International Journal of Engineering Science Invention
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org Volume 3 Issue 3ǁ March 2014 ǁ PP.09-16

Evaluation of Status of Ph and Conductivity on Transfer and Enrichment Factors of Soil and Vegetables of Some Agricultural Areas of Kaduna Metropolis Nigeria

[1]Mahmud Imam Mohammed , [2] W.L.O Jimoh
[1]*Department of Applied Science, College of Science and Technology, Kaduna Polytechnic*
[2]*Department of Pure and Industrial Chemistry, Bayero University, Kano Nigeria.*

ABSTRACT: *In this research work soil and some vegetables were collected from various irrigation sites of Kaduna metropolis and analyzed for PH and conductivity using Jenway PH and conductivity meter. Transfer factor and enrichment factor of the vegetable (tomatoes,lettuce, cabbage and spinach) were also determined via heavy metal (Cu, Zn, Pb,Fe and Cd) analysis with the aid of atomic absorption spectrophotometer. In the soil analysis it was found most PH values were mostly acidic which ranges between 5.8 to 6.9 with the exception of. from Unguwan Dosa and Kurmin mashi with pH of 8.27 and 8.50 respectively. Based on pH values obtained in this work which were predominantly acid and this influence the conductivity to be within the normal range as well as moderately saline, hence, transfer factors from soil to spinach, tomatoes, cabbage and lettuce were mostly below 1 showing that heavy metals are accumulated in their edible portion (leaves) and were less compared to that of the soil (that is, absorb small amount of metal from the soil.) while few samples had concentrations above or equal to 1 (≥ 1). This indicates that, the concentration of heavy metal accumulated in the vegetable were higher than that of the soil. EF was also found to be from the anthropogenic source of contamination with very few samples were from natural source, that is EF values ranges between 0.5 and 1.5 indicates that the metal is entirely from crust materials or natural processes, whereas EF values greater than 1.5 suggest that the sources are more likely to be from the anthropogenic source. This is because absorption and accumulation of heavy metals in plant tissue depend upon many factors such as moisture,organic matter, conductivity, pH and nutrient availability*

KEYWORDS: *Heavy Metals, Soil, vegetable, PH meter, conductivity meter, Atomic Absorption Spectrophotometer (AAS), kaduna Metropolis,Nigeria.*

I. INTRODUCTION

Heavy metals are among the major contaminant of food supply and are considered as problem to the environment (Zaidi *et al, 2005*). Heavy metals contamination may occur due to irrigation with contaminated water, the addition of fertilizers, metal based pesticides, industrial emissions, transportation, harvesting process and storage. Advancement in technology has lead to high levels of industrialization leading to the discharge of effluent bearing heavy metals into our environment.Toxic element is one which has neither essential nor beneficial effect but only negative effects on normal metabolic function even when present in only small amount. When vegetable accumulates heavy metals at a proportion exceeding the tolerance limit and if consumed by man or other animals, then the excess proportion of these metals from the vegetables tend to accumulates gradually in animal tissues at a very high concentration where it becomes toxic and causes varieties of illness e.g. brain damage, tumor cell, miscarriage etc.Heavy metals concentrations in soil are associated with biological and geological cycles and are influenced by anthropogenic activities such as agricultural practices, industrial activities and waste disposal methods (Eja *et al.,* 2003, Zuluyah *et al,* 2004). Contamination and consequent pollution of the environment by toxic heavy metals have become an issue of global concern due to their sources, widespread distribution and multiple effects on the ecosystem (Nriagu, 1990). Heavy metals are generally present in agricultural soils at low levels. Due to their cumulative behaviour and toxicity, however, they have a potential hazardous effect not only on crop plants but also on human health (Das *et al.,* 1997).Excessive amount of fertilizers are applied to crops, considering that they are reasonable insurances against yield losses and their economic consequences. Fertilizers contain not only major elements necessary for plant nutrient and growth but also trace metal impurities such as Cd, Pb, or Ni (Zhan and Shan 2001). The uptake of these heavy metals by plants especially leafy vegetables is an avenue of their entry into the human food chain with harmful effects on health (Uwah *et al.,* 2009).

Human beings are encourage to consume more vegetables and fruits, because they are good source of vitamins, minerals, fibres and also beneficial to their health. However, these plants contain both essential and toxic metals over a wide range of concentrations.The aim of this research work is to assess the effect conductivity on the soil and also determine the level of some heavy metals absorb by some vegetables as well as correlate the origin of such pollution due to human activities.

