AN UPDATE ON THE QUALITY OF WATER IN SAMARU STREAM, ZARIA, NIGERIA

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ABSTRACT

An assessment of the level and type of pollutants flowing through the Samaru stream en route the Kubanni reservoir was undertaken. Ten water samples were collected along the stream starting from upstream (a point where effluents discharged from Samaru village empty into the stream) up to its confluence with the reservoir. Water samples were collected into 120 ml polythene containers after filtration using a 0.45 µm Millipore paper. Two sets of samples were collected from each sampling point, one for anion and the other for the cation and other trace elements analysis. Samples for the cations were treated in-situ with acid before preservation in a cooler pending analysis. Results obtained showed the conductivity of all samples except two, to be below 1000mg/l, Pb value ranged between 0.02 - 2.57, Cd between 0.05 – 1.57 and Hg, below detection limit of the instrument used (1.03mg/l). Other parameters measured include pH, TDS, Ca, Mg. K, Cu, Zn Fe, HCO_3*,* CO_3*, Cl and* NO_3*, all fall within the WHO (2011) and NIS (2007) permissible limit for drinking and other domestic uses.*

Key words: Effluents, Pollutants, Reservoir, Samaru stream.

INTRODUCTION

The existence of life and water are inseparable from each other; as all life forms are dependent on water. It is an essential commodity to life in general and human in particular. Water is needed for domestic and industrial uses, irrigation, hydro-electric power generation and recreation, to mention but a few. Most of the water that is used for consumption and other domestic uses is stored in aquifers which often discharge into streams and rivers to augment their flow. Also as a result of extreme fluctuations in river discharges in some climatic regions, dams are constructed across rivers to create water reservoirs (Strahler and Strahler, 2006), which also recharges the aquifer.

Although, it is one of the most abundant resources on earth, many important issues and problems are involved in water management. The utmost source of water is rainfall or precipitation and this is the source of recharge.

If water is contaminated, it poses a great health hazard to man causing various types of water borne and water related diseases. Therefore the presence of water in the environment does not suffice, rather how useful it is to man is what qualifies it as a resource to man. Considering the usefulness of water, evaluating its quality, quantity and the reliability of all the possible water sources becomes expedient (Yusuf and Shuaib, 2012).

Samaru stream, which takes its source from Samaru, Zaria, is a headwater tributary of River Kubanni and its reservoir is the only source of domestic water supply for Ahmadu Bello University community. All the streams that drain into the reservoir are seasonal, with the exception of Samaru Stream which is semi-perennial and is fed in the dry season mostly by effluents from Samaru town, with little contribution, from groundwater. The effluents drained by this stream include household waste, sometimes human waste from houses that have improperly constructed latrines, waste from mechanics workshops and battery charging shops. All these effluents flow through Samaru Stream through Rafin Malmo into the Kubanni impounding reservoir. Other streams drain mostly farmlands; these also carry organic and inorganic pollutants that are used in agriculture, most especially towards the end of the rainy season when pesticides are sprayed on farms.. This makes Kubanni reservoir vulnerable to chemical pollution and the concern of the University is the level of chemical pollutants that this waste water carries. Chemical pollution is not completely removed through water purification process. This work therefore is aimed at determining the trend of changes in quality of water in the Samaru Stream and comparing the results with previous works done on the Kubanni Reservoir and Samaru Stream in particular.

Several attempts have been undertaken by different persons to assess some quality parameters of drinking water from Kubanni reservoir. The pioneer work is that of Ogunrombi (1977), whose work was limited to the major cations and anions only with no trace element analysed. This was followed by the works of Udoh *et al.* (1986), Dahiru (1989), Yusuf (1992), Jeb (1996), Obamuwe (1998), Udoh (1999) and Garba (2000).

