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Analysis of Heavy Metals Concentration in Sediments and Water Samples of Selected Functional Dams in Oyo State, Southwestern Nigeria.

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Abstract
The quality as well as the quantity of clean water supply is of vital significance to the welfare of mankind particularly in the developing countries. Therefore, knowing the concentration of heavy metals present in Dams can help us to ascertain the health safety of the populace using the water for drinking and domestic purposes. Ten Dams at Oyo State in the Southwestern Nigeria were studied for the heavy metals concentration contained in the sediments and water of the selected Dams. Bottom sediments and water were collected from the selected dams for analysis. Analysis of both the water and sediments to determine the concentration of each heavy metal was evaluated. The result obtained shows that, the concentration of Manganese (Mn) ranges from 14.8 mg/kg to 332.96 mg/kg followed by Zinc (Zn) which ranges between 6.18 mg/kg and 52.53 mg/kg which spread across all locations., Lead (Pb) was not detected in virtually all the locations except in Ilora which has a concentration of 0.87 mg/kg and this may be as a result of the activities of motor mechanics and vulcanizers around the dam. In the water samples, the result showed that the concentration of heavy metals is very low which is far below the limit specified by World Health Organization (WHO). Zn has the highest concentration ranging from 0.049mg/kg to 0.729mg/kg, followed by Mn which has concentration between 0.011mg/kg and 0.344mg/kg. Pb, Cadmium (Cd) and Cobalt (Co) were not detected at all in all the water samples. The variation in the concentrations may be due to geological nature of the ground, solubility, an ion exchange and human activities.

Introduction

With exploding population and increasing industrialization and urbanization, water pollution by agricultural, municipal and industrial sources has become a major concern for the welfare of mankind" (Dara, 2005). Some of the water pollutants include heavy metals which are a member of an ill-defined subset of elements that exhibit metallic properties, which would mainly include the transition metals, some metalloids, lanthanides and actinides. Many different definitions have been proposed—some based on density, some on atomic number or atomic weight, and some on chemical properties or toxicity. It can also be referred to as a metal with density equal to or greater than 5.0 x 10^4 kg/m^3. Heavy metals are stable and persistent environmental contaminants since they cannot be degraded or destroyed hence, they tend to accumulate in the soil, seawater, freshwater, and sediments. Excessive levels of metals in the marine environment can affect plants and animals and pose risk to human consumers of seafood (Begun et al, 2009). Also, it can have deleterious effects on soil fertility and water quality (Sun et al, 2001). Heavy metals are also known to have adverse effects on the environment and human health (Adriano, 1986).

During the last two to three decades, considerable attention has been given to problems concerning negative effects of heavy metals on various ecosystems in different environmental media (Majid and Argue, 2001). Numerous field observations indicate a significant increase of heavy metal

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concentrations in agricultural and forest soils as well as in marine and inland water sediments (Adriano, 1986, Sawyer et al, 1994 and Gualin et al, 2005).

The menace of toxicity and heavy metals coupled with epidemics still threaten the well-being of many people, particularly in under-developed and developing countries. Thus, the quality as well as the quantity of clean water supply is of vital significance to the welfare of mankind. This therefore motivated the present study at determining the concentration of heavy metals present in the sediment and water samples from some selected functional dams in Oyo State in Southwestern part of Nigeria, and to ascertain the health safety of the populace using the water mainly for drinking and domestic purposes.

Materials and Method

Bottom sediments were collected by ocean divers and water-samples were collected from study sites too. Altogether, 30 sediments and 20 water samples were collected from all the 10 selected dams using polythene bags for sediments and clean covered bottles for water samples in order to avoid contamination and prevent unwanted chemical reactions. The sediments were air dried in the laboratory and sieved using 1mm BS sieve. After sieving, 30 sediment samples of 3 samples per each dam were mixed in order to get the composite sample of each dam. This was done in order to prevent the occurrence of unwanted chemical reactions. The samples were preserved properly by storing them in air-tight containers so as to avoid absorption of NH_3, SO_3 and or SO_2 gases in the laboratory (Kim, 1996).

