Assessement Soil Quality at Dumpsites in Keffi Town, Nasarawa State, Nigeria

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ABSTRACT

This study assessed soil quality at dumpsites in Keffi town, Nasarawa State, Nigeria. Soil samples were collected from two major dumpsites in the study area which are Nasarawa Road and Market/ Emir-Palace Road dumpsites and control sites. A total of sixteen (16) soil samples were collected from dumpsites and control sites. These samples were examined in the laboratory using twelve soil quality parameters such as pH, Temperature and Electrical Conductivity, Calcium (Ca), Magnesium (Mg), Sodium (Na) and Potassium (K) lead (Pb), Nikel (Ni) copper (Cu) Cadmium (Cd) and Iron (Fe). Results of soil samples for the two sites where compared using student 't' test. The findings showed that the soil pH at dumpsites ranged from 7.84 to 8.26 with mean value of 8.10 while the concentrations of the metals range from 2.74-27.82mg/kg for Pb, 1.05-16.7 mg/kg for Ni, 15.65-684mg/kg for Cd, 19.7-129.8 mg/kg for Cu, 40.87-282.7 mg/kg for Fe and 10.4-21.3, 4.98-7.78, 0.87-2.06 and 0.95-1.97 mg/kg for Ca, Mg, Na and K respectively. The concentrations of chemical properties at the soil dumpsites were in the order of Fe > Cu > Cd > Ca >Pb>Ni > Mg > K> Na. The results show that soils at the dumpsites are highly polluted since most parameters fall short of Food and Agricultural Organization permissible limits for crop production. There is a significant difference at 0.05 level in the concentration of metallic ions between soil samples at dump sites and control sites using t test to compare the results. Dumpsites soils recorded higher mean concentrations of metallic ions than the control sites with lower mean values. Student't' test however, reveals no significant difference in concentration of heavy metals at the top and subsurface soil at the dumpsites but a significant difference in concentration of macro nutrients between dumpsites and control sites at 95% confidence level was recorded because the latter had higher mean concentrations of soil nutrients than the former. The study therefore recommended among other things that the solution to solid waste management should not be disposal but, 'waste' should be seen as a resource by way of reuse, recycling and recovery so as to reduce the amount of it that is been disposed at dumpsites.

INTRODUCTION

The menace of environmental pollution has been hunting the human world since early times and is still growing due to excessive population growth in developing countries.

Deteriorating soil quality and spread of diseases are grave consequences of open waste dumping which have resulted in growing public concern. In developing countries open dumpsites are common, due to poor knowledge on environmental sanitation and the low budget for waste disposal.

Waste carries different metals which are then transferred to plants by different ways *Voutsa et.al. (1996).* Depending on the tendency of the contaminants they end up either in water held in the soil or leached to the underground water. Contaminants like Cadmium (Cd), Copper (Cu), Nickel (Ni), Lead (Pb) and Zinc (Zn) can alter the soil chemistry and have an impact on the organisms and plants depending on the soil for nutrition *Shaylor et.al., (2009)* .

Nigerians are generally faced with rapid deterioration of environmental conditions due to the poor system of collection and dumping of solid wastes. Therefore urban waste management has become a major concern in cities. Little efforts have been made in order to improve the waste collection and disposal facilities. This has some consequences ranging from deterioration of soil quality to reduction of plant diversity. Thus, this study was conducted on soil quality at dumpsite by assessing the physio-chemical characteristics of soil in dumpsite.

3. Research Elaborations

This study used both primary and secondary sources of data ; while secondary data was gathered through review of existing literature. Primary data were obtained through the collection of soil samples at dumpsites and control sites.

Stratified random samples of soil were collected from two (2) dumpsites and two (2) control sites located one kilometer away from the dumpsites (opposite Gauta primary school and adjacent

Emir Palace for Nasarawa road and Emir palace- market road dumpsites respectively). The sampling points were at adequate points to take soil samples in other to capture variability. Soil samples (using auger) were collected at 0-15 cm for the top-soil and 15-30 cm for the sub-surface soil.

A total of sixteen (16) soil samples were collected in a polyethylene bag and labeled with alphabets and figures for dumpsites and control sites respectively. One kilogram (1Kg) of soil samples were collected at four (4) sampling points in each of the two dumpsites and their control sites. In each sampling point, two samples were collected (top and subsurface soil). Samples rushed to laboratory within two hours to eliminate micro/macro variabilities by ensuring that samples collected on the field are not exposed before laboratory analysis to determine the soil quality.