The first published work on the water quality of the reservoir that has to do with trace elements was 18 years ago, by Udoh *et al* (1986), which found lead concentration in raw water of Ahmadu Bello University reservoir as 500 ppb (2), with arsenic and mercury to be below the detection limit of the instrument used. In 1989, Dahiru analysed treated water from ABU taps and found lead to be 70 ppb and cadmium, 10 ppb. Yusuf (1992) analysed nine raw water samples from the Kubanni reservoir and found lead in the range of 243 to 409 ppb, with average of 279 ppb. Jeb (1996) sampled head waters of ABU Reservoir and found lead concentration between 1 and 5 ppb. Usman (1998), tested lead in water of Samaru Stream, a tributary to the Ahmadu Bello University Reservoir where he found lead to be 2160 ppb. This stream is very important for the present discussion because it is suspected of carrying into the dam residential effluents from Samaru town. In the same year, Obamuwe (1999) used XRF technique at (CERT) laboratory, ABU, Zariaand found lead concentration in raw unfiltered water to range between 17 and 97 ppb. Udoh (1999) using AAS technique at the Department of Geology, ABU, Zaria tested water before treatment and after treatment. There were insignificant differences between the two groups of samples. Lead values recorded ranged between 0 and 37 ppb. Garba (2000), Garba and Schoeneich (2003, 2004) used different methodologies for inter laboratory comparison and came up with lead values for the reservoir in the range of 14 to 8 ppb. Yamasaki *et al.* (2004) analysed raw water collected from the dam and their results shows lead to be in the range of 7 to 340 ppb with 48% of their sample (114 samples) to be above the WHO (2011) drinking water guideline value (0.01mg/l).

STUDY AREA

Zaria is located between latitudes 11°03′ to 11^{0}10' North and longitudes 7°30′ to 7°45′ East of the Greenwich meridian. The town is almost centrally located in Northern Nigeria and is a major city in Kaduna State, northern Nigeria. The plain of Zaria is on an undulating one, which is gently rolling (Wright and McCurry, 1970).

The study area is located mainly within the Ahmadu Bello University Main Campus in Samaru. However, the high density Samaru town deeply encroaches into part of the drainage basin deeply encroaches into high-density Samaru town, from which untreated urban storm and waste water, mostly residential effluents flow into the Ahmadu Bello University reservoir. These effluents are composed of all domestic wastes in some cases including human wastes.

The area experiences the typical seasonal climate of northern Nigeria which belongs to the Aw climate of the Kop pen's classification that has two distinct seasons; the dry or the harmattan season lasting between October to May, while the other season is the rainy season and lasts from May to October. The temperature of Zaria varies throughout the year. The minimum daily temperature rises gradually from its lowest 15°C December and January to its highest 26°C in April. The maximum daily temperature rises from its lowest 30.1°C in December/January to its highest 39.5°C in April. Mean monthly minimum temperature rises gradually from its lowest 9.4°C in December to its highest 26.0°C in April. Mean monthly maximum temperature rises gradually from its lowest 29.7°C in January to highest 40.60°C in April (Oladipo, 1985).

The area belongs to the Precambrian Basement Complex of northern Nigeria. It is composed of three rock types; the basement gneiss, porphyritic granite and medium grained granite (Fig. 1). The last two were intruded into the basement gneiss during the Pan African. The greater part of the area is covered with thick regolith mainly derived from in-situ weathering of the basement rocks, which in some areas on the watershed is up to 30 metres thick (Garba, 2000).

The soil of Zaria is termed "the Zaria soil group" and usually has material covering up to 4.27 in depth and consists of deposited silt. Alluvial soils are expansive in Zaria and in low land areas they are easily drained to produce what is known as the hydromorphic soil/fadama. These are found in the Kubanni and Galma river basins and are mainly for sugarcane cultivation. It also supports vegetables like onions, spinach, pepper, tomatoes; hence contributing to market gardening (Ologe, 1973).

