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Assessment of Physico-Chemical Properties and Heavy Metal Contamination in Soil Samples from Benue South,North Central Nigeria.

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Abstract: *Pollution is the introduction of contaminants into a natural environment that causes instability, disorder, and harm to the ecosystem i.e. physical system or living organisms pollution refers to the occurrence of an unwanted change in the environment caused by the introduction of harmful substance or production of harmful conditions In this study, different soil samples were collected from different sampling points and dried, then digested with acid using standard methods. The concentration of Fe, Zn, Cu, Ni, ,Cd and Pb were determined using Atomic absorption spectrophotometer. The result of the analysis indicates that Fe has the highest concentration among the all metals found in all the locations. Iron has the highest concentration among all the metals studied and its levels ranged from 95.20 to 104.2 (mg kg^{-1}) with mean value of 94. 90 ± 17.19.Iron is vital for almost all living organisms,participating in a wide variety of metabolic processes,including oxygen transport,DNA synthesis,and electron transport.High concentration of Fe (104.2mg kg^{-1}) in soil samples was observed in Otukpo –ijo while ugboju shows the lowest value. While the concentration of Pb was found to be low in this study. Physico- chemical properties were also determined showing that the soil PH was moderately acidic and presence of some organic matters and the soil was moderately saline. Furthermore, agricultural practices affect the environment on, near and beyond the farm; and it is important to examine some of the different impacts that agriculture may have on the environment such as change of land use and chemical pollution. .*

Keywords: *Heavy Metals, pollution, Contamination and soils*

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I. Introduction

Urban Soils vary spatially due to soil composition (Burghardt, 2002). Urban areas are expanding all over the world utilizing more and more agricultural and natural areas (Norra and Stuben, 2003) changes in land use and land cover are gaining wide recognition as a key driver responsible for environmental change (Imberion, 1999). In the last two decades, reduction of land cover is attributed to accelerated rate of urbanization along with explosive economic growth (Chen, 2007). Land converted to urban land use such as housing parks, industrial and disposal sites has resulted in loss of cultivated green land and arouses special attention. (Zhang et., 2003)

Bioaccumulation is the increase in the concentration of chemicals in organisms over time, compared to the chemical concentration in the environment (Adriano, 1986). Plants take up heavy metals in addition to essential minerals directly from the soil Heavy metals are non-biodegradable hence, when taken up by plants and animals they remain for a period of time. When such plants and animals are consumed by humans, the heavy metals then bio accumulate in the human system resulting in health problems. Metals such as Cd, Pb, Cu, Cr, Ni and Zn have been listed by European Commission Directorate, to be of great hazard to plants and animals (Varoney and Roy, 2005). Cd is one of the most toxic elements with reported carcinogenic effects in humans. Soil pH is considered one of the most important factors determining the concentration of metals in the soil solution, their mobility and availability to plants (Alkorta *et al*., 2004; Van Loon *et al*., 2007). Increase of hydrogen ion concentration affects the mobilization intensity of heavy metals (olufemi *et al*., 2014) Soil organic matter is the fraction of the soil that consists of plant or animal tissue in various stages of breakdown (decomposition) (Fenton et al., 2008). Soil organic matter consists of a range of materials from the intact original tissues of plants and animals to the substantially decomposed mixture of materials known as humus (Bot and Benites, 2005).

II. Materials and Methods

2.1. Study Setting and Design

Four different farmlands were selected for this study. This farmlands includes:Ugboju,Adoka,Akpa,and Otukpo –Ijo,and a control site at Eupi primary school all in Benue south senatorial district.The rainy season runs from the month of April to October and dry season from the month of November through the month of April.The temperature ranges from 42^{o} **C to 25^{o}**C during the dry season and in the rainy season temperature ranges from28^{O}C TO 31^{O}C.

2.2. Sample Collection

A 20g portion of soil sample were collected in each of the four selected farmlands which include; Ugboju,Adoka, Akpa, Otukpo- Ijo and the control site. The samples were obtain from the soil surface at a depth of (0-15cm) using a hand auger from the four different sites. The soil sample were collected from the different points of particular location of the sites and transferred into polyethylene bags with tight plastic clips and the bags were labeled properly with the date and site location code (Custo *et al.,* 2005) and then taken to the laboratory .

