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RESEARCH ARTICLE

DETERMINATION OF HEAVY METALS CONCENTRATION IN IRRIGATED SOILS IN GOMBE STATE, NIGERIA

[*,1]Babangida Hammani, [2]Fatima Algunaid Hassan, [3]Khalid Abdallah Mohamed Hassan and [4]Umar Ibrahim

[1]Department of Agricultural Education, F.C.E. (T) p.m.b. 60, Gombe, Gombe. Nigeria
[2]Department of Forestry and Range Science University of Bakht-Er-ruda, Ed-duim, Sudan
[3]Department of Crop Science, University of Bakht-Er-ruda, Ed-duim, Sudan
[4]Department of Biology Education, F.C.E.(T)p.m.b 60Gombe. Nigeria

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ABSTRACT

Heavy metals are contaminants with the ability to accumulate in soil. Certain contaminants are also bioavailable and depend on many characteristics of the soil and of the zones. Study on heavy metals concentration in irrigated soil was conducted in Gombe State, Nigeria with the aim of evaluating the concentration of heavy metal in irrigated soil in the three zones that makes up the state namely; Northern zone, Central zone and Southern zone. From each zone, four locations were selected including one control. Soil samples were taken randomly from the selected areas of the study and replicated thrice. The collected sample were transported in airtight polythene bags to the laboratory for analyses using Atomic adsorption spectrophotometer. The result from this study revealed significant differences in soil heavy metals Concentration in the three zones. A factor attributed to partly to the to pogenetic variability and anthropogenic activities. Results obtained revealed moderately variable concentrations with coefficient of variation of Zn (32.14%), Cu (25.93%), Fe (34.09) and Pb (36.32%). Low variability was recorded on Cd (14.16%), Cr (10.86%), Ni (7.16%) and As (18.98%). However, all the metals were below the permissible limit of heavy metal in soil according to WWF standards. Regular monitoring of heavy metal in Fadama Soil was recommended asessential to prevent future excessive build up. The study served as baseline information for further research.

INTRODUCTION

Heavy metals are contaminants with the ability to accumulate in soil. Certain contaminants are also bioavailable and depend on many characteristics of the soil and of the zones. The zones conditions affect how tightly the contaminant is held by soil particles and its solubility (Shylyle *et al.,* 2009). Regardless of how important soil is, anthropogenic activity plays a significant role in soil contamination as evidenced in the high horizontal and vertical variability on soil formation and development (Fong *et al*., 2008). Human activities including municipal waste disposal, industrial emissions, military testing and agricultural practices have left their impacts on soils in the form of elevated and high level of toxicants. Materials that find their entry into the soil system persist and accumulate in toxic concentrations becoming sources of pollution in the soil (Misra and Mani, 2009). Parent rock, climate and anthropogenic activities can influence the concentration of heavy metals in soil and their impact on ecosystems (Jia *et al.,* 2010). Some pollutants that persist and accumulate in the soils include; inorganic toxic compounds for example fertilizers, organic wastes, organic pesticides and radio nuclides' (Misra and Mani, 2009; Jia *et al.,* 2010). This makes the soil more polluted which can eventually be ingested by man through food chain via surface or ground (Misraand Mani, 2009). Expansion of industrial areas, mine tailings, disposal of high metal wastes, leaded gasoline and paints, land application of fertilizers, animal manures, sewage sludge, pesticides, wastewater irrigation, coal combustion residues, spillage of petrochemicals, and atmospheric disposition are factors that can lead to soil contamination (Kar *et al.,* 2008 and Zhang *et al.,* 2010). Soils are the major sink for heavy metals release into the environment by afore mentioned anthropogenic. If their total concentration in soils persists for a long time after their introduction, changes in their chemical forms (speciation) and bioavailability are, however, possible activities (Sadia *et al.,* 2016). Toxic metals in soil can severely inhibit the biodegradation of organic contaminants

****Corresponding author:*** **Babangida Hammani,**
Department of Agricultural Education, F.C.E. (T) p.m.b. 60, Gombe, Gombe. Nigeria.

(Maslin and Maier, 2000). This paper evaluated heavy metals concentrations in Agricultural irrigated soils in three senatorial zones that make up Gombe state in Nigeria

Sources of Heavy Metals in Contaminated Soils

Processes of weathering of parent materials is the major source of heavy metals in soil at levels that are regarded as trace (<1000 mg kg−1) and rarely toxic (Kebata and Pendias, 1992; Pierzynski *et al.*, 2000). Slowly occurring geochemical cycle of metals by man as a result of disturbance can lead to soils of rural and urban environments accumulating one or more of the heavy metals high enough to cause risks to human health, plants, animals, ecosystems, or other media (D, amore *et al.*, 2005). Although mineral, organic metals are not immediately absorbed by plants, they can slowly release metals into solution (Jones, 2003),the heavy metals essentially have become contaminants in the soil environments because (1) their rates of generation via man-made cycles are more rapid relative to natural ones, (2) they become transferred from mines to random environmental locations where higher potentials of direct exposure occur, (3) the concentrations of the metals in discarded products are relatively high compared to those in the receiving environment, and (4) the chemical form (species) in which a metal is found in the receiving environmental system may render it more bioavailable (D'amore, *et al.*, 2005).