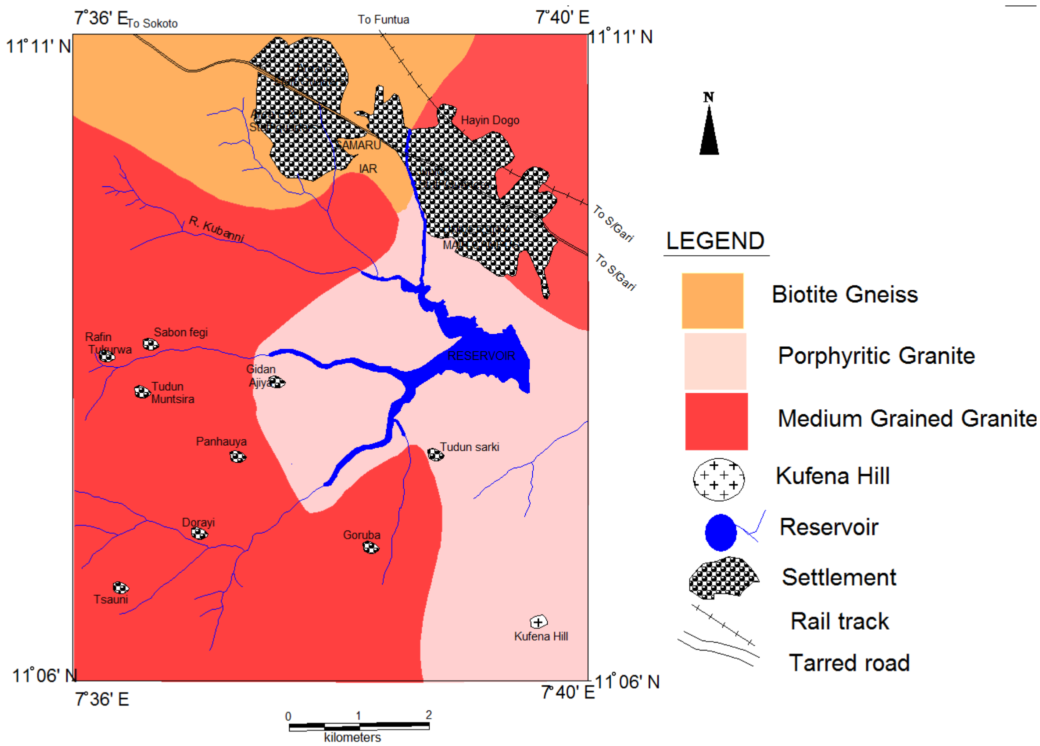

Fig. 1: Geological map of part of Kubanni drainage basin showing the reservoir.

Although the Zaria environment belongs to the northern guinea savannah which is moist woodland undergrown with thick bushes and shrubs, the vegetation is gradually becoming artificial. Some of these vegetation include elephant grass, *Isoberlina doka*, *Isoberlina tomentosa*, *Tamarindus* spp, locust beans, silk cotton trees, and baobab tree are commonly seen. Human activities such as cultivation, construction, bush burning and grazing have greatly modified the natural vegetal cover and composition (Jaiyeoba, 1995).

MATERIALS AND METHODS

Ten water samples were collected along Samaru stream starting from across the bridge in Samaru down to the point at which the stream empties into the reservoir (Fig. 2.) Samples were collected following the standard approved for the collection and preservation of water samples. Filtered water samples were collected into a 120 ml pre-washed polyethylene bottles. The bottles were well rinsed with the water to be sampled before finally filling the samplers. Two samples were collected from each sampling point. One of the sample set were acidified to pH < 2.0 using concentrated HNO_3 acid for the preservation of trace components, and thereafter transported to the laboratory for deep refrigeration.

