

Quantitative Investigation of Heavy Metals in Water Samples of River Jakara in Kano State of Nigeria

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Abstract – Environmental pollution is a major global problem posing serious risk to man and animals. Quantitative investigation of six heavy metal ions which include Pb, Cd, Cu, Cr, Fe and Zn in the water samples of River Jakara of Kano State have been carried out using atomic absorption spectrophotometry. Calibrations were constructed for the six metals using standard solution. The analysis showed that the concentrations of Pb, Cd, Cu, Fe, Zn and Cr are moderately high in the water samples analyzed when compared to guidelines given by WHO. River Jakara is highly polluted by heavy metals like cadmium, zinc, lead, chromium, copper and iron. Prominent among the sources of this pollution is the discharge of effluent waste from local dyeing occupation, peculiar to people of this area and industrial waste from the proximate industrial location among others.

Keywords – Heavy Metal, Ions, Analysis, Atomic Absorption Spectrophotometry.

I. INTRODUCTION

Environmental pollution is a major global problem posing serious risk to man and animals. The development of modern technology and rapid industrialization are among the foremost factors contributing to environmental pollution. Environmental pollutants are spread through different channels, such as air, water, soil which eventually enter into food chain of livestock and man [1]. There is increasing concern about environmental pollutants emanating into the livestock production systems [2]. Pollution of the environment has significant impact on living organisms. Heavy metals toxicity is one of the major current environmental health problems and each is potentially dangerous because of its bioaccumulation through the food chain [3]. Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans and ground waters). Water pollution occurs when pollutants like heavy metals are discharged directly or indirectly into the water bodies. The presence of polluting metals like Pb, Cd, Cu, Cr, Fe and Zn are known to show

effect on human body [4&5]. Non-essential heavy metals have directly or indirectly adverse effect on biological activities. The presence of heavy metals in water degrades their quality which affect human health. Even the essential metals at higher concentration are toxic. The livestock systems are prone to general problem of pollution emanating from industrial activity. Excessive accumulation of Pb causes impaired kidney functions, multiple sclerosis, anaemia neurological diseases and encephalitis [6]. Excess Cd leads to nephritis and wrong bone metabolism [6]. Wilson's disease is caused by excess Cu and excess Zn causes the disease of metal fume fever. Water is one of the most essential component of life on earth. In its purest form, it is odourless, colourless and tasteless but due to human and animal activities, it is usually contaminated with solid, human wastes, effluents from chemical industries and dissolved gases. During last decade, it is observed that ground water got polluted tremendously due to increased human activities. Consequently, the number of cases of water borne diseases have been observed in some proximate localities along various water settlements. This study is limited to heavy metals pollution index in River Jakara, Kano state of Nigeria.

II. MATERIALS AND METHODS

Description of Sampling Site

River Jakara lies within the latitude 18.35°N and longitude 05.8°E, which make it to occupy a central position in Kano State, Northern part of Nigeria. Kano State is a highly populated and industrialised state (Said, 2008). Industrial waste from Bompai industrial area are discharged into drain, which channel out to River Getsi, which flows to River Jakara then to Jakara dam. Other Rivers such as River Gwagwarwa, River Rafin Malam, and River Cijaki, among others also drain from different locations into River Jakara. Below is figure 1 showing map of sampling location.