For the acid digestion of the sediments, 1.2g of the sieved sample was weighed and put into the Teflon vessel of the acid digestion bomb .After adding 0.5mL aqua regia and 3.0mL HF (48%), the vessel was closed and reassembled in the stainless steel body of the bomb. The bomb was sealed by turning the knurled cap, placed in an oven, and heated at 110°C for 40 minutes. These were cooled and later unscrewed the bomb. The content was washed with 4-6mL distilled water by spraying into 100mL polyethylene beaker. Care was taken to wash all precipitates into the beaker. 3.0g H_3BO_3 was added, and stirred with a plastic stirrer to dissolve the boric acid. A 5-10 mL H_2O was and any precipitate was expected to dissolve at this time (Kim, 1996). The resultant solution was analysed for heavy metals using Atomic Absorption Spectroscopy (AAS).The mean concentrations of the heavy metals for digested samples and water samples were then obtained.

Table 1 shows the elevation and the geographical coordinates of sites examined while Fig.1 shows the map of Oyo state with various locations of the dams. Also Figs. 2 and 3 shows the concentration of heavy metals in sediment and water respectively.

Table 1 The elevation and geographical coordinates of sites examined

S/N	Name of Dam	Location	Elevation (ft)	Latitude (N)	Longitude (E)
1.	Erelu	Oyo town	728	07° 52.314	003° 54.201'
2.	Fiditi	Fiditi	902	07° 42.725	003° 54.913'
3.	Eleyele	Ibadan	682	° 25.361'	003° 51.504'
4.	Eruwa	Eruwa	357	07° 31.115'	003° 22.887'
5.	Asejire	Ibadan	478	07° 21.466'	004° 07.971'
6.	Iluju	Ogbomoso	975	08° 11.467'	004° 12.483'
7.	Awba	U.I, Ibadan	608	07° 26.546'	003° 53.198'
8.	Ilora	Ilora	932	07° 48.017'	003° 54.960'
9.	Ogbomoso	Ogbomoso	983	08° 11.762'	004° 12.292'
10.	Awe	Awe	952	07° 50.384'	003° 56.664'

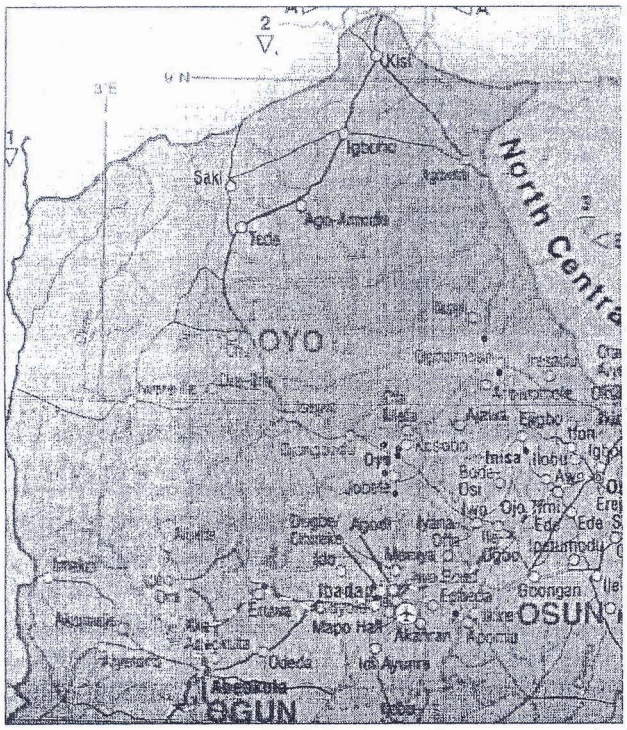

Fig.1: Map of Oyo state showing locations of selected dams

Results and Discussion.

Table 2 and 3 shows the heavy metal concentration in sediments and water samples of the selected dams. Surprisingly, Cobalt (Co), Lead (Pb) and Cadmium (Cd) were not detected in water samples of the selected dams. From the tables, the results show that Manganese (Mn) had the highest concentration in most of the sediments with a peak value of 332.96mg/kg in the sediments from Ogbomoso dam. The only exceptions to this are Fiditi and Awe dams where Zinc (Zn) had the highest concentration. The high concentrations of Mn and Zn obtained may be due to the high agricultural practices which involve high use of fertilizers by the farmers in order to enhance their productivities. Lead was detected only in the sediment from Ilora dam with a concentration of 0.87mg/kg. Zn had the highest concentration in most of the water samples with a peak value of 0.729mg/kg in Eruwa dam. However, the metal with the highest concentration in Fiditi is Copper (Cu) with a concentration of 0.990mg/kg which may be due to dyeing activities that are taking place in the area. Cadmium, Lead and Cobalt were not detected in any of the water samples.