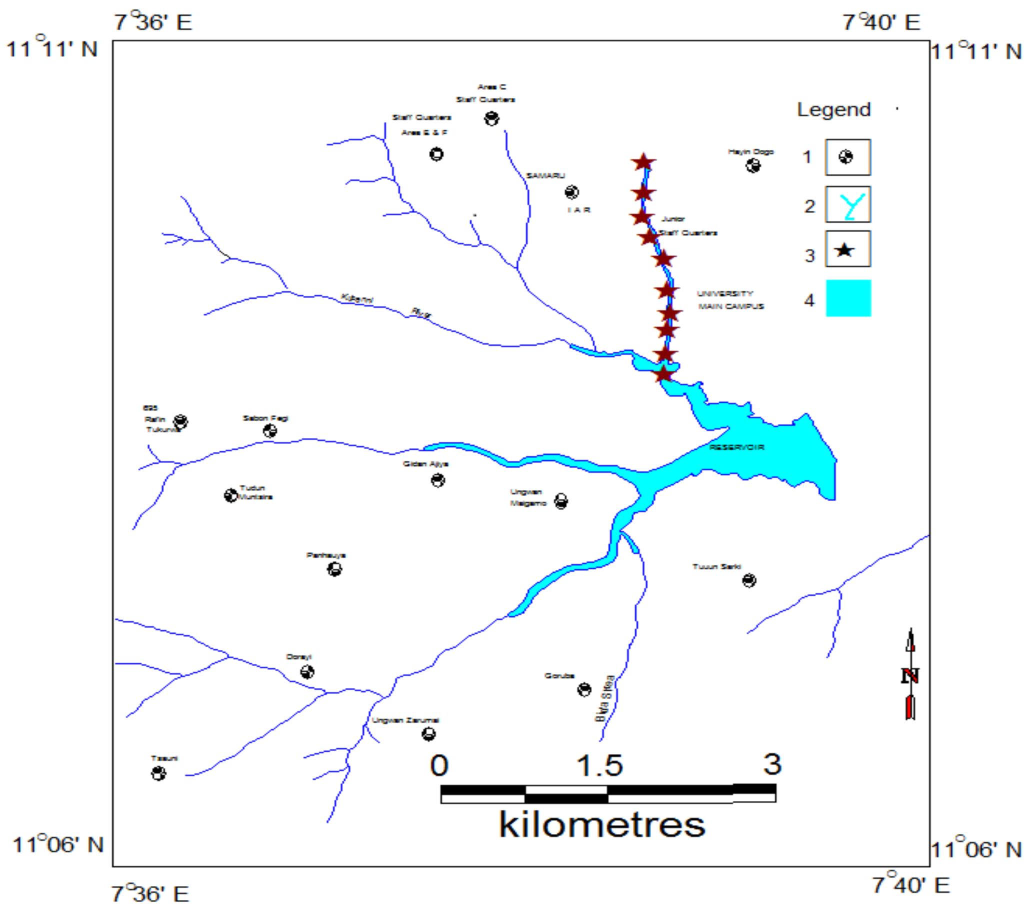

Fig. 2: Location of Sampling Points. (Where 1: Samaru Stream and Sampling Points, 2. Streams, 3. Reservoir, 4. Settlements).

Chemical analyses were carried out for the major ion concentrations of the water samples collected from different locations using the standard procedures recommended by APHA (1994). V2000 multi analyte photometer was utilized in the analsis of all the element measured except Na, ca and K that were analyzed usingflame photometer

RESULTS AND DISCUSSION

Table 1 below is the result of water analysis done on the samples collected. Following the WHO 2010 and the Nigerian drinking water standard 2007 the water is polluted in lead and cadmium with all samples being above the WHO (2011) and NIS (2007) drinking water standard of 0.01mg/l for lead and 0.003mg/l for cadmium. Besides lead and cadmium the concentration of mercury at sampling points 4 and 5 are also above the 0.006 mg/l WHO drinking water standard. The implication is that long time use of this water may result to health hazards attributed to these metals. This has confirmed the earlier report given by Udoh *et al.* (1986) and Usman (1998).

