol. 7, Issue, 09, pp.20410-20413, September, 2015

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

COMPARATIVE ASSESSMENT OF THE PHYSICOCHEMICAL PARAMETERS AND IMPACT OF WASTE DUMP SITE ON GROUND WATER QUALITY IN AJATA AND GOSA DURING WET SEASON IN FCT ABUJA, NIGERIA

*Gberikon, G.M., Anaga, S.O. and Ogbonna, I.O.

University of Agriculture Makurdi, Benue state

ARTICLE INFO

Article History:
Received 18th June, 2015
Received in revised form
17th July, 2015
Accepted 15th August, 2015
Published online 30th September, 2015

Key words:
Groundwater,
Physicochemical,
Trace Metals,
Wells,
Boreholes,
Ajata,
Gosa,
Dumpsite.

ABSTRACT

Investigations were carried out to ascertain the level of trace metals and physicochemical parameters of ground water inAjata and Gosa waste dumpsites in FCT Abuja. Samples were collected during wet season from ten wells and ten boreholes each in Ajata and Gosa. Samples were taken to the laboratory and were analysed using standard methods (APHA). Result of ANOVA revealed that there was no significant difference in trace metals found in wells with respect to season and location except nitrate. ($p<0.05$) also, there was no significant difference in trace metals foundin boreholes with respect to season and locations ($p>0.05$). Physicochemical parameters of most groundwater investigated in Ajata and Gosa fall within the guidelines recommended by (WHO) and (NSDWQ) of maximum acceptable standard for drinking water except total dissolved solids. Results oftrace metals and physicochemical analysis of groundwater in some areas in Ajata and Gosa was also found to exceed guidelines standards of (WHO) and (NSDWQ)as a result of compromised sanitary conditions and leachates from dumpsites waste. This can constitute serious public health issues. Government policies on waste disposal and management should be enacted and strictly enforced to avoid gross contaminations of groundwater.

Citation: Gberikon, G.M., Anaga, S.O., Ogbonna, I.O. 2015. "Comparative assessment of the physicochemical parameters and impact of waste dump site on ground water quality in ajata and gosa during wet season in fct abuja, Nigeria", *International Journal of Current Research*, 7, (9), 20410-20413.

INTRODUCTION

Waste is been generated through activities such as industrialization, urbanization, explosive population growth, technological evolutions and domestic human activities. These wastes in large quantities have progressively developed over time with little or no regard to environmental consequences (Zektser *et al*., 2005). Disposal and treatment of this waste is a major challenge in a country like Nigeria, where most of the waste is disposed on open grounds without recourse to the injurious effect of the waste to the environment and human health (Uwidia and Ademorati, 2011). This non-engineered and unscientific method of disposal of waste results to different environmental hazard (Bayode *et al.,* 2012). Disposal of waste on open grounds may contaminate the groundwater as well as surface water due to leachatesfrom the waste (Fatta*et al.,* 1999). Groundwater is a valuable resource often used for industrial, commercial, agricultural, domestic and most importantly for human consumption (Musa, 2014).

Corresponding author: Gberikon, G.M.,
University of Agriculture Makurdi, Benue state.

The raw water used for domestic purposes is vulnerable to contamination due to the human influence on the environment resulting in pollution (Akinbile, 2011). Knowing quality status of groundwater is indispensable to determine the suitability of water for various purposes (Abdulrafiu *et al.,* 2011). Variation of groundwater quality in any area is a function of physicochemical parameters which are greatly influenced by geological formations and anthropogenic activities of the area. Toxicological studies have revealed the mobility of toxic metals into groundwater and the health implication of these heavy metals (Ikem *et al.,* 2002). These heavy metals may constitute an environmental problem, if the leachate from these dumpsites percolates the soil and pollutes the ground water (Abdulrafiu *et al.,* 2011).

MATERIALS AND METHODS

Water Sample Collection

Water samples for physico-chemical analysis were collected with transparent plastic containers of 1.5 litre capacity which werethoroughly washed with 5% HNO_3 acid and rinsedwith deionised water. At the point of sampling, the containers were also rinsed using the groundwater several times before the respective samples were taken. Hydrochloric and Boric acids were used as preservatives in the sampling bottles for trace elements and nitrate respectively (APHA, 1999). The samples were transported to the laboratory in an ice parked cooler and kept in a freezer. In the laboratory the water samples for trace metal analysis were digested and preserved prior to AAS analysis. Preservative was required for sampling bottles for physicochemical parameters. Each sample container from each site was marked for identification for physicochemical analysis, and trace element analysis.

