Leachate Pollution of Cocoyam and Pawpaw Crops Grown Around Anaekie Obiakor Illegal Dumpsite, Awka, Anambra State, Nigeria

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ABSTRACT: Leachate pollution of Aneakie Obiakor illegal dumpsite, Awka was studied. Leachate and plant samples (cassava and pawpaw) were collected from the waste dumpsite and control site during wet season, and analysed for level of concentration of 10 heavy metals; Cd, Zn, Cu, Ni, Pb, As, Hg, Cr, Fe using Atomic Absorption Spectrophotometric (AAS). The result was compared with the control and WHO/FAO standard. It was observed that all the heavy metals present in the plants were within WHO/FAO safe limit with the exception of Pb, Hg, As and Cd. The study revealed that the presence of leachate on agricultural soil results in heavy metal accumulation in soils and bioaccumulation in plants. The work therefore, recommended that the agricultural farmland on which this illegal waste dumping is going on should be recover by stopping the illegal waste dumping and using bioremediation and phytoremediation to extract the already accumulating pollutant in the soil.

Keywords – Cocoyam, Heavy metals, Leachate, Pawpaw, Waste Dumpsite

1 INTRODUCTION

Solid wastes that are disposed on lands are buried in the soil especially in humid areas. The wastes are subjected to leaching by percolating rain water. The leaching process is accompanied by chemical reactions that tend to consume all available oxygen, while releasing carbondioxide, methane, ammonium, biocarbonate, chloride sulphate and heavy metals. The liquid mix of the constituent is referred to as leachate. Leachate emanating from dumpsite contains contaminants and toxic constituent derived from solid wastes as well as from liquid and industrial waste (Odukoya, Bamgbose and Arowolo, 2007 and Oni, 1987). Leachate from dumpsites is of particular interest when it contains potentially toxic heavy metals. These metals are known to bioaccumulate in soil and have long persistence time through interaction with soil component and consequently enter food chain through plants or animals (Dosumu, Salami and Adekola 2003). Household and industrial garbage may contain toxic materials such as lead, arsenic, copper, nickel, cadmium, mercury, iron from batteries, insect sprays, nail, polish, cleaners, plastics polyethylene or PVC (polyvinyl chloride) made bottles and other assorted products. Inorganic chemical contamination of the environment is due essentially to anthropogenic source, improper disposal and lack of awareness of the health-risk created by such indiscriminate disposal.

Awka economy is reasonably dependent on the crops that are grown in the region. This includes; yams, cassava, corn, kernels and palm oil (Egboka and Okpoko, 1984). Studies on refuse dumpsites in Awka revealed that refuse dumps can substantially increase the environmental burden of heavy metals in Awka Municipality (Nduka, Orisakwe, Ezenweke, Chendo and Ezenwa, 2008). Moreover, soil contamination can adversely affect human health when contaminated agricultural produce grown in and around dumpsites are ingested, or when infiltration and surface run-off contribute to ground and surface water contamination.

The uncontrolled input of heavy metals in soils is undesirable because once accumulated in the soil, the metals are generally very difficult to remove (Smith, Hopmans and Cook, 1996). However, it is a common practice of small farmers to make use of abandoned waste dumpsite for crop production due to lack of resources to acquire fertilizers for getting meaningful harvest (Okoronkwo et al., 2005). Chaney (1980) and Smith et al (1996) cautioned on the use of waste in crop production since it may be possible for heavy metals from waste to accumulate in the soil and thereby enter the food chain and cause health hazard. To this effect, this study assesses the leachate pollution of the agricultural produce of Anaekie Obiakor Illegal Dumpsite in Awka.

1.1 The Problem of the Study

In Awka, there are only two recognized waste dumpsites namely; Agukwa and Umoeke waste dumpsites. Unfortunately in Anaeke Obiakor Lane, illegal waste dumping is grossly going on, this has resulted to all kinds of environmental and health problems for the inhabitant of the area.

Activities of crop production and cultivation such as cassava, plantain, vegetables, corn, yam, cocoyam, potatoes and fruits are grown in the area. It is an axiom that crops absorb whatever is present in the soil medium and use them for photosynthesis. Therefore, these hazardous pollutants, especially the heavy metals absorbed become bioaccumulated in the roots, stems, fruits, grains and leaves of the crops (Fatoki 2000). These finally get transferred to man through food chain. Also, during the dry season, when wind blows, it carries the dust particles emitted from the dumpsite to the leaves of foods crops planted around the area. Plants around the dumpsite are observed to have a blanket deposit of fine particles on the leaves surface after rainfall.

This become worrisome to the researcher, considering that heavy metal pollution may constitute hazard to the health of the inhabitants of Anaekie Obiakor, who grow and consume crops grown around the dumpsite. Heavy metals are not easily metabolized in human body. According to the scholars, Usman, Nda-Umar, Gobi, Abdullahi, Jonathan (2012), heavy metals become toxic in human when they are not metabolized by the body and accumulate in the soft tissues causing health problems. Therefore, there is a great need to assess the heavy metal content of plants of the area in order to ascertain the rate of leachate pollution of the agricultural land.

