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Comparative Assessment of the Quality of Ground and Surface Water for Irrigation in Mando, Kaduna, Nigeria

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ABSTRACT: *The comparative assessment of groundwater and surface water samples from well* ***and*** *stream leading to the farm at Mando area was carried out for irrigation purpose* **.** *Ten ground water and surface water samples were collected for analysis of physico-chemical parameters such as:* ***pH, EC, TDS, TSS, TS,*** ***Ca^{2+}, Mg^{2}, Cl, BOD and COD.*** *The results of the analysis showed that 90% of the surface water samples to be within the limit of WHO/NSDWQ. However,* ***50 to 60%*** *of the parameters including* ***PH, TDS, Total Solid, Calcium and Electric conductivity (EC)*** *for the ground water were found not to be within the permissible limits of the two standards. The assessment showed that surface water is having the best quality status for irrigation purposes in Mando area of Kaduna.*
KEYWORDS: *Ground water, surface water, Physicochemical Parameters*

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I. INTRODUCTION

Water is not only one of the most essential commodities of our day to day life but plays a crucial role in economic and social development processes. While the total amount of water available in the World is constant and is generally said to be adequate to meet all the demands of mankind, its quality and distribution over different regions of the World is uneven and causes problems of scarcity and suitability. Quality can be defined as fitness for use (Gyrna,Chua and Defeto ,2007) it is therefore imperative that man uses and manages this scarce commodity rationally and efficiently. Unfortunately, more than one in six people lack reliable access to this precious resource (G. Sri Bala, e tal.).

The quality of ground and surface water is equally important to its quantity due to the suitability of water for various purposes ranging from drinking, domestic, industrial and agricultural purposes all over the world (Biswas et al., 2002). Generally, it is recognized that economic advancement is dependent on the development of water resources for irrigation and other uses (Adewuyi, 2008). In the last century, surface water resources have been polluted to such levels that they could no longer be used in agricultural irrigation (Simsek and Gunduz, 2007). The quality of groundwater in a particular region is a function of physical, chemical and biological parameters (Badmus et al 2014). According to Rizwan, R. and Gurdeep S (2010), groundwater quality depends on the quality of recharged water, quantity and quality of generated waste, sewage treatment and subsurface geochemical processes. The vast majority of surface water on the Earth is neither potable nor toxic. This remains true when seawater in the oceans (which is too salty to drink) is not counted. Another general perception of water quality is that of a simple property that tells whether water is polluted or not. In fact, water quality is a complex subject, because water is a complex medium intrinsically tied to the ecology of the earth. Industrial and commercial activities (e.g. manufacturing, mining, construction, transport) are a major cause of water pollution as are runoff from agricultural areas, urban runoff and discharge of treated and untreated sewage.

Quality of ground water is equally important to its quantity owing to the suitability of water for various purposes (Biswas et al., 2002). Ground water chemistry, in turn, depends on a number of factors, such as general geology, degree of chemical weathering of the various rock types, quality of recharge water and inputs from sources other than water rock interaction. Such factors and other interactions result in a complex ground water quality (.Guler and .Thyne, 2004).

All waters contain substantial amounts of dissolved salts such as chlorides, sulphates, carbonates, bicarbonates of calcium, magnesium, sodium and potassium. Soil sodicity refers to the amount of sodium present in irrigation water. Highly saline and sodic waters are big problems for irrigation (Michael et al., 1978). Salts and other substances begin to accumulate in water and water evaporates from the surface and crops withdraw water by transpiration. Generally two types of salt problems exist in irrigation waters like salinity and sodicity. Soils may be affected by salinity or by a combination of both salinity and sodium (Talukder et al., 1998).

Several researchers have identified contamination plumes from disposal sites (Matias et al.,1994, Ikem et al 2002,and Tijani et al. 2002 **)** with most of these studies focusing on defining the spatial extent of groundwater pollution based on geochemical analysis results. However, the investigation of the suitability of groundwater collected from hand-dug wells within the vicinity of open dumpsite for irrigation needs was not included (Badmus et al 2014).

This study was carried out to assess both ground and surface water of Mando area,Kaduna, Nigeria.

II. PROJECT AREA

The project area is the Mando neighboring NDA (Nigerian Defence Academy) permanent site Kaduna, which is situated along Birnin-Gwari Lagos expressway Afaka Kaduna, Nigeria. Its geographical coordinates are 10° 43' 0" North, 6° 34' 0" East . The area survey sites is seen to have gentle slope, few out crops covered by farmland, interspersed with shrubs and scattered trees. The area can be accessed by motor vehicles, motorcycles and foot traverses. The Manado area drainage pattern comprises of four main rivers, which are seasonal rivers, Gora, Debu, Doka and river mashi Among the entire rivers only river Gora is the major river which runs southwards at the lowest part of the general area. The total population of Mando is approximated to be 6935persons (Tukur 2 006).