Quality Control Measures

Quality control measures started before sample collection on the field. Standard sampling methods (APHA, 1999) was adopted in the collection of samples.

Physico-chemical Analysis of Water Samples

Physicochemical analysis such as pH, conductivity, turbidity and total dissolved solids were also analysed adopting APHA (1999) methods.

Statistical Analysis: Results obtained were subjected to descriptive statistical analysis (mean and standard deviation) at 95% confidence level using statistical package for social sciences (SPSS). ANOVA was determined and p= 0.05 was considered to indicate statistical significance. Means were separated using Ducan's multiple range Test.

RESULTS AND DISCUSSION

The mean values of pH, electrical conductivity (EC), total dissolved solids (TDS), fluoride, copper and manganese for groundwater samples studied in Ajata and Gosa fall within NSDWQ(2007) and WHO(2011) permissible limits. Permissible limits for pH is (6.0-6.5), EC (1000µS/Cm), fluoride (1.5mg/L), copper(2mg/L), TDS(500mg/Land manganese (0.2mg/L)There was no significant difference in pH, EC,TDS, fluoride, copper and manganese in both wells and boreholes in the studied locations during wet season (ANOVA-p > 0.05).

This may be that the season and locations had no impacting effect on pH, EC, TDS, fluoride, copper and manganese. The low values of EC may indicate the low effect of dumpsites on the water quality. Zektser *et al*. (2005) reported that electrical conductivity is a valuable indicator of the amount of material dissolved in water whereas Sophocleous (2002) reported that the high values of electrical conductivity can be attributed to high levels of the various anions. Electrical conductivity can be influenced in water due to decomposition and mineralization of organic materials (Abida and Harikrishna, 2008).Total dissolved solid in groundwater originates from natural sources, sewage, urban and agricultural runoffs. The concentration of TDS in water in contact with granite, siliceous sand, well leached soil or other relatively insoluble materials is usually below 30mg/l (Akaahan, 2008). Mean values for turbidity, chloride, sulphate, lead and chromium were above NSDWQ (2007) and WHO (2011) permissible limits.

There was significant difference in turbidity, chloride, sulphate, TDS, lead and chromium in the wells across the studied locations (ANOVA-p < 0.05). However there was no significant difference in wells and boreholes during the wet season in the studied locations (ANOVA-p> 0.05). This may be that the locations impacted on the turbidity, chloride, sulphate, lead and chromium of the wells at Gosabut the season was not impacting on the boreholes at Gosa and both wells and boreholes at Ajata. The WHO limit of turbidity is 0.5mg/L, but from the results obtained in wet season, showed that mean values of wells at Gosa, falls above the standard.

Table 1. Physico-Chemicalparametersof Boreholes Water in Ajata During Wet Season

Parameter	Unit	Mean	Standard Deviation	NSDWQ(2007)	WHO(2011)
pH	-	6.60	0.09	6.5-8.5	6.5-8.5
Electrical Conductivity	µS/Cm	232.10	166.28	1000	1000
Turbidity	NTU	2.00	0.00	5	1
Total Dissolved Solids	mg/l	26.67	11.55	500	600
Fluoride	mg/l	1.87	1.10	1.5	1.5
Chloride	mg/l	130.00	70.00	250	250
Nitrate	mg/l	15.33	2.31	50	50
Sulphate	mg/l	86.67	11.55	100	250
Lead	mg/l	0.17	0.23	0.01	0.01
Copper	mg/l	0.12	0.03	1.0	2.0
Chromium	mg/l	0.46	0.80	0.05	0.05
Manganese	mg/l	0.01	0.01	0.2	0.2

Table 2. Physico-Chemicalparameters of Well Water in Ajata Duringwet Season

Parameter	Unit	Mean	Standard Deviation	NSDWQ(2007)	WHO(2011)
pH	-	6.63	0.10	6.5-8.5	6.5-8.5
Electrical Conductivity	µS/Cm	271.50	51.01	1000	1000
Turbidity	NTU	3.00	0.00	5	1
Total Dissolved Solids	mg/l	23.50	11.36	500	600
Fluoride	mg/l	2.85	1.43	1.5	1.5
Chloride	mg/l	252.50	312.13	250	250
Nitrate	mg/l	18.75	1.50	50	50
Sulphate	mg/l	137.50	197.04	100	250
Lead	mg/l	0.26	0.11	0.01	0.01
Copper	mg/l	0.16	0.11	1.0	2.0
Chromium	mg/l	0.06	0.12	0.05	0.05
Manganese	mg/l	0.14	0.10	0.2	0.2