II. MATERIALS AND METHODS

Sample and Sampling:

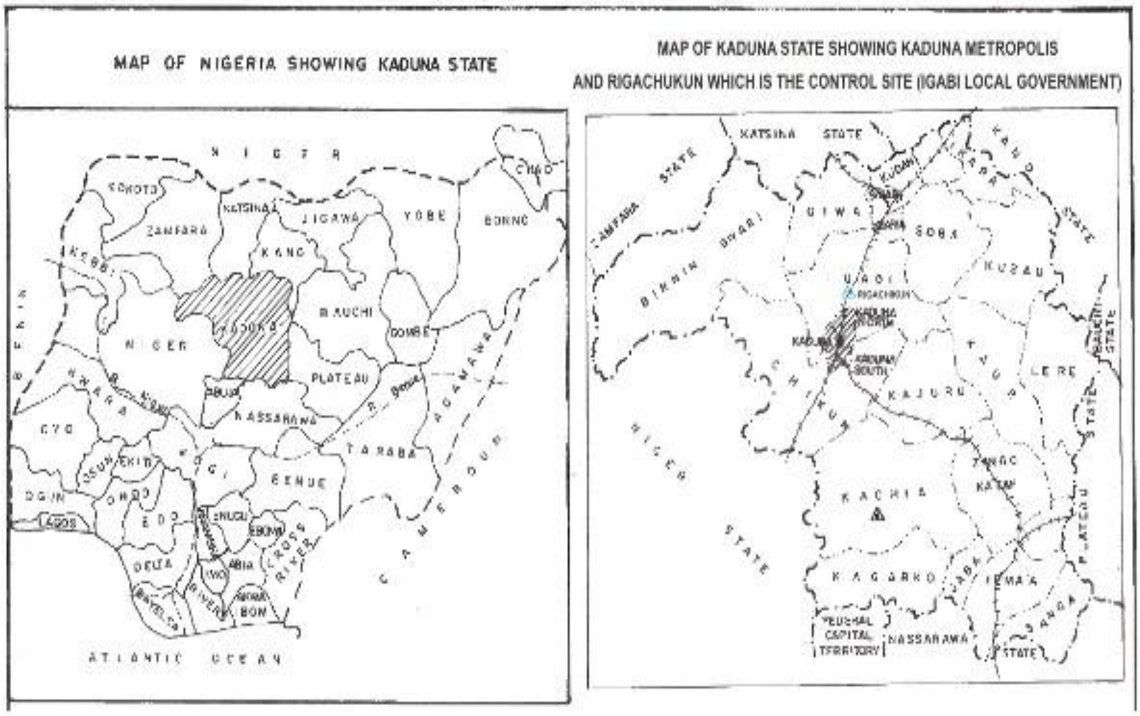
Vegetables such as Spinach, Cabbage, Tomatoes and Lettuce samples were collected from twenty one (21) different irrigation sites of the farmlands of the Kaduna metropolis where they were irrigated with water from the river or pond which are sometimes contaminated. Soil samples were also randomly collected from the farm where these vegetables were grown and irrigated with water. These samples were then stored in polythene bags and taken to the laboratory and dried in an oven at 105^{0}c.The dried samples were ground with mortar and pestle and sieved with 2mm sieve.

