مؤتمر عجمان
الدولي السادس للبيئة
Ajman 6th International
Environment Conference

Detection of Heavy Metals Concentrations in Plant: Case study Wadafiea Dumpsite, Khartoum North, Sudan

TOWARDS >>>
2071
SHAPING THE
FUTURE
FOR ENVIORMENTAL
SUSTAINABILITY

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TOWARDS 2071 SHAPING THE FUTURE FOR ENVIRONMENTAL SUSTAINABILITY

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1.Introduction

In this paper, we focused on the increase in the amount of solid waste generated as a result of the rapid urban growth rate and economic growth and the impact of this rapid increase on environmental parameters such as plants. The management of various types of solid waste over the years has been a difficult and challenging issue worldwide including Sudan.

The decay of those solid wastes releases substances that will affect the soil nutrients content, increase the concentration of heavy metals within the soil, altering the Natural balance of nutrients available for plant growth and development thereby affecting species diversity and agricultural productions. Heavy metals are natural components of the Earth’s crust.

Heavy metals can enter a water system by industrial and consumer wastes, or maybe from acidic rain breaking down soils and releasing heavy metals into streams, lakes, rivers, and groundwater. Heavy metals have received the eye of researchers everywhere on the planet, mainly because of their harmful effects on plants and other living organisms.

The heavy metal content of soils may be a critical measurement for refuse dumpsites assessment and necessary to facilitate advice on appropriate remedial measures. It's expected that results obtained from the study will widen our knowledge of the environmental risks related to solid waste dumps in terms of heavy metal toxicity and therefore the suitability of such sites for plant cultivation.

1.1 Research Problem

In Khartoum state there was no system that matches the systems of solid waste management in cities of the world in which the management operations during the past periods fluctuate between political decrease and the capabilities available.

Khartoum State became surrounded by wastes from all directions and the spread of aimless dumping sites in all places resulted in heaps of wastes. There is no differentiation in the treatment of waste in Sudan. Industrial, medical and municipal wastes are simply dumped in the same dumping site.

Khartoum North city is facing now more problems these reflected to the movement of rural population to the city.

1.2 Objectives

1- Determine the contents of heavy metals in plants around the solid waste dumpsites; and

2- To compare the seasonal variations in the concentration of heavy metals in plants.

2. Materials and Methods

2.1 Study area

This study has been conducted during the months of October 2019 till August 2020 in Khartoum North and comprised of lab analysis for plants around the wadafiea landfill Fig. (1) and (2).