Fertilization

Agriculture was believed to be the major human influence on the soil (Scragg, 2006). The growth of plants does not require only macronutrients (N, P, K, S, Ca and Mg), but also other essential micronutrients. Some soils are deficient in the heavy metals such as Co, Cu, Fe, Mn, Mo, Ni, and Zn that are essential for healthy plant growth (Lasat, 2000) and crops may be supplied with these as an addition to the soil or as a foliar spray. Certain deficient micronutrients may be directly applied as supplements to the soil for crops. Large quantities of fertilizers are regularly added to soils in intensive farming systems to provide adequate N, P, and K for crop growth. The compounds used to supply these elements contain trace amounts of heavy metals (e.g., Cd and Pb) as impurities, which, after continued fertilizer application may significantly increase their content in the soil (Jones and Jarvis, 1981).

Pesticides

Most of pesticides that were used in the past in Agriculture contained substantial concentrations of metals. One of such examples is, in the recent past, about 10% of the chemicals approved for use as insecticides and fungicides in UK were based on compounds which contain Cu, Hg, Mn, Pb, or Zn. Examples of such pesticides are copper-containing fungicidal sprays such as Bordeaux mixture (copper sulpHate) and copper oxychloride (Jones and Jarvis., 1981). Lead arsenate was used in fruit orchards for many years to control some parasitic insects. Arsenic-containing compounds were also used extensively to control cattle ticks and to control pests in banana in New Zealand and Australia, timbers have been preserved with formulations of Cu, Cr, and As (CCA), and there are now many derelict sites where soil concentrations of these elements greatly exceed background concentrations which has the potential to cause problems, particularly if sites are redeveloped for other agricultural or non-agricultural purposes. Compared with fertilizers, the use of such materials has been more localized, being restricted to particular sites or crops (McLaughlin, *et' al*., 2000).

Biosolids and Manures

Application of numerous biosolids such as livestock manures, composts, and municipal sewage sludge can lead to accumulation of heavy metals such as As, Cd, Cr, Cu, Pb, Hg, Ni, Se, Mo, Zn, Tl, Sb, and so forth, in the soil (Basta and Ryan,2005). Some animal wastes such as poultry, cattle, and pig manures produced in agriculture are commonly applied to crops and pastures either as solids or slurriescontain fairly high concentrations of heavy metals. Soils receiving repeated applications of organic manures, fungicides, and pesticides have exhibited high concentrations of extractable increased concentrations of heavy metals in run off (Sumner, 2000).Although most manure are seen as valuable fertilizers, in the pig and poultry industry, the Cu and Zn added to diets as growth promoters and as contained in poultry health products may also have the potential to cause metal contamination of the soil (Sunner, 2000, Chaney and Oliver., 1996). Heavy metals most commonly found in biosolids are Pb, Ni, Cd, Cr, Cu, and Zn, and the metal concentrations are governed by the nature and the intensity of the industrial activity, as well as the type of process employed during the biosolids treatment (Mattigod and Page, 1983).

Irrigation water

Application of municipal and industrial wastewater and related effluents has been in practice as far back as 400 years and still is commonly practiced in many parts of the world (Reed, *et'al*., 1995). Globally, it has been estimated that 20 million hectares of arable land are irrigated with waste water and in several Asian and African cities, studies suggest that agriculture based on wastewater irrigation accounts for 50 percent of the vegetable supply to urban areas (Bjuhr, 2007). Farmers do notcare about environmental hazards but are primarily interested in maximizing their yields and profits. Although the metal concentrations in wastewater effluents are usually relatively low, long-term irrigation of land with such can eventually result in heavy metal accumulation in the soil (Bjuhr, 2007).