2.3 Sample Preparation

The soil sample collected at different locations were mixed properly to ensure homogeneity. The various sample was then placed in an oven at a temperature of 80^{o}C and was heated for 12 hours in order to remove the moisture. The dried sample was then pulverized using porcelain molar and pestle and sieved using 2mm mesh sieve to obtain fine particles.

2.4 Sample Digestion

The sample soil, 1g was put into pyrex flask and a mix of ($25cm^{3}$) of concentrated nitric acid against ($75cm^{3}$) of concentrated hydrochloric acid which is in the ratio of 1:3, was added in order to dissolve metals. The mixture was placed on a hot plate and allow to be cool. The solution was filtered and made up to a 50ml mark with distilled water.

2.5 Sample Analysis : Heavy metals (Zn, Cu, Ni, Fe, Pb,) were determined using atomic Absorption spectrophotometer (AAS), with the appropriate hollow cathode lamp and wavelength of each of the metals. .

2.6 pH AND ORGANIC MATTER.

The pH were measured using 1:2 soil,water ratio with the the pH(Mclean 1982) Organic matter were determined by the Anne Method(modified Walkey- Black method, Malthien & Preltain,2003).

2.7 Total organic carbon (TOC)

5g of the soil sample were heated for 30mins at 20^{o}C. The soil samples were then shaking in distilled water. The soil sample was pretreated with hydrochloric acid to evaporate the inorganic carbon. The test was passed over a catalyzer to drive away the carbonic acid with a non-carbon dioxide, and then the solution was quantified. The instrument used is Shimadzu TOC-VCPH with a THM-1 Model and a sample changer, ASI-V (SLU 2013)

2.8 Statistical Analysis: Data collected was subjected to one way Analysis of variance **(ANOVA)** to assess whether heavy metals varied significantly between location,possibilities less than 0.05 ($P<0.05$) will be considered statiscally significant**.**

III. Results

The result of the heavy metal levels from the studied farmlands in Benue south Senatorial, District are presented in tables 4.1 While table 4.2 shows the physicochemical parameter values of the soil samples in all the sample sites.

Table :1 Concentration of heavy metals in all the sites (mg kg^{-1})

s/no	Sample code	Zn	Cu	Cd	Pb	Fe	Ni
1	UGBOJU	28.20	2.402	0.071	0.081	95.20	1.520
2	ADOKA	18.20	2.22	0.113	0.053	131.4	1.622
3	AKPA	22.10	2.51	0.084	0.071	82.20	2.143
4	OTUKPO	16.40	3.020	0.210	0.060	104.2	2.072
	Mean±SD	17.36±4.679	2.396±0.604	0.140±0.068	0.067±0.013	94.90±17.19	1.710±0.430
	CV%	32.93%	27.30%	47.57%	18.40%	17.11%	25.14%