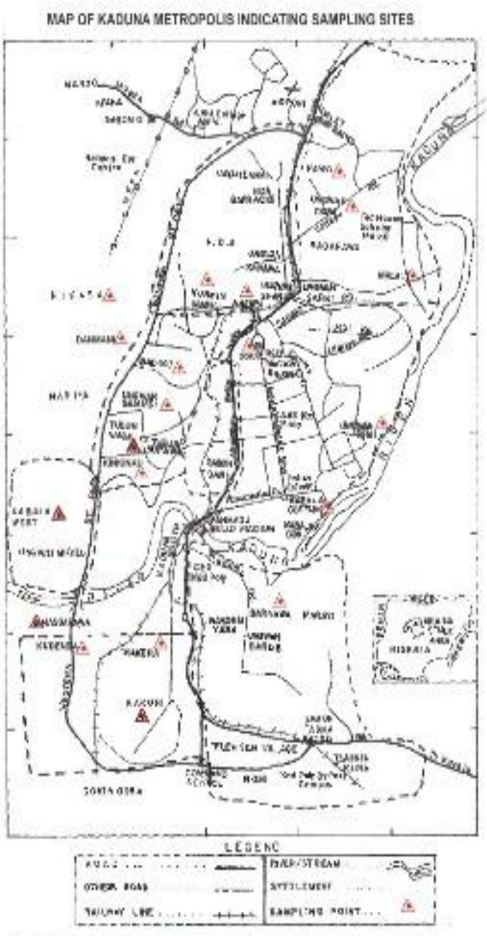
DESCRIPTION OF THE SAMPLING SITES

Soil samples for heavy metal determination were collected from twenty one (21) irrigation sites of the Kaduna metropolis. These sites were Kabala (KBL), Danmani (DMN), Rigasa (RGS), Barnawa (BNW), Makera (MKR), Kakuri (KKR), Badiko (BDK) Nasarawa (NAS, Malali (MAL), Kudenda (KUD), Kinkinau (KKN), Kawo (KWO), Unguwan Rimi (URM), Unguwan Sanusi (UNS), Tudun Wada (TDW), Doka (DKA), Unguwan Dosa (UDS), Kabala Costain (CTA), Kurmin Mashi (KMS) and Abakpa (ABK). In this research work soil sample from Rigachikun (RCK) irrigation site was taken as control site.

Map of the Sampling points and the control

III. SITES


MAP OF NIGERIA SHOWING KADUNA STATE
MAP OF KADUNA STATE SHOWING KADUNA METROPOLIS
AND RIGACHUKUN WHICH IS THE CONTROL SITE (IGABI LOCAL GOVERNMENT)
SOKOTO
ZAMFARA
KATSINA
JIGAWA
YOBE
BORNO
KANO
BAUCHI
NIGER
GOMBE
PLATEAU
ABUJA
NASSARAWA
TARABA
BENUE
ENUGU
DELTA
ABIA
ATLANTIC OCEAN
KATSINA STATE
KADUNA SOUTH
KACHIA
KAGARKO
FEDERAL CAPITAL TERRITORY
NASSARAWA
STATE


MAP OF KADUNA METROPOLIS INDICATING SAMPLING SITES
LEGEND
ROAD
OTHER ROAD
RAILWAY LINE
RIVER/STREAM
SETTLEMENT
SAMPLING POINT

SAMPLE PREPARATION

Determination of PH and conductivity

20g of the ground soil samples was placed in a beaker. 100cm^3 of distilled water was added to form solution. The PH and conductivity of sample solutions were determined using 3305 Jenway pH meter and ELE 470 conductivity meter respectably. The PH and conductivity of the soil samples were taken and recorded.

Vegetable samples

5g of the ground Vegetable samples were ashed in a muffle furnace at a temperature of 550^{0}c for five hours and digested with 20cm^3 of HNO_3/H_2O_2 (2:1). The digested residues were dissolved with 50cm of distilled water and filtered in 50cm^3 volumetric flask.

Soil samples:

20g of the finely ground soil samples was mixed with 60cm^3 (5:5:1) $H_2SO_4/HNO_3/HCl$ acid mixtures and the content were refluxed for 12 hours. The sample was washed with 1M HNO_3 and 100cm^3 of deionized water was also added and centrifuged. The elements were determined using bulk scientific model VPG 210 model atomic absorption spectrophotometer (AAS).

In order to investigate the ratio of the concentration of heavy metal in a plant to the concentration heavy metal in soil, the transfer factor was calculated based on the method described by Oyedele et al, 1995 and Harrison and Chirgawi, 1989).

$TF = Ps\ (\mu gg^{-1} / St\ (\mu gg^{-1})$

Where Ps is the plant metal content originating from the soil and St is the total content in the soil.

The enrichment factor (EF) has been calculated to derive the degree of soil contamination and heavy metal accumulation in soil and in plants growing on contaminated site with respect to soil and plants growing on uncontaminated soil (Kisku *et al*., 2000).

According to Ergin *et al*., (1991) and Rubio *et al.,* (2000) the metal enrichment factor (EF) is defined as follows:

$$EF = \frac{\left(\frac{M}{Fe}\right)sample}{\left(\frac{M}{Fe}\right)background}$$

Where M = Metal Concentration in soil sample and EF is the enrichment factor. $(M/Fe)_{sample}$ is the ratio of metal and $(M/Fe)_{background}$ is the ratio of metals and Fe concentration of a background. The background concentrations of metals were taken from an undisturbed area.

