

Urbanization and Ecological Health: The environmental impact of a micro-enterprise center in Kumasi, Ghana

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Introduction: It is projected that by the year 2030, 60 % of people will live in urban areas. In 1999, 37.8 % of the African population lived in urban areas. Accra, Ghana, grew by 247 % between the years of 1970 and 2000. Urban expansion causes stress on infrastructures like roads, water supplies, sanitation, and waste management. The expansion has led to soil degradation and pollution. Soil contaminated with heavy metals is a problem caused by industrialization. The Magazine micro-enterprise center may be a source of heavy metal contamination in Kumasi (Figure 1). Heavy metals can be released to the environment from paint, motor oil, gasoline, tires, batteries, and other car parts (Figure 2). These heavy metals can adversely affect humans and the environment. It is therefore, important to determine where heavy metal soil contamination occurs.

Objectives:

- 1) Determine heavy metal concentrations of soil in a watershed that is impacted by activities of the Kumasi micro-enterprise center.
- 2) Compare and contrast heavy metal values to those of soils from a watershed on similar fluvial landform that is not within the sphere of influence of the micro-enterprise center.



Figure 2: Paint, gasoline, oil, and car parts in Magazine micro-enterprise.

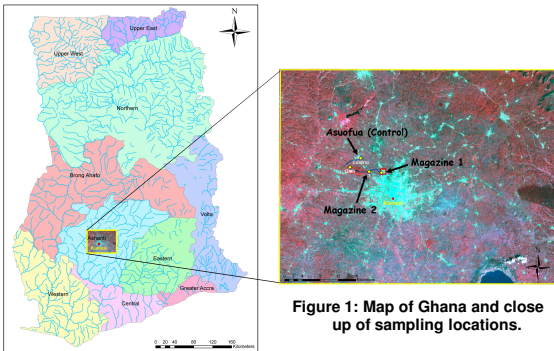


Figure 1: Map of Ghana and close up of sampling locations.

Methods: Soil samples were collected in composite at 0-5, 5-10, 10-20, and 20-30 cm from two sites affected by the Magazine industrial area and one control site (Figure 3). Samples were digested and analyzed for heavy metals with an ICP.



Figure 3a: Magazine 1 and 2 sites littered with debris and planted with sugarcane and plantain. Figure 3b: Control site without debris and planted with corn, okra, and onions.

Discussion: Correlations between all heavy metals are given in Table 1. Highly significant correlations suggest that natural as well as anthropogenic sources of heavy metals are closely related. Concentrations of all the heavy metals are highest from the Magazine 1 area, followed by Magazine 2, and finally the control area (Figure 4). Concentrations of Ni and As are within the normal range for soils at all three locations. Concentrations of Cr, Co, Cu, Zn, Pb, and Hg are higher in the Magazine impacted soils compared to the control. They are most likely coming from pollutants in the Magazine area.

Table 1: Correlation table.

Element	Cr	Co	Ni	Cu	Zn	As	Pb	Cd	Hg
Cr	1								
Co	0.84***	1							
Ni	0.67**	0.69**	1						
Cu	0.67**	0.84**	0.89***	1					
Zn	0.79**	0.77**	.54	0.95***	1				
As	0.60*	0.55	0.72**	0.54	0.31	1			
Pb	0.86***	0.73**	0.45	.89***	0.94***	0.39	1		
Cd	0.71**	0.73**	0.81***	0.73**	0.53	0.96***	0.57	1	
Hg	0.90***	0.84***	0.86***	0.97***	0.97***	0.66**	0.84***	0.81***	1

* p< 0.05, **p<0.01, ***p<0.001

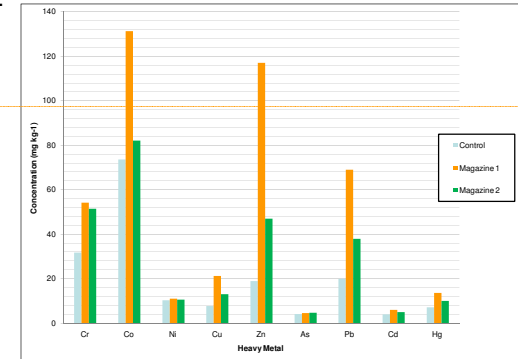


Figure 4: Heavy metal concentrations at each sampled location.

Conclusions:

- 1) Soils influenced by the activities of the micro-enterprise center showed a wide range in heavy metal concentrations
- 2) Soil impacted by the magazine had enhanced levels of Cr, Co, Cu, Zn, Pb, and Hg but there is no apparent threat of As and Ni pollution
- 3) Considering the rate of expansion of the center and the waste disposal practices, pollution will be on the increase with serious consequences to environmental integrity

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