Fig 1: Map of the study area

III. MATERIALS AND METHODS

The samples were collected in pre- cleaned and sterilized 2L polyethylene bottles provided with a cover . The ground water was collected from a well which is used for irrigation in the farm while the surface water was collected from a stream leading to the farm. The plastic bottles were thoroughly washed and rinsed with distilled water on the sampling site, the container was half filled with test sample shaken and thrown away before taking full and was immediately covered and taken to the water quality lab for preservation and laboratory analysis. Parameters such as pH, TDS and EC were determined on sites with the aid of multipurpose conductivity meter. Other parameters of interest were analyzed in the laboratory using standard procedures recommended by APHA(1998).

Total dissolved solids (TDS) were measured with digital EC-TDS analyzer model No: CM 183, make Elico, India. Turbidity was measured by using Nephalo-meter model No: 2100 Q-01 make: Hach USA. Iron, Nitrate, Calcium, Magnesium, ion concentrations were determined by spectrophotometer, using UV-Vis laboratory spectrophotometer (Model No: DR 5000) make Hach, USA.

IV. RESULTS AND DISCUSSION

Table 1 and 2 shows the Summary of Results for Ground and Surface Water in Comparison With the World Health Organization (WHO) and Nigerian Standard for Drinking Water Quality (NSDWQ) Standards. The pH of 6.4Mg/L and 6.8Mg/L for both ground and surface water compared to the standard limit of 6.5-8.0. This shows the ground water to be more acidic. The TDS for the ground water obtained as 1350ppm while that of the surface water was 500ppm compared to the standards limit of 450-1000ppm only the surface water is in conformity with the standard limit, which shows that the ground water has less organic and inorganic substance present.

The results of total suspended solid of 1.4197 and 2.8497 mg/l for the ground and surface water were obtained both samples were in conformity with the standard of < 30 mg/l. For the total solid that of ground water was obtained as 101.42Mg/L while for surface water was 502.85Mg/L, the ground water is not in conformity with the standard limit of 500-2000Mg/L. The calcium concentration values of 255 mg/l and 105mg l for ground and surface water were obtained, the ground water was found to be not in conformity with the standard limit of 250 mg/l. For magnesium, the values of 139mg/l and 152mg/l were obtained for the two samples, and found to be both in conformity with the standard of 250mg/l. For chloride the ground water has a value of 9.93Mg/L while that of surface water has 29.78Mg/L. These were found to lie within the permissible level of 250 mg/L. Electric conductivity of 2000 mg/l and 980 mg/l for both ground and surface water were obtained, ground water does not lie with the standard limit of 1000mg/l. For biochemical oxygen demand the ground water result obtained from the analysis was 0.6Mg/L while that of surface water was 2.4Mg/L, both ground and surface water is in conformity with the standard limit of <30Mg/L. For chemical oxygen demand the values of 2.56Mg/L and 11.52Mg/L for the ground and surface water were obtained , both samples are in conformity with the standard limit of <100Mg/L.

Table 1: Summary of Results For Ground Water Compared With The Standard Limits.

S/N	Parameter	Permissible Limits as per the Standard		Experimental Results of the Sample	Units
		WHO	NSDWQ		
1	PH	6.85 – 8.5	6.5 – 8.5	6.4	
2	Total dissolve solid	450-1000	1000	1350	
3	Totalsuspended solid	-	< 30	1.4197	
4	Total solid	-	500-2000	101.42	
5	Calcium	250	-	78	
6	Magnesium	250	-	139	
7	Chloride	250	200	9.93	
8	Electric conductivity	-	1000	2000	
9	Biochemical oxygen demand(BOD)	-	< 30	0.6	
10	Chemical oxygen demand (COD	-	<100	2.56	

Table 2: Summary of Results For Surface Water Compared With The Standard Limits.

S/N	Parameter	Permissible Limits as per the Standard		Experimental Results of the Sample	Units
		WHO	NSDWQ		
1	PH	6.85 – 8.5	6.5 – 8.5	6.8	
2	Total dissolve solid	450- 100	450- 100	500	
3	Totalsuspended solid	-	< 30	2.8497	
4	Total solid	-	500-2000	502.85	
5	Calcium	250	-	105	
6	Magnesium	250	-	152	
7	Chloride	250	200	29.78	
8	Electric conductivity	-	1000	980	

9	Biochemical oxygen demand(BOD)	-	< 30	2.4	
10	Chemical oxygen demand (COD	-	<100	11.52	

V. CONCLUSION

The conclusion from the findings showed that groundwater samples were found not to be within the permissible limits of WHO and NSDWQ for almost 50 to 60% of the parameters analyzed including PH, TDS, Total Solid, Calcium and Electric conductivity (EC) which is a measure of the amount of dissolved salts present in groundwater samples. EC is also a good measure of salinity hazard to crops as it reflects the TDS in groundwater but it happens to be not within the permissible limits of the two standards, for this reason ground water for the study area is having a poor quality status for it to be used for irrigation purposes as their TDS values also was above 1000 mg/L. Whereas 90% of the parameters analyzed for the surface water lie within the permissible limit of the standards, based on the comparison for the two results surface water is having the best quality status for irrigation purposes.

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