1.2 Aims and Objectives

The aim of this work is to assess the leachate pollution of the selected agricultural products of Aniekie Obiakor Illegal Dumpsite, Awka.

To achieve the above aim, the following objectives will be required:

- To determine the heavy metals concentration of some plants and leachate of Aniekie Obiakor dumpsite.
- To ascertain the level of interaction between the leachate and the farm products
- To suggest possible ways of managing or reclaiming contaminated soil.

1.3 Research Hypothesis

Ho: The leachate of Anaekie Obiakor Dumpsite does not interact with agricultural products of the area.

2 Methodology

Experimental design was used to derive information used for the study. Laboratory analyses of the leachate samples collected from Anaekie Obiakor dumpsite were carried out. This methodology was chosen because the data needed for the study include heavy metals concentration of the leachate.

The roots of two plant samples; pawpaw and cocoyam were collected from the farm which shared the same boundary with the dumpsite, stored in polyethene bag and carried to the laboratory for analyses. The samples obtained from ashing was dissolved with $50cm^3$ of concentration hydrochloric acid (Hcl) and made up to $100cm^3$ with distilled water. This was filtered into plastic sample bottle using filter paper

The leachate sample also collected from the experimental site was transferred into a beaker and $5cm^3$ of nitric acid was added. The beaker with the content was placed on a hot plate and evaporated down to about $20cm^3$. The beaker was cooled and another $5cm^3$ of nitric acid was also added. The heating was continued, and then small portion of nitric acid was added until the solution appeared light coloured and clear. The beaker wall and watch glass were washed with water and the sample was filtered to remove any insoluble materials that could clog the atomizer. The volume was adjusted to $100cm^3$ with distilled water and (Ademoroti, 1996). The heavy metals studied were Cd, Hg, As, Pb, Cr, Fe, Ag, Zn, Ni and Cu (Table 1.1).

The heavy metal content of the leachate and plant was determined using the Atomic Absorption Spectrophotometers (AAS) Unican 969 Instrument. The trace metals in the samples were determined with aliquots of the digest. The quantity of each trace metal in each sample was calculated by proportion methods using the standard curve method. The absorbance and concentration were read from a calibration curve drawn by computer software attached to AAS.

Table 2.1 Concentration of Heavy Metals (Mg/kg) (mg/l) in Leachate and Plant Root from Anaekie Obiakor Dumpsite

ND: Not Detected
Source: Author's Laboratory Analysis and Computation (2012)

3 DISCUSSION

	Dumpsite			Control Site	
Heavy Metals	**Pawpaw**	**Cocoyam**	**Leachate**	**Pawpaw**	**Cocoyam**
As	0.20	0.10	0.40	0.03	0.02
Cd	0.76	0.81	1.75	0.22	0.30
Zn	0.20	0.20	0.06	ND	ND
Pb	0.55	0.51	1.88	0.21	0.10
Cr	0.34	0.25	0.41	0.12	0.02
Hg	0.96	0.79	0.48	0.51	0.30
Cu	0.10	ND	0.30	ND	ND
Ni	0.12	0.20	0.35	0.01	0.01
Fe	0.56	0.71	0.81	0.31	0.41
Ag	ND	ND	ND	ND	ND
TOTAL	**3.79**	**3.57**	**6.44**	**1.41**	**1.16**

3.1 DISTRIBUTION OF HEAVY METALS IN ANAEKIE OBIAKOR ILLEGAL

Table 1.1 shows the distributions of heavy metals in the plant roots and leachate of Anaekie Obiakor dumpsite. Silver (Ag) was not detected in any of the samples. The result revealed that cocoyam and pawpaw plant from the dumpsite had the highest total concentration of heavy metals when compared with the control. This implies that the influx of leachates through the soil is gradually affecting the agricultural products of the dumpsite due to increase in heavy metal concentration. The high levels of heavy metals in the dumpsite leachate and plants could be attributed to huge amounts of waste products dumped at the dumpsites.

The distribution pattern of heavy metals among the plant species was highly variable (Table 2.1), which may be attributed to differential exposure time and absorption capacity of the plants for different heavy metals. Pb, Cd, Hg and Fe are the most abundant heavy metals in the leachate and plant of the dumpsite. There is therefore need to alert residents of the area about the health effect of ingesting agricultural products planted around the dumpsite.

3.2 Test of interaction (relationship) between leachate and the Pawpaw plant in the dumpsite.

The analysis of the interaction (relationship) between the leachate and the Pawpaw plant in the dumpsite was carried out using simple regression at 5% level of significance as displayed in Table 3.1.

Table 3.1 Summary of Regression result for Hypothesis

Variables	Coefficients	Std. Error	t-statistics	Probability
Constant	0.190	0.121	1.571	0.153
Leachate (X)	0.294	0.135	2.183	**0.050**

Dependent Variable (Y): Pawpaw (polluted)
Source: Authors Computation (2012)

Mathematically the estimated regression model is:

Y = 0.190 + 0.294X

SEM = (0.121) (0.135)

t = (1.571) (2.183)

P = (0.153) (0.050)

R^2 = 0.373

The coefficient of determination (R^2) from the model result is 0.373 or 37.3%. This is quite low, indicating a weak positive relationship between the leachate and the agricultural product of the area (Pawpaw). Since the p-value (0.050) = 0.05, the null hypothesis is rejected and concluded that there is a weak positive interaction relationship between the leachate and pawpaw crop of the dumpsite. However, it is necessary to note that although the interaction is weak, there is still a positive interaction between the leachate and farm produce (pawpaw). The weak relationship may be as a result of short time of interaction between the two.