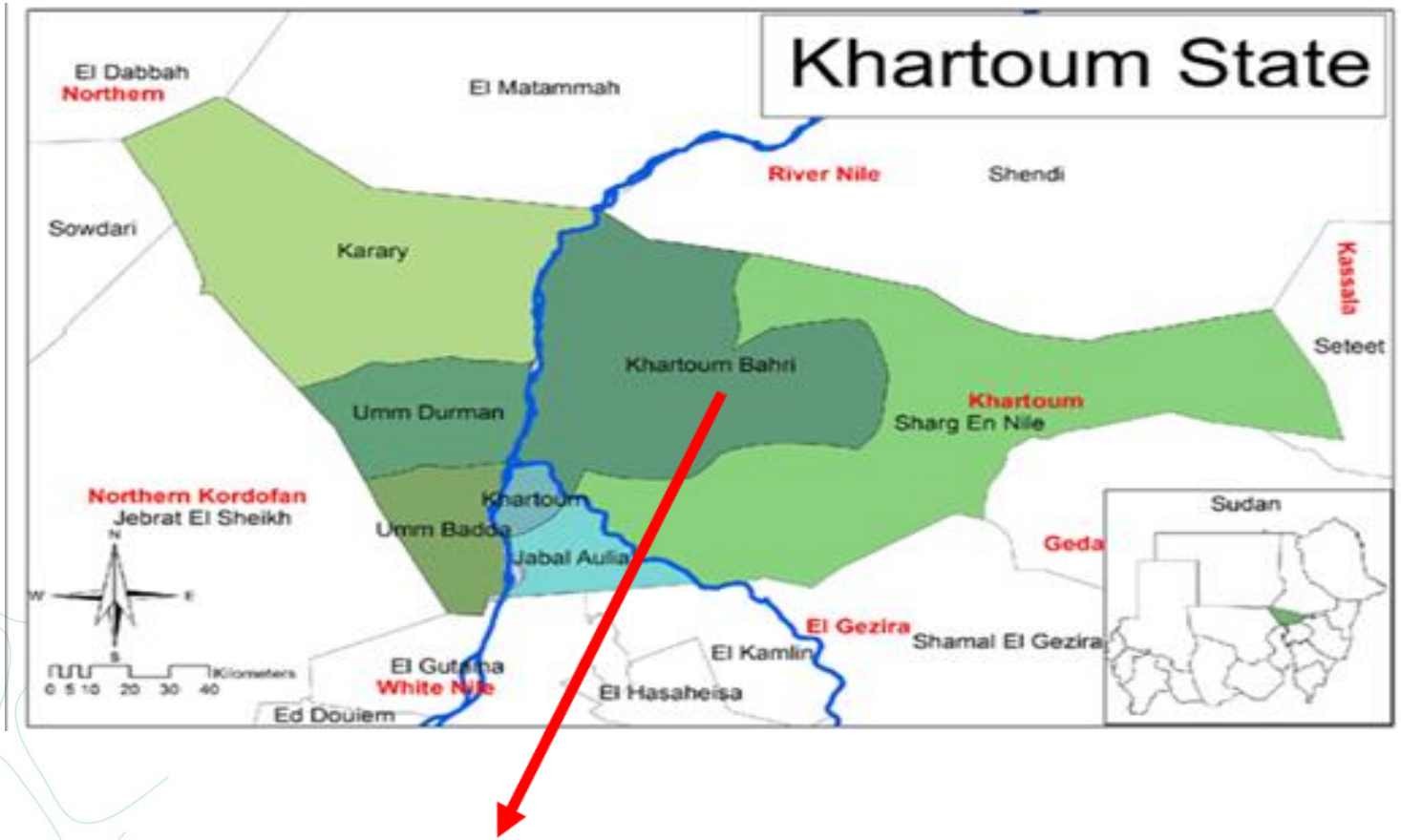

Fig.1. Study area (Khartoum Bahri) – Khartoum State Map

(A)

(B)

Fig. 2. Wadafiea dumpsite – Khartoum Bahari

2.2 Laboratory Tests

2.2.1 Plant samples collection and analysis

A grand total of (20) samples of plants were collected from two seasons the dry season and rainy season from landfill and the area surrounding by specialist from Faculty of Sciences and Technology - Al Neelain University Fig.(3). The extraction of the sample was analyzed by using (AAS).

A

B **C**

Fig 3. Plant samples from Wadafiea dumpsite and the area around it.

3.Results and Discussion

The concentrations of heavy metals in the plants analyzed differ from one sampling location to another and vary from one species of plant to the other. This may be attributed to the differential uptake capacity of plants for different heavy metals through roots and their further translocation within the plant parts.

The concentration of heavy metals in plants growing around the dumpsite was also determined in the dry and rainy seasons, the results are shown in Table (3.1). This results indicated that, the concentration of heavy metals in *Letadenia arborea* samples at dry and rainy season were higher than the control plant sample for (Cu) (0.44) and (Zn) (0.37)

Table 3.1: Heavy Metal concentration (mg/kg) in *Letadenia arborea* at Dry and Rainy Season

Parameters	*L. arborea* - South Dump		*L. arborea* West Dump (A)		*L. arborea* West Dump (B)		*L. arborea* North Dump (A)		*L. arborea* North Dump (B)		*L. arborea* East Dump		Control	WHO/FAO (2007)
	D	R	D	R	D	R	D	R	D	R	D	R		
Cd	0.115	0.11	0.085	0.120	0.08	0.110	0.06	0.160	0.065	0.220	0.07	0.190	ND	0.20
Cr	2.075	0.22	0.350	0.110	1.595	0.120	0.810	0.310	0.245	0.040	1.335	0.07	ND	-
Cu	**2.915**	**2.00**	**2.825**	**2.030**	**4.06**	**2.710**	**20.54**	**2.210**	**0.435**	**2.150**	**2.89**	**2.140**	0.44	40
Ni	0.125	0.26	0.105	0.160	0.06	0.10	0.120	0.340	0.230	0.150	0.180	0.18	ND	-
Pb	1.225	0.61	1.180	0.160	0.920	0.220	0.805	2.450	0.320	0.210	0.365	1.180	ND	60
Zn	**7.795**	**2.02**	**7.270**	**2.080**	**9.410**	**4.630**	**9.290**	**2.510**	**0.505**	**2.090**	**6.505**	**2.170**	0.37	5

ND means Not Detected.
D means Dry season.
R means Rainy season.

except, the concentration level of Cu in dry season which was found (0.435) at north (B) side was lower than the control plant sample (0.44). As indicated in the findings of heavy metals for (Cd, Cr, Cu, Ni, Pb and Zn) in *Letadenia arborea* at dry season were found to be higher than the concentration levels of (Cd, Cr, Cu, Ni, Pb and Zn) in rainy season.

This may be due to the fact that, during the rainy season, the possibility of rainwater leaching away parts of the metals that could be accumulated in the soil, thus reducing the quantity of these metals available to plants in the soil.