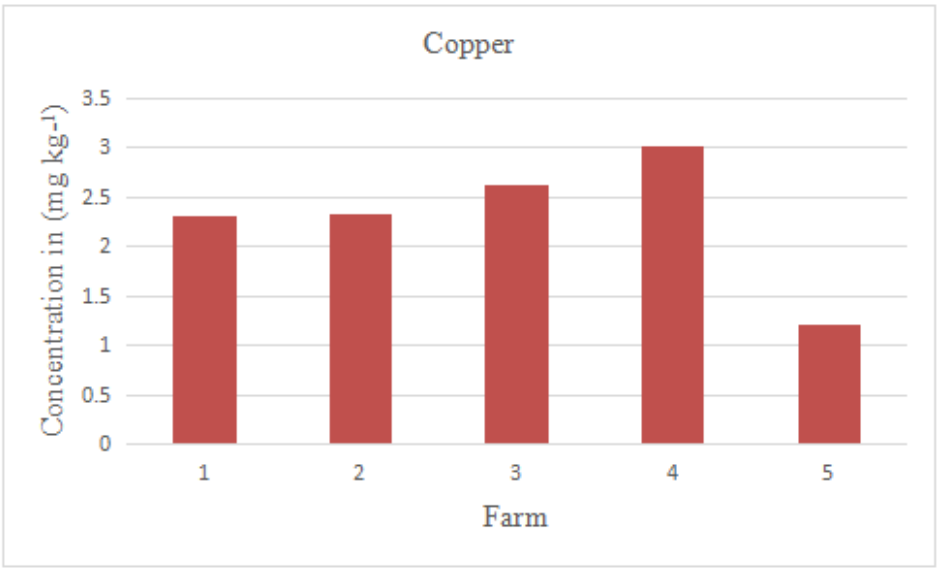
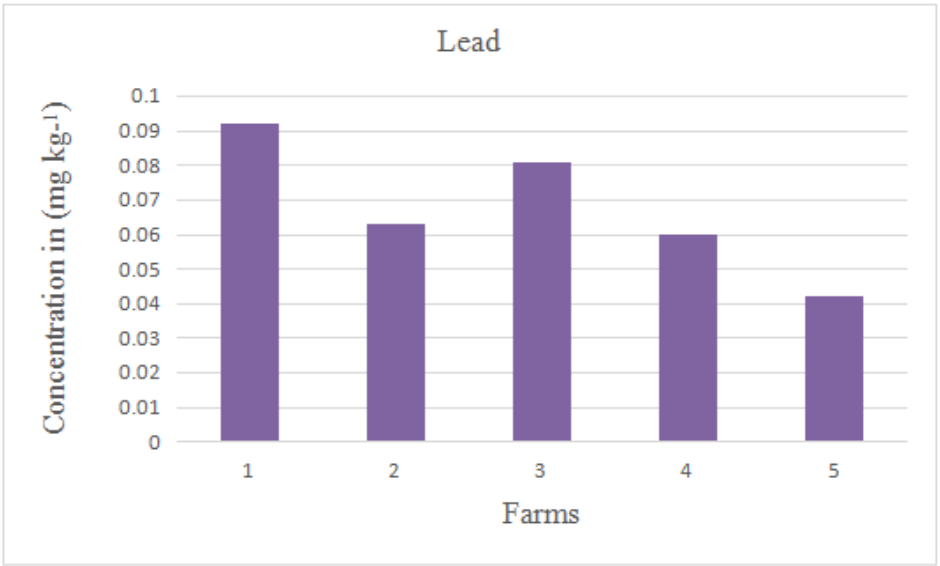
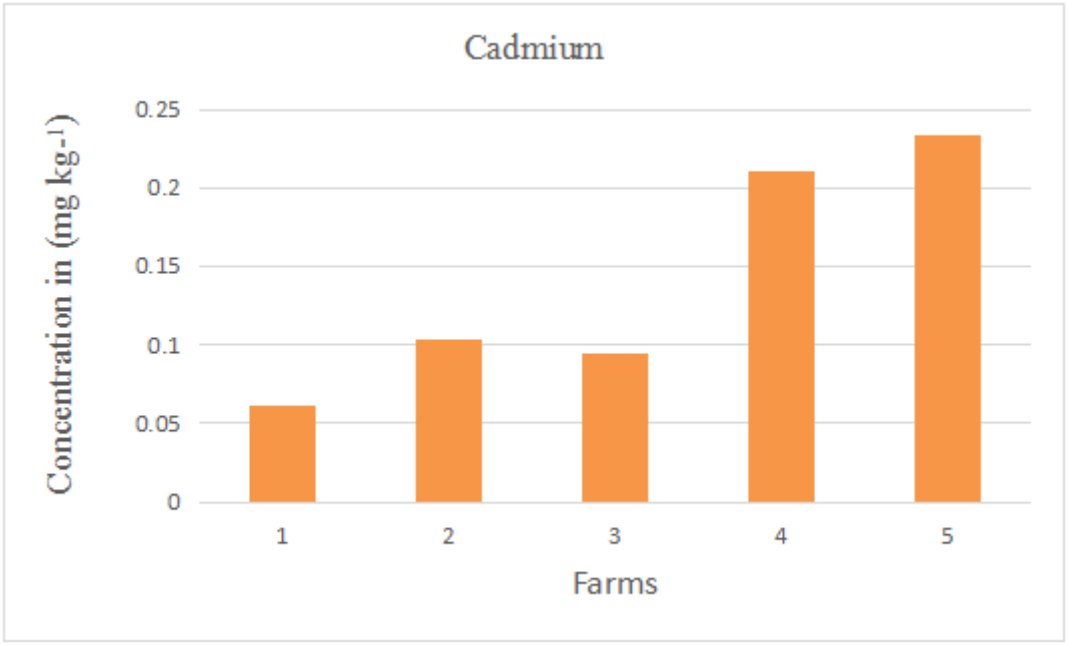