During the field work, it was observed that there is much improvement and total removal of refuse that is indiscriminately dumped into the stream part outside the campus, which before now used to be part of the pollutants dumped into the stream by the residents close to the water way and also from Samaru Market. Also the afforestation and grassing of stream catchment within the campus has helped in improving the quality of the water flowing Samaru stream.

Table 1: Concentration Level of Major Ions and some Trace Elements in the Analysed Water Samples

Sample ID	Coordinates	pH	COND (µs/cm)	TDS (mg/l)	MEASURED PARAMETERS (All results are in mg/l except for pH and conductivity)												
					Zn	Fe	Na	K	Ca	HCO_3	NO_3	SO_4	Cl	Pb	Cd	Hg	Cu
	% RSD				0.56	1.37	1.03	0.91	10.02	72.36	0.75	0.69	12.05	0.02	1.32	BDR	3.2
1	11° 09' 43.3″ N 007° 38' 35.8″ E	7.70	1904.00	676.00	0.31	1.51	73.20	53.50	12.00	68.12	1.67	27.29	17.80	0.38	0.99	BDR	1.09
2	11° 09' 41.8″ N 007° 38' 35.5″ E	7.30	1475.00	480.00	0.16	0.33	59.80	39.40	36.10	58.96	75.84	41.63	26.98	0.17	0.07	BDR	0.07
3	11° 09' 34.3″ N 007° 38' 38.0″ E	7.40	724.00	300.00	0.34	0.21	31.80	12.90	12.95	72.12	0.79	2.93	12.04	0.05	0.05	BDR	BDR
4	11° 09' 21.7″ N 007° 38' 41.6″ E	7.20	284.00	180.00	0.25	0.04	12.50	3.30	32.00	66.02	1.08	4.76	33.12	0.51	1.01	1.03	1.02
5	11° 09' 13.1″ N 007° 38' 45.4″ E	7.20	258.00	149.00	0.24	0.28	14.90	2.40	19.03	29.00	0.98	16.00	21.00	0.77	0.91	0.47	1.77
6	11° 09' 02.3″ N 007° 38' 45.7″ E	6.80	230.00	164.00	0.20	0.33	9.30	4.10	54.00	47.00	0.89	15.18	11.05	0.69	0.07	BDR	1.76
7	11° 08' 35.7″ N 007° 38'40.1 ″ E	7.70	99.20	111.00	0.39	0.39	10.40	2.50	34.31	23.00	0.79	4.91	14.00	1.32	0.68	BDR	0.92
8	11° 08' 30.8 ″ N 007° 38' 46.6″ E	7.30	150.00	122.00	0.28	0.09	10.60	2.60	17.00	19.95	0.51	3.13	10.05	2.57	1.23	BDR	0.73
9	11° 08' 24.6″ N 007° 38' 56.9″ E	7.30	132.00	121.00	0.25	0.05	9.30	2.90	151.00	97.15	1.21	3.07	21.10	1.04	1.77	BDR	0.91
10	11° 08' 16.9″ N 007° 38' 55.9″ E	7.70	128.00	112.00	0.41	0.22	9.30	3.40	27.00	67.00	2.46	3.31	19.21	1.93	1.09	0.07	0.79

Note: BDR = below detection

CONCLUSION

The effort of the University administration in mitigating the effect of effluents flowing into the Kubanni reservoir from Samaru and environs is yielding good result as the concentration of pollutants is reducing. Despite the effort however, the concentration of some of the heavy metals in the study area (Samaru stream) still exceeded the WHO Guideline limits for drinking and domestic use, most especially the values of cadmium, lead and mercury. The source of these elements is Samaru Village where most part of head waters of the stream lies. Most household waste generated and released from Samaru village, mechanic workshops and MRS filling station flows through this stream and there could be the source of these pollutants.

In view of the findings of this study, it is recommended that the University administration should not relax in its efforts but sustain the mitigation techniques adopted and increase awareness of the Samaru community towards appropriate waste discharge methods.

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