Five contamination categories are recognized on the basis of the enrichment factor as follows: (Sutherland 2000)

EF<2 is deficiency to minimal enrichment

EF<2-5 is moderate enrichment

EF<2-20 is significant enrichment

EF20-40 is very high enrichment

EF>40 is extremely high enrichment

IV. RESULTS AND DISCUSSION

Table 1.0: Mean pH and Conductivity in soil of different irrigation sites of Kaduna metropolis

Sampling Sites	Mean pH	Mean conductivity (μscm^{-1})
SL (KBL)	6.5 ± 0.306	1.793 ± 0.301
SL (DMN)	6.4 ± 0.451	1.570 ± 0.044
SL (RGS)	6.0 ± 0.681	1.760 ± 0.052
SL (BNW)	6.4 ± 0.400	1.827 ± 0.237
SL (MKR)	6.2 ± 0.115	1.720 ± 0.017
SL (KKR)	6.6 ± 0.173	1.990 ± 0.060
SL (BDK)	6.3 ± 0.306	1.138 ± 0.844
SL (NAS)	5.9 ± 0.473	1.470 ± 0.070
SL (MAL)	6.2 ± 0.252	2.537 ± 0.474
SL (KUD)	6.5 ± 0.173	1.960 ± 0.442
SL (KKN)	5.9 ± 0.603	2.297 ± 0.614
SL (KWO)	5.8 ± 0.300	2.633 ± 0.754
SL (URM)	6.9 ± 1.710	2.260 ± 0.862
SL (UNS)	5.9 ± 0.404	2.343 ± 0.560
SL (TDW)	6.1 ± 0.557	2.453 ± 0.912

SL (DKA)	6.3 ± 0.473	1.723 ± 0.059
SL (UDS)	8.3 ± 0.208	1.610 ± 0.036
SL (CTA)	6.2 ± 0.473	2.110 ± 0.235
SL (KMS)	8.5 ± 0.400	1.723 ± 0.211
SL (ABK)	6.4 ± 0.400	1.620 ± 0.062
SL RCK (Control)	5.8 ± 0.681	2.643 ± 0.625

Table 1.0 shows the summary of mean pH and conductivity in soil from different irrigation sites.

Conductivity is a measurement of ability of conductor to convey electricity and is mainly due to dissolved mineral matters as well as ionic solute. The magnitude of this, is a useful indication of the total concentration of the ionic solute. That is higher the conductivity value of a given soil the more the concentration of ions present. The above table also shows conductivity of the soil from the irrigation sites of Kaduna metropolis in which they are all within the normal range as stated by Zaku *et al*., (2011). Boulding (1994) classified conductivity in soil as: non saline when < 2; moderate saline when it is between 2 -8 ; very saline when it is between 8 – 16 ; extremely saline if > 16. From the results of this study, most of the conductivity are moderately saline with few being non saline. The amount of heavy metals mobilized in soil environment is a function of pH, properties of metals, redox conditions, soil chemistry, organic matter content, clay content, cation exchange capacity and other soil properties (Arun and Mukherjee, 1998; Kimberly and William, 1999; Sauve *et al*., 2000). The result of metal analysis showed that, most of the sampling sites had high concentration of metals such lead and cadmium evaluated in the soil and this account for high conductivity while others had moderate concentration of metals such (Zn,Cu and Fe) analyzed in the soil and may account for low conductivity. Heavy metals are generally more mobile at pH < 7 than at pH > 7.The pH of the soils from the irrigation sites of Kaduna metropolis ranged 5.80 to 6.93.This is therefore hazardous for agricultural purposes since crops are known to take up and accumulate heavy metals from contaminated soils in their edible portions (Wei *et al*.,) in contrast with samples from Unguwan Dosa and Kurmin mashi with pH of 8.27 and 8.50 respectively.

Table 4: Mean for all the transfer factor(TF) for the whole vegetable in irrigation sites.