3.3 Test of Interaction (Relationship) between Leachate and the Cocoyam Plant in the Dumpsite

The analysis of the interaction (relationship) between the leachate and the Cocoyam plant in the dumpsite was carried out using simple linear regression at 5% level of significance as displayed in Table 3.2.

Table 3.2 Summary of Regression Result for Hypothesis

Variables	Coefficients	Std. Error	t-statistics	Probability
Constant	0.149	0.115	1.286	0.234
Leachate (X)	0.324	0.129	2.511	**0.036**

Dependent Variable (Y): Pawpaw (polluted)
Source: Authors Computation (2012)

Mathematically the estimated regression model is:

Y = 0.149 + 0.324X

SEM = (0.115) (0.129)

t = (1.286)   (2.511)

P = (0.234)   (0.036)

R^2 =   0.441

The coefficient of determination (R^2) from the model result is 0.441, or 44.1%. This is fairly low, indicating a weak positive relationship between the leachate and the agricultural produce of the area (Cocoyam). Since the p-value (0.036) < 0.05, Ho is rejected and we conclude that the leachate of Anaekie Obiakor dumpsite does interact with this agricultural produce of the area (Cocoyam). Although, we rejected the null hypothesis, it is still necessary to note that there is a positive relationship between the leachate and cocoyam of the place. This low coefficient of determination can be traced to the short time of interaction between the leachate and cocoyam. This implies that shorter time of interaction enhance weak positive interaction.

Fig. 3.1 presents a positive trend between the leachate and the agricultural produce of the area (Pawpaw and Cocoyam) in a graph. From the figure, the leachate has the highest heavy metal concentration, followed by the pawpaw and cocoyam plant as also shown by the statistical analyses.

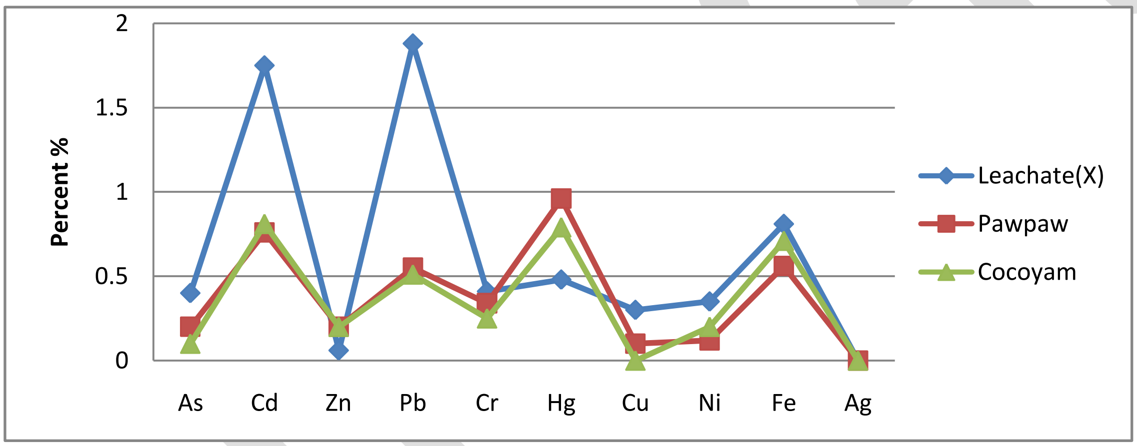

Fig. 3.1 Line Graph Displaying the Percentage Heavy Metal Concentration of Leachate and the Agricultural Products of the Dumpsite (Pawpaw and Cocoyam)

3.3 STATISTICAL ANALYSIS

Hypothesis: From the calculations made, tested at 5% significant, the calculated value, 0.050 (pawpaw) and 0.036 (cocoyam) are less and equal to the tabulated, which is 0.05. This shows that there is a weak positive interaction between the leachate and farm produce of Anaekie Obiakor dumpsite.

The implication of this is that the leachate actually pollutes the agriculatural products of Anaekie Obiakor Dumpsite. The weak interaction could be as a result of short term exposure of the plant to heavy metal pollution.

4 CONCLUSION AND RECOMMENDATIONS

The leachate and plants of Anaekie Obiakor Dumpsite contains heavy metals; and the leachate interacts with the agricultural products of the area.

The paper makes the following recommendations:

- There is also need for satisfactory soil and food quality monitoring procedures so as to prevent potential health hazards of heavy metal contamination of agricultural land.
- The agricultural farmland on which this illegal waste dumping is going on should be recover by stopping the illegal waste dumping and using bioremediation and phytoremediation to extract the already accumulating pollutant in the soil.

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