The findings of *Tamarix africana* samples showed that, the concentration levels of Cu and Zn had highest concentrations at both dry and rainy season Table (3.2). The concentration levels of (Cd, Cr, Cu, Ni, Pb and Zn) were lower than that of the control

Table 3.2: Heavy Metal Concentration (mg/kg) in *Tamarix africana* at Dry Season and Rainy Season

Plant Species	Cd	Cr	Cu	Ni	Pb	Zn
Tamarix africana	**0.415**	0.435	**1.810**	0.155	0.415	**7.395**
South Dump / Dry season						
Tamarix africana	0.100	0.340	1.570	0.230	1.190	1.470
South Dump / Rainy season						
Tamarix africana	ND	ND	0.29	ND	ND	0.90
WHO/FAO (2007)	0.20	-	40	-	60	5

ND means Not Detected

samples limit and WHO / FAO guideline value (2007) except, the values of Zn (7.395) and Cd (0.415) were higher than the WHO/FAO guideline value (5) for Zn and (0.20) for Cd respectively, in the control samples.

The results regarding heavy metals content in *Sudanese sorghum* samples at south side near the dumping area of solid waste at the dry and the rainy season were presented in Table (3.3). These results revealed that, the concentration levels of heavy metals in the dry season were greater than in the rainy season except, the value of Pb (1.16) in the rainy season was exceeded

Table 3.3: Heavy Metal Concentration (mg/kg) in *Sudanese sorghum* at Dry season and Rainy Season

Plant Species	Cd	Cr	Cu	Ni	Pb	Zn
***Sudanese sorghum South Dump* /Dry**	**0.085**	**1.980**	**0.555**	**0.200**	**0.325**	1.080
***Sudanese sorghum South Dump* /Rainy**	0.130	0.130	0.510	0.150	**1.160**	**0.420**
Sudanese sorghum South Dump	ND	ND	0.040	ND	ND	**0.930**
WHO/FAO (2007)	0.20	-	40	-	60	5

ND means Not Detected

the level of the dry season (0.325) , all findings of (Cd, Cr, Cu, Ni, Pb and Zn) in plant sample were far greater than the control samples and no trace of (Cd, Cr, Ni and Pb) was detectable in control except, the value Zn (0.93) which was found to be higher than the plant sample in rainy season (0.42) and Cd in dry season was found to be lower (0.085) than the rainy season.

The readings of *Ricinus communis* indicated that, the analyzed Zn and Cu had highest concentration levels in plant samples and all results of the dry season were higher than the rainy season and fall within the limit values of control plant samples and permissible limits recommended by WHO/FAO guideline values (2007) Table (3.4).

Table 3.4: Heavy Metal Concentration (mg/kg) in *Ricinus communis* at Dry Season and Rainy Season

Plant Species	Cd	Cr	Cu	Ni	Pb	Zn
Ricinus communis ***West Dump /*** **Dry**	0.055	0.865	**2.840**	0.115	0.835	**8.460**
Ricinus communis ***West Dump /*** **Rainy**	0.970	0.150	2.300	0.170	1.250	2.770
Ricinus communis	ND	ND	0.280	ND	ND	0.96
WHO/FAO(2007)	0.20	-	40	-	60	5

ND means Not Detected

The concentration of the heavy metals in all the samples cultivated around the dumping site were higher than those from the control site. This fact indicated that, the waste dump has affected the quality of the plants and crops grown around the area. This results of heavy metals of plants explained that, the highest values were detected in samples. Although heavy metals

are acknowledged as essential elements to plants, higher concentrations of these heavy metals could be toxic and the accumulation of heavy metals in plant will cause health problems for people living in the landfill, residential areas near the dumping site and farms adjacent the dumping site and also, these plants are commonly used to feed the residents' animals.

The results found that, the plants absorbed large amount of heavy metals from the soil around the dumping site and this is also an evident in the case of the higher concentration of soil which could be attributed to the mobility of metals from dumping sites to lands and plants around the dumping site through leaching and runoffs .

4.4. Conclusion and Recommendations

4.1 Conclusion

* The indiscriminate dumping of solid waste into the environment has caused great damage to the ecosystem by releasing pollutants such as heavy metals that are in high concentration in the soil that can be harmful to humans and plants.

* The results of this study found that the plants absorbed a large number of heavy metals from the soil around the dumping site in the dry season while in the rainy season the possibility of the rainwater is leaching away some of these metals and reduced the amount of these metals available to plants in the soil and found the fact

that the landfill affected the quality of any plants such as crops grown around the area.

* The wadafiea landfill is a multifaceted problem that badly affects the quality of soil and plants and leads to environmental pollution that poses a major problem for human health.

4.2 Recommendations

* The MWS should be classified and analyzed to understand what sources in the MSW landfill principally caused the leaches of HMs in groundwater, soil, and vegetation.
* Implementation of a strong policy and regulation for maintaining of solid waste and polluters.

* Building the capacity of the communities in the area of study (Khartoum North) and the municipalities concerned with planning for waste management in a proper manner.
* Frequent inspections of the solid waste landfill should be conducted to reduce the potential spread of waste contaminated with heavy metals to nearby densely populated areas, the cultivation lands, and water sources.

THANK YOU