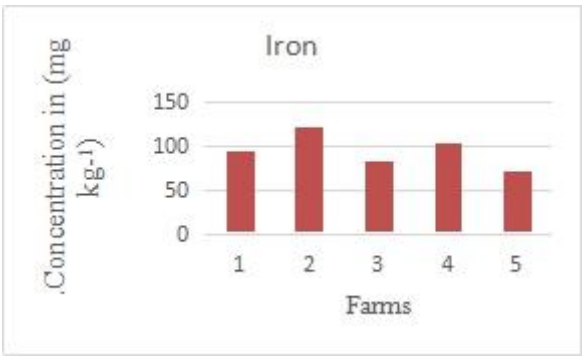
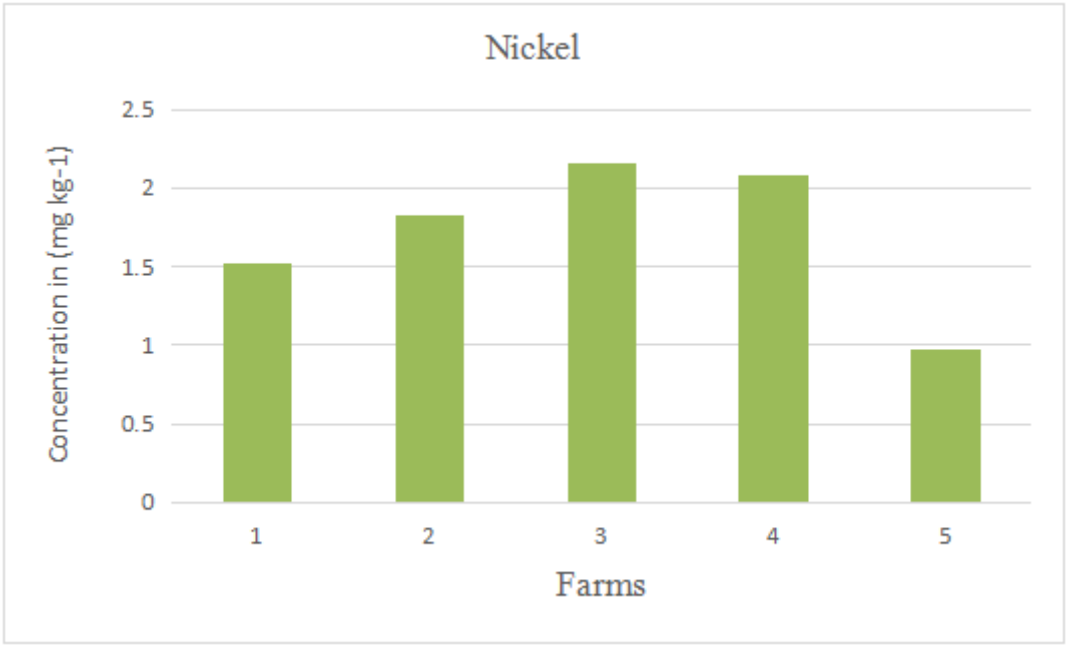


