# ANALYSIS OF HEAVY METALS IN SOIL SAMPLES FROM THE JAKARA RIVER CATCHMENT IN KANO STATE, NIGERIA

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## ABSTRACT

*Heavy metals contained in irrigation soils in the Jakara River catchment complex were analysed. Samples were collected from four different sites in the basin. Standard methods were employed to analyse the heavy metal content of the soils. Zinc, copper, nickel, lead and cadmium were specifically analysed using Atomic Absorption Spectrophotometer. The mean concentration of the heavy metals were taken and the results were compared with permitted heavy metals concentration in soil recommended by European Commission as soil quality standard. The results showed that, the soil contained significant concentrations of copper, zinc, nickel and lead, but only zinc and nickel were above the threshold level permitted, while cadmium was detected in traces. The implications of the findings on irrigation farming and human health were discussed and possible mitigating measures were recommended.*

**Key Words: Heavy metals, Irrigation, Jakara, Soil,**

## INTRODUCTION

Heavy metal pollution of the environment is an increasingly significant problem in the industrialized world. Heavy metals can enter the environment via several pathways, both natural and anthropogenic. The main sources of heavy metal pollution are the mining industry, agriculture, and the automotive industry (Sterrett *et al.*, 1996). Heavy metals pose a significant risk to human health, mainly due to the fact that heavy metals tend to bioaccumulate in tissues. Therefore, there can be a significant buildup of heavy metals in internal organs such as the liver, kidneys, and lungs. Some of the heavy metals are also

micronutrients and therefore are essential, at low levels, for the normal functioning of most of organisms, while other non-micronutrient heavy metals have no known biological function. Both essential and non-essential heavy metals can be extremely toxic at high concentrations (Popoyan, 2006).

The ever-increasing population and urbanization has necessitated the intensification of irrigation farming to overcome food deficits arising from such problems. These activities resulted in the construction of many artificial surface water storage devices such as Jakara Dam in Kano and many others. Many of these water bodies received untreated domestic, agricultural and industrial wastes (Balogun, 1998); and it is a common knowledge that most of these bodies are used as water supply sources for both human consumption and irrigation purposes.

Whatever may be the sources of irrigation water, some soluble salts are always dissolved (Michael, 1997). And it has long been discovered that, the main soluble constituents in these waters are heavy metals (Michael, 1997). In the same vein, Ademoroti (1996) reported that various activities of man in recent years have increased the quantity and distribution of heavy metals in the atmosphere, land, and water bodies. There is an increase in pollution of the ecosystem (Abubakar, 1999). These increase is of concern, because according to Garba (2006) the metals are non-degradable and are persistent in the ecosystem, physical, chemical and biological processes may combine under certain circumstances to concentrate metals-rather than dilute them and the impact of the contaminated system on the society is substantial.

Several studies were conducted on the Jakara catchment area, these include the works of Garba (2003) which focuses on pollution by heavy metals, Ardo (1995) which is on nitrite concentration, that of Faruk (1999) which is on the distribution of some heavy metals in the soil and water of the Jakara River valley and the work of Mbagwu (1994) which studies the impact of pollution on macrobenthic invertebrates. The objective of the present study is to determine the concentrations of copper, zinc, lead, nickel and cadmium in the soil of the Jakara River catchment.

## MATERIALS AND METHODS

### Study area

The soil studied was from an irrigated (experimental) farm at the Jakara Dam, Situated at about 40km north of Kano metropolis in Wase Village Minjibir Local Government. The Dam

was constructed by WRECA in 1957 purposely to contain wastewater from different areas of Kano City, flowing through Fagge, Abattoir and Bompai industrial areas and draining into Jakara River from which the Dam received its water and name.

The water is being used for irrigating a variety of vegetables and fruits, therefore, the consequences of repeated wastewater application of this agricultural land cannot be neglected.

**Analysis of soil samples**

Soil samples were randomly collected from different locations within the farms in cloth bags. The samples were dried, grounded and sieved to remove stones and plant debris.

The chemical analysis of soil samples was done using standard analytical methods of water analysis as described by Trivedi and Goyal (1986), APHA-AWWA-WPCF (1985) and USEPA (1979).

**RESULTS AND DISCUSSIONS**

The mean concentrations of the heavy metals analyzed in the soil samples are presented in Table 1. These values (mean) were compared with maximum metal concentrations in soils permitted under the European Community Regulation (Wild, 1996) presented below (Table 3).