Table 3. Physico-Chemicalparameters of Borehole Water in Gosa During Wet Season

Parameter	Unit	Mean	Standard Deviation	NSDWQ(2007)	WHO(2011)
pH	-	6.77	0.03	6.5-8.5	6.5-8.5
Electrical Conductivity	µS/Cm	566.33	253.37	1000	1000
Turbidity	NTU	2.33	0.58	5	1
Total Dissolved Solids	mg/l	53.47	22.98	500	600
Fluoride	mg/l	1.63	1.97	1.5	1.5
Chloride	mg/l	218.33	160.96	250	250
Nitrate	mg/l	15.33	2.31	50	50
Sulphate	mg/l	120.00	52.92	100	250
Lead	mg/l	0.42	0.03	0.01	0.01
Copper	mg/l	0.23	0.13	1.0	2.0
Chromium	mg/l	0.81	1.14	0.05	0.05
Manganese	mg/l	0.08	0.12	0.2	0.2

Table 4. Physico-Chemicalparameters of Well Water in Gosa During Wet Season

Parameter	Unit	Mean	Standard Deviation	NSDWQ(2007)	WHO(2011)
pH	-	6.61	0.05	6.5-8.5	6.5-8.5
Electrical Conductivity	µS/Cm	299.66	253.65	1000	1000
Turbidity	NTU	7.50	4.12	5	1
Total Dissolved Solids	mg/l	65.00	19.15	500	600
Fluoride	mg/l	3.95	1.46	1.5	1.5
Chloride	mg/l	216.25	299.32	250	250
Nitrate	mg/l	15.00	2.00	50	50
Sulphate	mg/l	125.00	37.86	100	250
Lead	mg/l	0.31	0.25	0.01	0.01
Copper	mg/l	0.17	0.02	1.0	2.0
Chromium	mg/l	0.52	1.03	0.05	0.05
Manganese	mg/l	0.14	0.10	0.2	0.2

It was observed that water in wells and boreholes at the two studied areas were very turbid. Akudo *et al*. (2010) reported to have turbidity values for wells higher than boreholes which may have been due to interaction of leachates within the dumpsites. Comparing the turbidity of groundwater in the locations with respect to the type of water point, it was observed that the mean turbidity concentration of boreholes (2.00 NTU) and wells (3.00) in Ajata were almost the same while in Gosa the mean turbidity of wells (7.50 NTU) was higher than that of boreholes (2.33 NTU). The highest recorded fluoride mean in this study was from wells having a mean concentration of 3.95mg/l. The highest mean value of chloride was also obtained from the wells.

When compared to standards, all water samples mean values for nitrate were below NSWDQ and WHO permissible limit of 50mg/L this is similar to the result by Ikem *et al.* (2002).There was significant difference in concentration of nitrate in the wells and boreholes during wet season (ANOVA-$p < 0.05$) and also a significant difference in wells between the seasons and the locations(ANOVA-$p < 0.05$). This is because the seasons and locations are impacting on the concentration of nitrate in wells but only the season is impacting on the boreholes. The sources of nitrate in ground water of the study area could be attributed to contribution from influence involving leachates infiltration from wastes dumpsites and faeces. High levels of sulphate in groundwater could be attributed to the sanitary state of the wells which has been compromised during the wet season all others were within limits of 100mg/l. All mean values obtained in the water samples at Gosa were above standard limit of 100mg/L as provided by the NSWDQ (2007) High levels of lead in the water could be linked to the effect of runoff and infiltration activities due to the waste material (Baig *et al.,*2010).

Conclusion

It was concluded from the analysis of this studythat levels of chromium, lead, sulphate, chloride and turbidity in Ajataand Gosaboreholes and wells during wet season were slightly above set standards by World Health Organization (WHO) and the Nigerian Standard for Drinking Water Quality (NSDWQ) guidelines for portable water. Such elevated levels of chloride, chromium, lead, turbidity and sulphate in groundwater used for drinking is a serious cause for concern. Although, most of the quality parameters tested were found within water quality standards, showing almost no impact of the dumpsite particularly samples from Gosa.

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