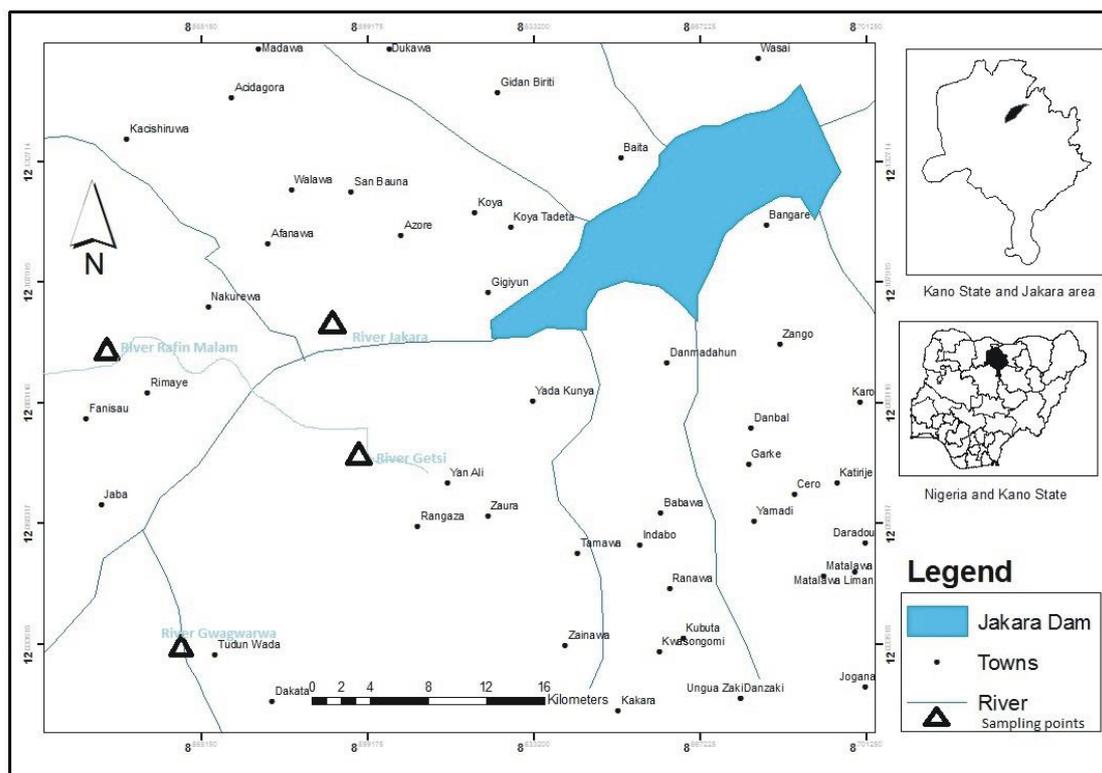


Fig.1. Map of Sampling site of River Jakara and its tributaries

Sample Treatment

The water samples (1000 cm³ each) were collected in ten (10) different locations along River Jakara by random sampling to provide representative coverage of the River. They were collected in inert polyvinylchloride (PVC) plastic bottle which were pre-wash and soaked with 0.1M HNO₃ acid solution for more than eight (8) hours. They were filtered and preserved by adding 10ml. of the 0.1 M HNO₃ acid solution to the sample in the bottle. Water samples obtained from different sites were pre-treated by repeated evaporation with analytical grade trioxonitrate (V) acid (HNO₃) as outlined in standard methods for water

and effluents analysis. The heavy metal concentration was determined using flameless Atomic Absorption Spectrometry-model 306, equipped with hollow cathode lamp graphite furnace.

III. RESULTS AND DISCUSSION

The atomic absorption spectrophotometric analysis of heavy metal in water samples of River Jakara are summarized in table 1. presented below.

Table 1: Concentration of heavy metals in water samples of River Jakara.

Sample No.	Metal quantity	Cd	Cu	Cr	Fe	Pb	Zn
1		6.60	2.33	2.33	40.00	1.45	2.43
2		0.35	2.33	1.18	9.45	1.75	2.00
3		2.20	1.90	1.03	9.85	0.10	2.70
4		0.18	1.43	0.25	5.40	5.02	2.10
5		0.58	5.68	0.58	7.98	2.20	0.83
6		0.80	4.18	0.58	8.05	0.40	0.78
7		0.70	2.18	1.00	27.40	4.40	0.30
8		1.30	1.30	1.05	25.20	4.60	2.50
9		0.70	1.33	1.00	26.80	8.45	0.23
10		1.03	2.83	1.25	32.25	6.97	2.25
Range		0.18-6.60	1.18-5.68	0.25-1.25	5.40-27.40	4.60-8.45	0.23-2.70
Mean±SD		1.44±1.80	2.45±1.39	1.77± 0.44	21.54±11.67	3.53±2.73	1.61±0.92
WHO		0.10	0.50	1.00	20.0	1.00	0.5

The results in table 1. reveals that the mean concentration of heavy metals were 1.44 mg l⁻¹ for cadmium, 2.45 mg l⁻¹ for copper, 1.77 mg l⁻¹ for chromium, 21.54 mg l⁻¹ for iron, 3.53 mg l⁻¹ for lead and 1.61 mg l⁻¹ for zinc. These concentrations were compared with the WHO standard guidelines and they indicated high levels for cadmium, copper, chromium, lead, iron and zinc. The high levels were attributed to the discharge of untreated industrial waste, domestic waste and agricultural waste into the river, indicating the level of pollution of River Jakara. Also, the results obtained from this investigation, indicates that there is positive correlation between copper and cadmium, iron and copper, chromium and lead. This implies that the presence of one of the coupled heavy metals influences the mechanism of accumulation of the other in River Jakara.

IV. CONCLUSION

Six heavy metal were identified and quantified in River Jakara. The results showed that the mean concentration of these heavy metals were 1-44 mg l⁻¹ for cadmium, 2.45 mg l⁻¹ for copper, 1.77 mg l⁻¹ for chromium, 21.54 mg l⁻¹ for iron, 3.53 mg l⁻¹ for lead and 1.61 mg l⁻¹ for zinc. These concentrations were compared with the WHO standard guidelines and they indicated high levels for cadmium, copper, chromium, lead, iron and zinc. River Jakara is highly polluted by heavy metals like cadmium, zinc, lead, chromium, copper and iron. Prominent among the sources of this pollution is the discharge of effluent waste from local dyeing occupation, peculiar to people of this area and industrial waste from the proximate industrial location among others.

There is need for government to legislate approximate laws, to regulate the treatment of River water before usage. Environmental assessment, monitoring and appraisal is necessary periodically on industrial waste. The most effective way to control, reduce and eliminate the impart of these toxic heavy metal is to develop proper environmental policies and implementation of both waste management plan and environmental assessment appraisal along with setting up task force to ensure compliance to such laws and policies.

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