**Table 1: Values of heavy metals in soils of Jakara Catchment**

| S/N | Heavy Metal | Site 1 | Site 2 | Site 3 | Site 4 |
|---|---|---|---|---|---|
| 1. | Zinc (Zn) | 316.1ug/g | 296.3ug/g | 283.1ug/g | 331.1ug/g |
| 2. | Copper (Cu) | 43.2ug/g | 38.4ug/g | 29.6ug/g | 41.3ug/g |
| 3. | Nickel (Ni) | 93.2ug/g | 88.6ug/g | 78.3ug/g | 89.4ug/g |
| 4. | Lead (Pb) | 12.2ug/g | 11.5ug | 12.4ug/g | 10.9ug/g |
| 5. | Cadmium (Cd) | 0.8ug/g | 0.2ug/g | 0.4ug/g | 0.6ug/g |

**Table 2. Mean and Standard deviation of metals**

| S/N | Heavy Metals Analyzed | Mean Conc. (ug/g) | Standard Deviation |
|---|---|---|---|
| 1. | Zinc (Zn) | 306.65 | 3.126 |
| 2. | Copper (Cu) | 38.13 | 0.589 |
| 3. | Nickel (Ni) | 87.33 | 1.434 |
| 4. | Lead (Pb) | 11.61 | 0.638 |
| 5. | Cadmium (Cd) | 0.71 | 0.012 |

**Table 3: Mean values obtained in the soil samples and the maximum metal concentration permitted in soil**

| S/N | Heavy Metals | Mean Value (ug/g) | Maximum Conc. (ug/g) permitted |
|---|---|---|---|
| 1. | Zn | 306.65 | 300 |
| 2. | Cu | 38.13 | 140 |
| 3. | Ni | 87.33 | 75 |
| 4. | Pb | 11.61 | 300 |
| 5. | Cd | 0.71 | 3 |

Based on the analysis, the results showed that the soil contain zinc (306.65), lead (11.61), copper (38.13) and Nickel (87.33) microgram per gram. Only the mean concentration Zinc and Nickel are significantly higher than recommended standard limits. The presence of heavy metals in soils affected plant growth.(Yakasai *et al.*, 2015). Seeds did not germinate on land overflowed by rivers draining the industrial wastewater and productivity was reduced by as much as 80 to 100 %, with the crops usually losing their traditional colour. (Yakasai *et al.*, 2015)

The higher concentrations of Zinc and Nickel in the soil may probably be associated with high discharge of Zinc and Nickel salts into the water from the industries within the catchment area of the Dam. Therefore, the soil might constitute a potential source of environmental pollution. Hence irrigation in the soil is risky because of the implications of heavy metals pollution. Heavy metals (Pb, Zn, Cd) are known to inhibit wheat growth and cause the decrease of crops (Singh and Nayyar, 1991). Kopittke e al.,(2007) reported that relative fresh mass of cowpea (*Vigna unguiculata*) was reduced by 10% at a $Pb^{P2+}$ activity of 0.2μM for the shoots and at a $Pb^{P2+}$ activity of 0.06 μM for the roots.

The lower concentration of the other metals, (Copper and Lead) found, be traced to the shortage or absent of their salt in water. Hence their precipitation in the soil would be less or completely absent as in the ease of cadmium. Therefore the soil might be a source of pollution for these metals, more treatment should be enforced to ensure that, levels continue to remain within the recommended limits. This is necessary to forestall environmental pollution. As it is known that metals affect human health. According to Daniel (2004) heavy metals pass into man through food chain, and the cumulative effects of these metals most of which are toxic are adverse generally. For instance, excessive exposure or accumulation of heavy metals in the body causes an array of symptoms and diseases such as vomiting,

dizziness, joint pains, slurred speech, lack of coordination, Kidney malfunctioning, hypertension, blurred vision, constipation, paralysis and even death.

## CONCLUSION AND RECOMMENDATION

It is Obvious from the result of this study that the suitability of soil for irrigation is determined by the amount and kind of heavy metals present in the soil. With poor quality of soil, various cropping problems can be expected to develop. It is therefore recommended that:

i. Water disposal authorities should exercise caution in the choice of refuse depots and dumping sites to ensure that the disposal of wastes does not pose danger to public health nor cause serious detriment to the amenities of the locality.
ii. Reinforcement and enforcement of the FEPA guidelines for water resources management in the federation.
iii. Installation of waste pretreatment facilities in all the industries operating in the states of the nation.
iv. Public enlightenment campaigns should he Intensified on the way of waste disposal.
i. Charges should be imposed on errant industries violating all environmental protection laws.

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