	SPINACH (µg/g)					TOMATOES (µg/g)					CABBAGE (µg/g)					LETTUCE (µg/g)				
SAMPLING SITES	Cd (μgg^{-1})	Fe (μgg^{-1})	Zn (μgg^{-1})	Cu (μgg^{-1})	Pb (μgg^{-1})	Cd (μgg^{-1})	Fe (μgg^{-1})	Zn (μgg^{-1})	Cu (μgg^{-1})	Pb (μgg^{-1})	Cd (μgg^{-1})	Fe (μgg^{-1})	Zn (μgg^{-1})	Cu (μgg^{-1})	Pb (μgg^{-1})	Cd (μgg^{-1})	Fe (μgg^{-1})	Zn (μgg^{-1})	Cu (μgg^{-1})	Pb (μgg^{-1})
KBL	0.12	0.30	0.41	0.41	0.88	0.31	0.20	0.60	ND	0.87	0.03	0.04	0.01	ND	0.64	0.07	0.41	0.57	0.75	0.82
DMN	0.09	0.21	0.18	ND	0.81	0.09	0.17	ND	ND	0.80	0.37	0.01	0.48	ND	0.84	ND	0.06	0.59	0.20	0.24
BNW	ND	0.05	0.27	ND	0.12	17.25	0.06	0.05	0.65	0.12	18.25	0.06	ND	ND	0.05	2.66	0.14	0.17	0.78	0.27
MKR	0.01	0.11	0.06	ND	0.05	0.28	0.31	0.04	0.05	0.05	0.39	0.08	0.11	0.04	0.08	0.37	0.05	0.21	0.06	0.04
BDK	0.51	0.22	0.18	0.38	0.50	0.47	0.15	0.11	0.53	0.50	0.14	0.19	0.21	0.40	0.63	0.37	0.22	0.15	0.32	0.74
NAS	0.92	0.05	0.30	0.51	0.14	1.01	0.11	0.11	0.34	0.14	1.27	0.09	0.14	0.19	0.04	0.04	0.13	0.01	0.02	0.11
MAL	ND	0.22	0.02	ND	0.63	0.29	0.13	ND	0.38	0.63	0.02	0.09	0.03	ND	0.53	0.37	0.26	0.19	0.55	ND
KUD	0.71	0.12	0.16	0.83	ND	0.74	0.17	0.31	0.57	ND	0.71	0.13	0.24	0.44	0.62	0.28	0.19	0.18	0.54	0.61
KKN	0.58	0.65	0.26	0.86	0.48	0.52	0.65	0.31	0.56	0.48	0.69	0.58	0.24	0.74	0.77	1.01	1.03	0.31	1.17	0.61
KWO	0.58	0.22	0.25	0.52	0.31	0.35	0.21	0.15	0.55	0.31	0.49	0.16	0.18	0.59	0.69	0.51	0.28	0.16	0.49	0.74
URM	0.47	0.23	0.23	3.63	0.56	0.65	0.24	0.23	0.77	0.56	0.39	0.35	0.17	0.47	0.50	0.73	0.25	0.18	0.58	0.49
UNS	2.46	0.06	0.19	0.23	0.07	1.56	0.05	0.16	0.16	0.07	2.35	0.07	0.17	0.17	0.04	1.48	0.09	0.11	0.13	0.05
TDW	0.73	0.06	0.10	0.13	0.23	0.03	0.08	0.12	0.13	0.23	0.03	0.12	0.11	0.25	0.16	ND	0.08	0.16	0.11	0.21
DKA	0.80	0.08	0.10	0.34	0.23	3.00	0.06	0.11	0.39	0.23	15.66	0.11	0.06	0.62	0.26	ND	0.17	0.31	0.08	0.13
UDS	1.00	0.08	0.31	0.16	0.34	1.60	0.12	0.01	ND	0.34	2.05	0.11	0.32	0.07	0.56	1.00	0.11	0.05	0.11	0.48
CTA	0.96	0.11	0.21	0.31	0.13	1.06	0.05	0.24	0.35	0.13	0.80	0.13	0.27	0.25	0.13	1.09	0.16	0.19	0.34	0.09
KMS	0.64	0.56	0.26	1.00	0.85	0.59	0.48	0.38	0.70	0.85	0.51	0.54	0.24	0.63	1.01	0.38	0.41	0.30	0.63	0.49
ABK	0.47	0.34	0.26	0.48	0.75	0.39	0.24	0.28	0.05	0.75	0.39	0.40	0.30	1.00	0.82	0.34	0.32	0.31	0.89	0.71
KKR	0.36	0.37	0.28	0.67	0.97	0.56	0.24	0.35	0.58	0.97	0.59	0.20	0.30	1.07	1.15	0.45	0.22	0.37	0.64	0.83
RGS	0.68	0.46	0.19	0.73	1.00	0.78	0.33	0.30	1.00	1.00	0.72	0.45	0.19	0.94	0.98	0.85	0.39	0.22	0.97	0.96
RCK	0.36	0.41	0.18	1.11	0.67	0.76	0.42	0.36	1.00	0.67	0.45	0.24	0.43	0.94	0.55	0.48	0.43	0.24	1.18	0.89