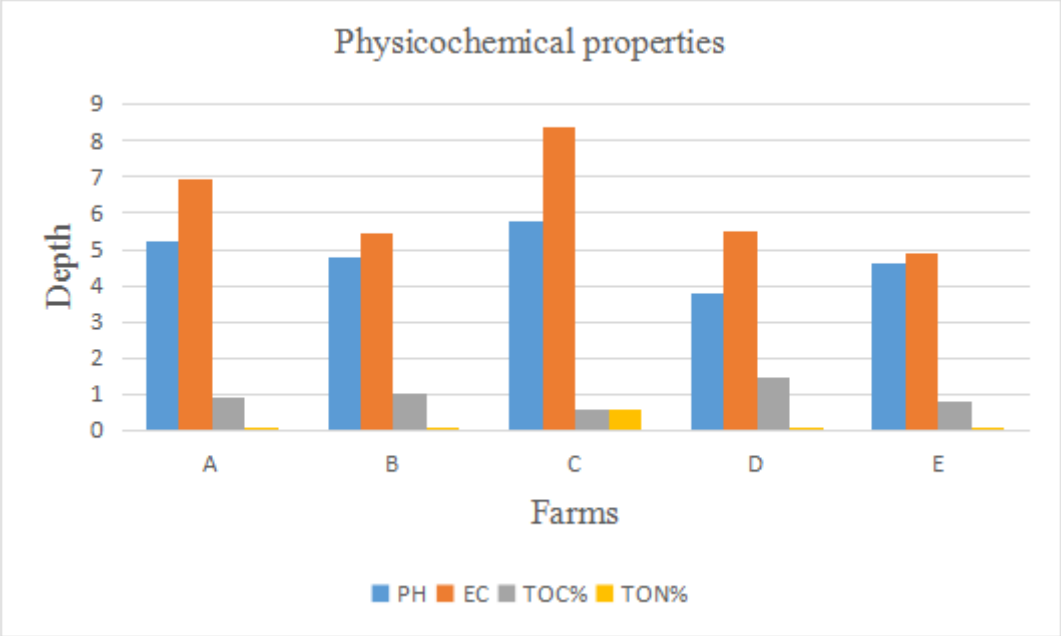
Figure:1 QC charts for Bilirubin




Cadmium
Concentration in (mg kg-1)
0.25
0.2
0.15
0.1
0.05
0
1
2
3
4
5
Farms


Iron
Concentration in (mg kg-1)
150
100
50
0
1
2
3
4
5
Farms


Nickel
Concentration in (mg kg-1)
2.5
2
1.5
1
0.5
0
1
2
3
4
5
Farms



IV. Discussion

The results of quality control showed that Trends (loss of reliability) and shifts (abrupt changes in the control mean)[18] were noted in the results of this study as presented in figure 1 to 4, there were two major trends in July and more shifts in the month of August than in the month of July for triglycerides and a major trend and two violations of the Westgard Rule for cholesterol.Two control values were out of control and violated the 1_2s Westgard rule for both triglycerides and cholesterol in the month of July and August .Two values were out of control and violated the 2_2s Westgard rule for cholesterol in the month of August and July for pathological controls and this indicate a systematic error. The internal quality control is a key technical requirement through Iron has the highest concentration among all the metals studied and its levels ranged from 95.20 to 104.2 (mg kg^{-1}) with mean value of 94. 90 ± 17.19.Iron is vital for almost all living organisms,participating in a wide variety of metabolic processes,including oxygen transport,DNA synthesis,and electron transport.High concentration of Fe (104.2mg kg^{-1}) in soil samples was observed in Otukpo –ijo while ugboju shows the lowest value.Results of analysis of variance (ANOVA) confirmed a significant difference in the concentrations of Fe within the sampling points. Zn concentration (mg kg^{-1}) vary from 16.40 to 28.40 with a mean value of 17.36±4.679 and CV % of 32.93%.The Zn concentration in Otukpo –ijo sampling site has the lowest value and this may be due to its proximity to the urban centre with less farming activities. In this study the levels of zinc in soil were lower than that of soil samples reported by other literature such as 499.20mg/kg in Delhi(Banerjee,2003). Nickel has its highest concentration in Otukpo-ijo (2.143 mg kg^{-1}) and its lowest concentration was inUgboju sampling site (1.520 mg kg^{-1}) with a mean value of 1.710±0.430 and CV% of 25.14. The burning of fossils fuels as well as the the refining of metals such as copper introduces considerable amounts of nickel into the atmosphere (Lee *etal.,2005*) The values obtained from this study were below (35 mg kg^{-1}) standard limits for soil samples. In this regards, so it is concluded that plants are safe from hazard effects of Nickel. The highest concentration of copper was recorded in Otukpo -ijo (3.020 mg kg^{-1}) while the lowest concentration was recorded in Adoka having the concentration of (2.224 mg kg^{-1}) with a mean value of 2.396±0.604 and CV% of 27.30. Copper is an essential element,yet it may be toxic to both humans and animals when its concentration exceeds the safe limits, and its concentration in some human tissues such as thyroid can be changed depending on the tissue state(Bakirdere and Yaman,2008). The mean concentration obtained in this study is lower to the WHO/FAO standard value of 36 mg kg^{-1} for soil samples. Lead is a non degradable and toxic element (Arsalan *etal.,2004*).The concentration of lead varied from 0.050 -0.081 mg kg^{-1} with the mean value of 0.067±0.013 and CV% of 19.40%. Exposure to lead occurs mainly through food chain, although ingestion of soil and dust can also be an important contributor (EFSA, 2012c). The concentration of cadmium ranged from (0.071 to 0.210mg kg^{-1}) with the mean concentration of 0.140±0.086 and CV% of 48.57%. Cadmiun is mostly encountered in cadmium-nickel battery production,although it continues to be used in paints as well as in plastic production where it is an effective stabilizing agent. The results obtained from the analysis shows that the soil was slightly acidic.The highest pH values of the soil sample was recorded Adoka(5.89) and the lowest pH value was recorded in Otukpo-ijo (3.98) with a mean value 4.84±0.66 and CV% 13.6. The results of this study is in agreement with the study done by (Akan *etal.*,2013).The pH value obtained are also in the