From the results obtained, it can be concluded that water from all the dams investigated are good for drinking based on the fact that their concentration levels of heavy metals meet the drinking water standards(IS: 10500 – 1991, WHO, 1993). Most of the dams studied were located at the outskirts of the town where there are reduced human and industrial activities

Table 2: Concentration of heavy metals in sediments in ppm (mg/kg)

Dam	Zn	Cr	As	Cd	Ni	Mn	Pb	Co	Cu
Erelu	18.54	4.50	0.89	ND	0.93	105.44	ND	ND	1.97
Fiditi	29.87	5.63	0.89	ND	ND	14.80	ND	ND	0.99
Eleyele	9.27	1.13	2.66	1.36	2.80	141.51	ND	ND	1.48
Eruwa	31.93	3.79	4.43	2.72	4.66	309.84	ND	ND	0.49
Asejire	48.41	2.25	1.77	ND	3.73	123.07	ND	2.01	0.99
Iluju	26.78	4.50	1.77	1.36	2.80	171.11	ND	ND	0.99
Awba	6.18	2.25	0.89	ND	0.93	15.72	ND	2.01	1.48
Ilora	52.53	2.25	2.66	ND	1.87	135.96	0.87	ND	1.48
Ogbomoso	22.67	4.50	ND	ND	0.93	332.96	ND	ND	0.99
Awe	11.33	3.79	0.89	ND	0.93	6.00	ND	2.01	1.48

ND – not detectable

except Awba and Eleyele dams which are located within Ibadan metropolis. Some of the dams however need to be more properly managed in order to ensure that the concentrations of some of the heavy metals do not increase beyond the required limit, since this can endanger the lives of the people sourcing their drinking water from these dams. The results also clarify that the water from these dams can be used for crop cultivation and animal rearing without any threat to the proper growth of plants and animals and the human beings who may feed on them.

The concentrations of heavy metals obtained show that the water samples from the dams do not pose any threat to human life. Problems can only arise due to bioaccumulation in human tissues over a long period of time

Table 3: Concentration of heavy metals in water samples in ppm (mg/kg or mg/L)

Dams	Zn	Cr	As	Cd	Ni	Mn	Pb	Co	Cu
Erelu	0.087	0.014	ND	ND	ND	0.033	ND	ND	0.006
Fiditi	0.062	0.014	ND	ND	ND	0.011	ND	ND	ND
Eleyele	0.099	0.027	0.011	ND	0.022	0.022	ND	ND	0.006
Eruwa	0.729	0.041	0.011	ND	0.034	0.012	ND	ND	0.012
Asejire	0.457	0.027	0.011	ND	0.011	0.089	ND	ND	0.006
Iluju	0.111	ND	ND	ND	0.011	0.033	ND	ND	0.012
Awba	0.087	ND	ND	ND	0.011	0.011	ND	ND	ND
Ilora	0.049	ND	ND	ND	ND	0.011	ND	ND	0.006
Ogbomoso	0.490	ND	ND	ND	ND	0.344	ND	ND	ND
Awe	0.062	0.014	ND	ND	ND	ND	ND	ND	0.006