Table shows the transfer factor of heavy metals from soil to vegetables such as spinach,tomatoes,cabbage and lettuce. For spinach samples, TF values were below 1 with the exception of samples from Kawo (2.45 for Cd) and Tudun wada (1.00 for Cd), Unguwan dosa (1.00 for Cu), Abakpa (1.00 for Pb) and Rigachikun (1.11 for). For tomatoes samples are below 1 with the exception of samples from Rigasa (17.25 for Cd), Kakuri (1.01

for Cd), Kawo (1.56), Unguwan Sanusi (3.00), Tudunwada (1.60) , Doka (1.06), Abakpa (1.00 for both Cu and Pb) and Rigachikun (control) (1.00 for Cu). All TF for cabbage samples are below 1 with the exception of samples from Rigasa (18.25 for Cd), Kakuri (1.27 for Cd), Kawo (2.35 for Cd), Unguwan Sanusi (15.66 for Cd), Tudunwada (2.95), Costain (1.00 for Cu) and Kurmi mashi (1.07 for Cu and 1.15 for Pb). For lettuce samples are below 1 with the exception of samples from Rigasa (2.66 for Cd),Malali (1.01 for Cd, 1.03 for Fe and 1.17 for Cu),Kawo (1.48 for Cd) , Tudun wada(1.00 for Cd),Doka (1.09 for Cd) and Rigachikun (control) 1.18 for Cu.).In situation whereby the TF values were below 1 showing that heavy metals are accumulated in their edible portion (leaves) are less compared to that of the soil (that is, absorb small amount of metal from the soil.)
Transfer factor is one of the key components of human exposure to metals through the food chain. Transfer factors were computed for the heavy metal to quantify the relative differences in bioavailability of metals to plants so as to identify the efficiency of a plant species to accumulate a given heavy metal. these factor were based on the root uptake of the metals and discount the foliar absorption of atmospheric metal deposits (Lokeshwari and Chandrapper,2006).Based on pH values obtained in this work which were predominantly acid and this influence the conductivity to be within the normal range as well as moderately saline, hence, transfer factors from soil to spinach, tomatoes, cabbage and lettuce in this research work were mostly below 1 showing that heavy metal is accumulated in their edible portion (leaves) and were less compared to that of the soil (that is, absorb small amount of metal from the soil.) while few samples had concentrations above or equal to 1 (≥ 1). This indicates that, the concentration of heavy metal accumulated in the vegetable were higher than that of the soil.

This is because absorption and accumulation of heavy metals in plant tissue depend upon many factors such as moisture,organic matter, pH and nutrient availability (Sharma *et al*., 2004) so also the physiological response of each plant do exerts control on the degree of bioaccumulation of different metal. Consequently, metal mobility and plant availability are very important when assigning the effect of soil contamination on plant metal uptake as well as translocation and toxicity or ultra structural alterations (Luo and Rammer,1995;Stresty and Madhara ,1999; Chandra *et al.*, 2001.). The mobility and bioavailability of trace elements in soil has been increasing concern both in agricultural and environmental studies due to possible toxic effect of bioaccumulation in plants and vertical leaching or transport into shallow ground water system. The mobility of metal like zn increase with decreasing pH but in alkaline soils it could be mobile because of its ability to create mineral – organic compound and complexes. Pb has a strong affinity for organic ligand and the formation of such complexes may greatly increase the mobility of pb in soil. The acidic range of soil in this work was found to increase the mobilization of heavy metals and as such increase their uptake.

Table 3.0 Enrichment factor of heavy metals in soil in irrigated farmland of Kaduna metropolis

Sampling sites	Elements				
	Cd	Zn	Cu	Pb	Fe
Kabala	0.5	0.9	0.5	0.5	1.11
Danmani	0.4	0.7	0.7	0.5	1.15
Rigasa	0.01	0.8	0.2	0.8	1.22
Barnawa	0.4	0.4	2.6	2.1	2.37
Makera	0.7	1.2	1.2	0.4	0.84
Kakuri	0.1	0.7	0.2	2.2	1.49
Badiko	0.5	0.7	0.6	0.3	1.51
Nasarawa	0.7	0.9	1.1	0.6	1.11
Malali	1.6	2.2	2.1	0.2	0.37
Kudenda	0.8	1.1	1.1	0.6	0.94
Kinkinau	0.3	1.0	1.1	0,6	0.97
Kawo	0.1	0.6	1.2	2.3	1.75
Unguwan Rimi	ND	0.8	1.3	0.2	1.33
Unguwan sanusi	0.01	0.6	0.5	0.1	1.65
Tudun wada	0.1	0.5	1.5	0.3	1.98
Doka	0.3	0.5	1.2	2.4	1.99
Unguwan Dosa	1.6	2.0	2.0	1.3	0.51
Costain	0.9	1.2	0.9	0.5	0.84
Kurmin mashi	0.6	0.7	0.9	0.4	0.74
Abakpa	1.0	1.6	1.1	1.0	0.61