same range reported by Osakwe (2014). Evans *etal*.,(1995) explained that pH has a major effect on metal dynamics because it controls adsorption and precipitation,which are the main mechanisms of metal retention to soils.

V. Conclusion

In all sampling points ,Fe and Zn shows the highest concentration value while Pb shows least concentration value .The study has presented data on the concentrations of some heavy metals and physiochemical properties of soil samples from soil samples within BenueSouth senatorial district, Benue State, Nigeria. The results showed that heavy metals accumulation occurred at various levels within all the samples. From the results obtained, Fe, was the most accumulated metal in soil while lead was the least from all the locations investigated Heavy metals levels in the studied samples and areas were within the WHO and FAO permissible limits. The results obtained from the physiochemical analysis of the soil samples showed that the soil pH were moderately acidic and the soil was discovered to be moderately saline.

VI. Acknowledgement

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References

[1]. Adriano, D. C. (1986). Heavy Metals in the Environment. Springerverlag, New York.
[2]. Alkorta, I., Hemandez-Alica, J., Becerril, J.M., Amezaga, I., Albizu, I., &Garbisu, C. (2004). Recent findings on the phytoremediation of soils contaminated with environmentally toxic heavy' metals and metalloids such as" zinc, cadmium, lead and arsenic, *Reviews in Environmental Science and Biotechnology*, **3**: 71-90.
[3]. Alloway, B. J. (1995). Heavy metals in soils (2nded). New York: Blackie.
[4]. Anthony, A., E. (2002). Compositional character: veritable tool in the appraisal of geomaterials. Nigeria: University of Ibadan.
[5]. Chary, N.S., & Kamala (2008). Assessing risk of heavy metals from consuming food grown on sewage irrigated soil and food chain transfer. *Ecotoxicology Environmental Safety*, **69** (3): 513-524.
[6]. Chaudheri, K.G (2013). Studies of Physiochemical Parameters of Soil Samples. *Advance in Applied Sciences Research*, 4 (6) 246-248.
[7]. KabataPendias, A. (2001). *Trace Elements in Soils and Plants*. Third Edition, CRC Press. Pp 2-4.
[8]. Osakwe, S.A (2013): Assessment of the Effects of Wood Processing Industries in Selected Parts of Delta State, Nigeria on the Soils and vegetation in their Vicinities. *IOSR Journals of Applied Chemistry* 2 (4) 48-58
[9]. Perkin-Elmer Corporation (1996). Analytical Methods for Atomic absorption spectroscopy. United States of America: The Perkin-Elmer Corporation.
[10]. WHO/FAO/IAEA/, (1996). Trace elements in human nutrition and health. Geneva: World Health Organization

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