A total of twelve (12) soil quality parameters were analyzed to determine the soil quality. The parameters include:

i. Physical properties (pH, Temperature, Salinity /Conductivity).
ii. Macro nutrients[Calcium (Ca), Nitrogen (N), Magnesium (Mg), Sodium (Na) and Potassium (K)],
iii. Heavy metals (Pb, Cd, Fe, Ni, Cu,).

4. RESULTS AND DISCUSSION

The result of soil properties from both dumpsites and control sites is presented in table 1.

Table 1: Soil Properties from Both Dumpsites And Control Sites

	Nasarawa Rd							Emir Palace/Mkt RD					
Dept	0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm		0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm
Lable	1A	A2	B1	B2	C1	C2		EA1	EA2	EB1	EB2	EC1	EC2
pH	7.98	8.02	8.26	8.43	7.84	8.09		8.5.	8.3	7.93	7.8	8.12	7.82
Temp.	37	29	31	28	30	29		30	27	31	27	32	29
EC	0.2	0.2	0.1	0.5	0.3	0.1		0.1	0.1	0.4	0.3	0.2	0.2

	Nasarawa Rd Control Sites							Emir Palace/Mkt RD Control Sites					
Dept	0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm		0-15cm	15-30cm	0-15cm	15-30cm	0-15cm	15-30cm
Lable	1Ac	A2c	B1c	B2c	C1c	C2c		EA1c	EA2c	EB1c	EB2c	EC1c	EC2c
pH	7.8	8.12	7.82	8.43	8.5.	8.3		7.84	8.09	7.93	7.98	8.02	8.26
Temp.	27	32	29	28	30	27		29	30	31	37	29	31
EC	0.3	0.2	0.2	0.5	0.1	0.1		0.3	0.1	0.4	0.2	0.2	0.1

4.1 Determination of the physicochemical properties of soil around dumpsites

The soil (pH) at dumpsites was alkaline as it ranged from 7.84 to 8.26 with mean value of 8.01. The control sites were also alkaline, ranging from 7.8 to 8.5. The levels of heavy metals at dumpsites were generally higher than permissible limit at both surface and subsurface soils.

Concentrations of heavy metals at dumpsites were significantly higher than the concentration at the control sites. Thus, the soils at dumpsites were highly polluted.

4.2 Soil Quality at Dumpsites Compare to Control Sites

The dump sites were found to contain significant amount of metals generally than the control sites. This higher concentration of metallic ions in dumpsites is attributed to leachates from unsorted wastes comprising of metals and other substances as observed in the dumpsites. Moreover, concentrations of Macro nutrients [Calcium (Ca), Magnesium (Mg), Sodium (Na) and Potassium (K)] were compared between the dumpsites and control sites. It was found that 'there is a significant difference in concentration of soil nutrients [Calcium (Ca), Magnesium (Mg), Sodium (Na) and Potassium (K)] between dumpsites and control sites". Therefore, dumpsite soil with higher mean have higher concentrations of macro nutrients than the control sites with lower mean.

4.3The Quality of Soil at the Dumpsites

The results of the heavy metal concentration in both top and subsurface samples of the waste dumpsites were above FAO permissible limits for crop production. Student 't' test was used to test for a significant difference in the heavy metal concentration of top and subsurface soil samples. It was found that there is no significant difference in concentration of heavy metal between the top and subsurface soil samples at the dumpsites. Therefore, both the surface and subsurface soil of dumpsites have high concentration of heavy metals. Thus, the soil was found to be polluted by heavy metals.

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4.4 Comparison of Soil Quality Between the Dumpsites

There are variations in the soil quality of Nasarawa road and the Emir-Palace/market road. The mean concentrations of metals between the dumpsites are 57.09 and 15.43Mg/Kg for Nasarawa road and the Emir-Palace/market road respectively. Moreover, there is high variation in the concentration of individual metal within each of the dumpsite especially the Nasarawa road dumpsites with value of 82.95 variance compare to the Emir-Palace/market

5. Conclusion

It was concluded as follows: (1) The soil at the dumpsite are highly polluted since most parameters fall short of FAO permissible limits; (2) there is a significant difference in the concentration of metallic ions between soil samples at dump sites and 1Km away from the dump sites (control sites) such that , dumpsites soil with higher mean have higher concentrations of metallic ions than the control sites with lower mean;(3) dumpsite soil is polluted by heavy metals because “there is no significant difference in concentration of heavy metal between the top and subsurface soil samples at the dumpsites”.