Table3.0 shows enrichment factors for heavy metals such as Cd,Fe ,Zn ,Cu and Pb in soil. Cadmium from Malali (1.6) and Unguwan Dosa (1.6) samples occurred with EF valued greater than 1.5 suggesting anthropogenic. The enrichment factor for Zinc shows that samples from Malali (2.2) and Unguwan Dosa (2.0) are moderately enriched. Enrichment factors (EF) for copper showed that samples Barnawa (2.6), Malali (2.1) and Unguwan Dosa (2.0) are moderately enriched and as such they are from anthropogenic source.

The table also showed enrichment factor for lead in which it has the following, Kakuri (2.2), Kawo (2.3), Barnawa (2.1) and Doka (2.4) suggesting that they are from anthropogenic source.The EF for iron are mostly from natural source. All these prediction were made in accordance with Zhang and Liu (2002) The effect of conductivity of soil is also extended to their enrichment Factor, since enrichment factor (EF) is the degree of soil contamination and heavy metal accumulation in soil and plants growing in such contaminated site. In this research work it was found that the conductivity are within the normal range, moderately saline while some are non saline, as a result of this EF was found to be from the anthropogenic source of contamination with very few samples were from natural source as stated by Zhang and Liu (2002), that is EF values ranges between 0.5 and 1.5 indicates that the metal is entirely from crust materials or natural processes, whereas EF values greater than 1.5 suggest that the sources are more likely to be from the anthropogenic source. Similar enrichment factor which was ascribed to the uptake of heavy metals by plant during their growth and development. The rate of metal uptake by the plant, that is TF as well as EF could have been affected by other factors such as plant age, plant species, soil pH ,nature of soil and climate. (Alloway and Ayres,1997)

V. CONCLUSION

From the result of the pH and metals analyzed in this work, some areas had moderate concentration of metals as evaluated in the soil and may account for the low conductivity while others had high metal concentration of metals with respect to their pH and hence account for high conductivity. Heavy metals are generally more mobile at pH < 7 than at pH > 7.The pH of the soils from the irrigation sites of Kaduna metropolis ranged 5.80 to 6.93. It has been established that transfer factor (TF) and enrichment factor (EF) have strong relationship with one another. Since heavy metals accumulated in the soil and transfer to the vegetable (plant) were either from natural source or from the human activities known as anthropogenic source as revealed from the study of enrichment factor (EF). transfer factors from soil to spinach, tomatoes, cabbage and lettuce in this research work were mostly below 1 showing that heavy metals were accumulated in their edible portion (leaves) and were less compared to that of the soil (that is, absorb small amount of metal from the soil.) while few samples had concentrations above or equal to 1 (≥ 1).In this research work it was found that the conductivity are within the normal range, moderately saline while some are non saline, as a result of this EF, the soils analyzed were found to be from the anthropogenic source of contamination with very few samples from natural source

ACKNOWLEDGEMENT

The Authors were grateful to the management of Kaduna Polytechnic for using their laboratory, and equipment in carrying out this research work.