ND – Not Detectable

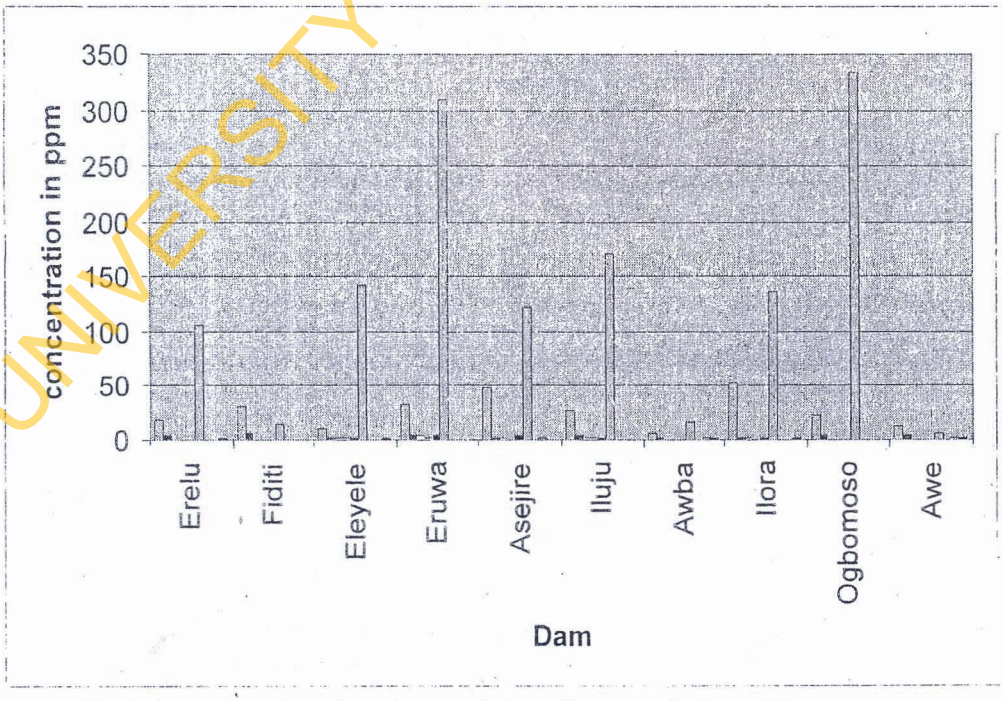

Fig.2: Concentration of heavy metals in sediments of selected dams.

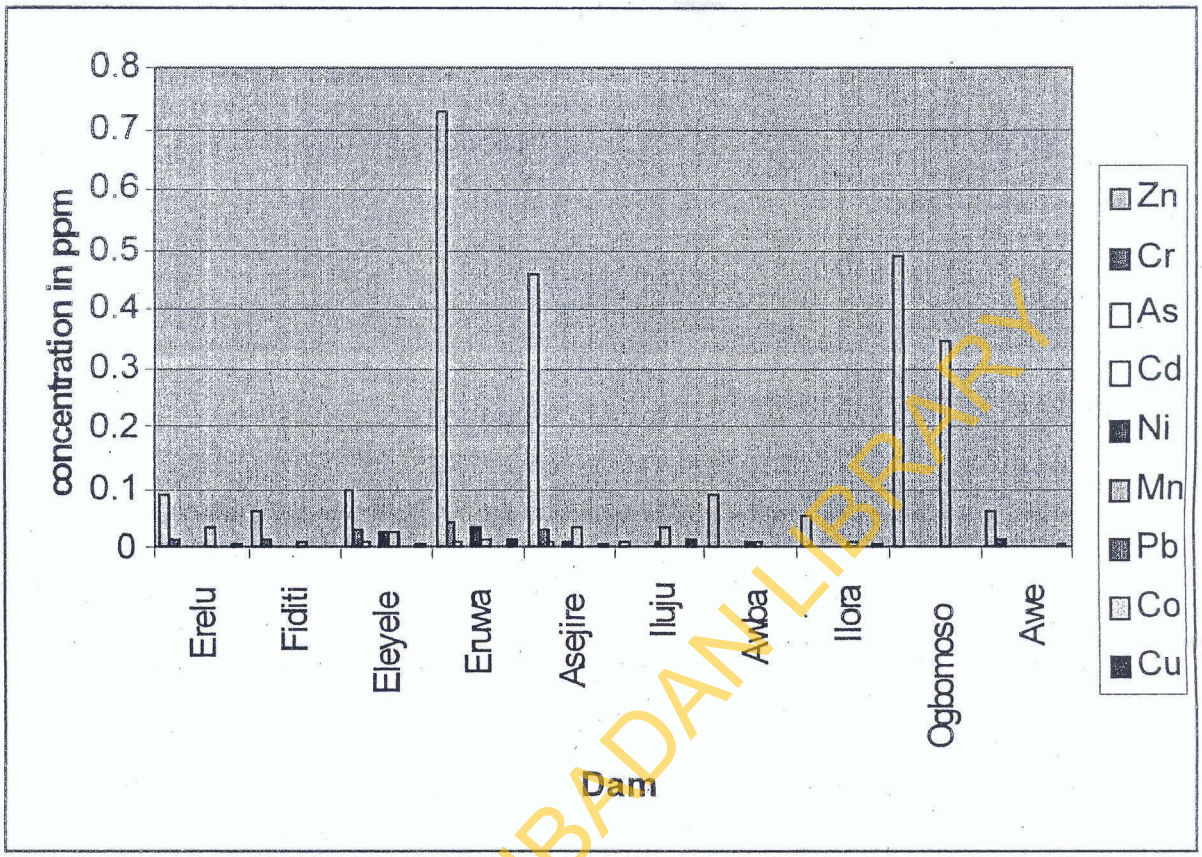

Fig.3: Heavy metals concentration in water samples of selected water dams

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