REFERENCES

[1] Alloway, B.J, Ayres, D.C, (1997). *Chemical principles of environmental pollution,* Blackie Academic and professional 2nd.edition Blackie press UK pp190 – 220.
[2] Arun, B and Mukherjee, (1998)Nickel: a review of occurance, uses,emissions and concentration in the environment in Finland. *Rev*; 6: 1 – 15.
[3] Boulding, J.R(1994). *Description and sampling of contaminated soils.* Alfeid Guide. 2nd Edn. Lewis publishers, Boca Raton, FL. Pp 5
[4] Chandra Sekhar, Rajni Supriya K., Kamala, C.T., Chary, N.S., Nagewara Rao T.., Anjaneyulu Y. (2001): Seciation, accumulation of heavy metals in vegetation grown on sludge amended soils and their transfer to human food chain – a case study. Toxicoloical and environmental chemistry 82 : 33 – 34.
[5] Das, P. Samantarary S. and Rout G.R. (1997). Studies on Cadmium toxicity in plant. *A Review Environmental Pollution* 98:29-36
[6] Eja M.E., Ogri O.R and Arikpo O.E (2003). Bioconcentration of heavy metals in surface sediments from the great Kwa River Estuary, Calabar, Southeastern Nigeria. *J. Nigerian Environmental society 1:247 – 256.*
[7] Ergin, M., Saydam, C., Basturk, O., Erdem, E., Yoruk, R., (1991). Heavy metal concentrations in surface sediments from the two coastal in lets (Golden horn Estuary and Izmit Bay) of the northeastern Sea of Marmara. *Chem. Geo.* 91,269-285.
[8] Harrison R.M and Chirgawi M.B, (1989). The assessment of air and soil as controbutor of some trace metal to vegetable plants III-experiment with field-grown plants.*Sci Total Environ,* 83:47-63.
[9] Kimberly M.F.H, William H.(1999) Trace metal in Montreal urban soils and the leaves of Teraxacum officinale.Can. *J. Soil Sci*. 79 : 385 - 385
[10] Kisku, G.C., Barman S.C and Bhargava S.K (2000): Contamination of soil and plants with potentially toxic elements irrigated with mixed industrial effluent and its impact on the environment. *Water Air Soil Pollut.,* 120, 121-137.
[11] Lokeshwari, H. and Chandrappa G.T. (2006). Impact of Heavy Metal Contamination of Bellandar Lake on Soil and Cultivation Vegetation Current Science, *Research Articles* Vol. 91 (5): 622-627.
[12] Luo, Y., Rimmer D.L., (1995): Zinc – Copper interaction affecting plant plant growth on a metal contaminated soil. *Environ pollut*. 88: 79 – 83.
[13] Nriagu J.O (1999). A global assessment of Natural sources of Atmosphere Trace metals *Nature* vol. 338, pp 47 – 49.
[14] Oyedele, D.J. Obioh, I.B, Adejumo J.A, Oluwole A.F, Aina, P.O, Aubiojo, O.I (1995); Lead contamination of soils and vegetation in the vicinity of a lead smelter in Nigeria. *The Sci. of the total Environ*. 1732: 189 – 195.
[15] Rubio B., Nombela,M.and Vilas,F., (2000).Geochemistry of major and trace element in sediment of the ria de Vigo (NW Spain) an assessment of metal pollution, *Marine pollution Bulletin,* 40(11),968-980.
[16] Sauve S, Henderson W, Allen H.E ,(2000). Solid – solution portion of metals in contaminated solis : dependence on pH, total metal burden and organic matter. *Env.sci. Tech.* 34: 1125 - 1131

[17] Sharma, O. Bangar P. Rajesh jain K.S, Sharma P.K. (2004): Heavy metals accumulation in soils irrigated by municipal and industrial effluent. *Journal of Environmental Science and Engineering.* 46 (1): 65 – 73.

[18] Sresty,T.V.S. Madhava Rao K.V. (I999): Ultra structural alteration in response to zinc and nickel stress in the root cells of pigeon pea. Journal of Environmental and Experimental botany 41: 3 -13

[19] Sutherland, R.A., (2000). Bed sediment-associated trace metals in an urban stream, Oahu, Hawaii. *Environ. Geol.*, 39: 611-37.

[20] Uwah, E.I, Ndah: N.P and Ogugbuaja, (2009) study of the levels of some agricultural pollutants in soil and water leaf (Talinum triangulare) obtained in Maiduguri, Nigeria. 4(2): 71 – 78.

[21] Wei S, Zhou Q, Xin W. (2005). Identification of weed plant excluding the uptake of heavy metals. Environment International. 31: 829 – 834.

[22] Zaidi M.I.; Asrar A; Mansoor, A; Farooqu, M.A (2005): the heavy metal concentration along roadside trees of Quetta and its effects on public health. J. Appl. Sci. (4), 708 – 711.

Zaku S.G, Emmanuel S.A and Thomas S.A (2011).Assessing the level of soil nutrient : a case study of Donga,Ibi and Wukari farmlands in Taraba State, Nigeria, Agric.Biol.J.N. Am., 2(1) : 101 – 108.Zaluyah S., Juliana B, Noorhafizah R, Fauzah, C.I. and Rosenami A.B (2004): Concentration andspeciation of heavy metals in some cultivated and uncultivated ultisols and inceptisols in peninsular Malaysia, super soil 3rd Australian New Zealand soils conference, University of Sydney Australia pp 70 - 72.Zhang, J. and Liu, C.L, (2002),Riverine composition and estuarine geochemistry of particulate metals in china-weathering features, anthropogenic impact and chemical fluxes. Estuar.Coast.Shelf S. 54, 1051-1070.