Industrial Wastes and Metal Mining

Mining and milling of metal ores coupled with industries have bequeathed many countries, the legacy of wide distribution of metal contaminants in soil. During mining, tailings (heavier and larger particles settled at the bottom of the flotation cell during mining) are directly discharged into natural depressions, including onsite wetlands resulting in elevated concentrations (De'Volder *et al.*, 2003). Extensive Pb and Zn, ore mining and smelting have resulted in contamination of soil that poses risk to human and ecological health. Many reclamation methods used for these sites are lengthy and expensive and may not restore soil productivity. Soil heavy metal environmental risk to humans is related to bioavailability. Assimilation pathways include the ingestion of plant material grown in (food chain), or the direct ingestion (oral bioavailability) of, contaminated soil (Basta and Gradowl, 1998). Other materials are generated by a variety of industries such as textile, tanning, petrochemicals from accidental oil spills or utilization of petroleum-based products, pesticides, and pharmaceutical facilities and are highly variable in composition. Although some are disposed of on land, few have benefits to agriculture or forestry. In addition, many are potentially hazardous because of their contents of heavy metals (Cr, Pb, and Zn) or toxic organic compounds and are seldom, if ever, applied to land. Others are very low in plants nutrients or have no soil conditioning properties (Sumner, 2000).

Soil Heavy metals and their effect

Heavy metal pollution in soils means a situation whereby the quantities of the elements in soils are higher than maximum allowable concentrations and this is potentially harmful to biological life at such locations (Adeleken and Abegunde, 2012). Although heavy metals occur in all ecosystems, anthropogenic releases can result in higher concentrations of these metals relative to their normal background values therebyresulting into pollution (Adeleken and Abegunde, 2012). Vehicular emission releases heavy metals which can accumulate in surface soils and their deposition over time can lead to abnormal enrichment thereby causing metal contamination of the surface soils (Fong, *et al*., 2008). High concentrations usually occur in soils below or near landfills and agricultural lands that have been irrigated with contaminated water (Mamtaz and Chowdhury, 2006). It has been observed that both long term and short term contamination of soils have effects on microbial activity and enzyme activities of the soil (Adeleken and Abegunde, 2012). Not onlythe total concentration of heavy metals determines its toxicity and mobilitybut also their specific chemical form, bonding state, metal properties, environmental factors, soil properties and organic matter content (Osu and Okoro, 2011). Migration of metals in the soil is influenced by physical and chemical characteristics of each specific metal and by several environmental factors. The most significant environmental factors appear to be (i) soil type, (ii) total organic content, (iii) potential pH (Murray *et al*., 1999). In addition, organic matter is another soil component influencing the availability of heavy metals in soil through its binding effects on soil component (Naidu *et al*., 2003). Exposure of children, generally accepted as the highest risk group who have a higher adsorption rate of heavy metals because of their active digestion system and sensitivity of hemoglobin, to heavy metals, can greatly increase ingestion of metal laden soil particles via hand -to-mouth activities. In addition, adults may be exposed to threat since inhalation is easier pathway for toxic metals to enter their body (Fong *et al.*, 2008).

MATERIALS AND METHODS

Characteristic of the Study Area

This research was conducted in Gombe State, Nigeria in the period of 2014 – 2015. Gombe State; Jewel in the Savannah, is located within the latitude 9^o 30 and 12^o 30^o N and longitude 8^o 45 and 11^o45 E in the sub-Sudan savannah region of the North-east region of the country. The State covers an area of 20,265 km^2 attitude at 400 – 500m above sea level, (yahya, 2005). The area is underlain by basement complex structure in the south and sedimentary chad formation in the north – eastern part of the state (Umar, 2003). The study area lies mostly within the poor ground water province in the sandstone which occur between 18m depth and generally emetic (Olofin, 1989; Umar, 2003) with annual average rainfall of 850mm and temperature ranges from 17^o c – 42^oC. The soil of Gombe state is underline by keri – keri chad formation, have open grassland, shallow to moderately impoverished deep but sandy clay and silt clay which are blanketed by sand dunes in the Northern part. In the Southern part of the state are sedimentary rock formation with shallow deep loamy, sandy day loam isolated hills, vertisol soil with cracking clays that have weathered from shale. The vegetation of the area is of several types consisting of complex composite of thick acacia shrubs and open grassland. The vegetation is predominantly of tree species of fine leaf. Thorny trees *selerocengaburce* (Danya), Acacia *Serberiana* (Fara Kaya), *Bombercostatun* (Gurjiya), *Acaciaalbedo* (Gawo) *Acacia nilotica* (Gabaruwa).The vegetation in most cases is interrupted with farming activities, indiscriminate deforestation, bush burning and other construction purposes. (www.gometonigeria.com; www.onlin enigeria.com/links/gomeadv.asp)

Sampling, Preparation and Analysis

Soil Sampling

Soil samples were taken from the three studied zones in the state namely: Northern zone, Central zone and Southern zone. At each zone three locations were randomly chosen with three replicates from each zone and samples were taken using an auger at the depth of 0-30cm. Samples taken were separately labelled and transferred into air tight polythene bags and brought to the laboratory. Care was taken, to the extent possible, to ensure that there was no source of contamination at the sites or locations of investigation. In the laboratory the soil samples were air-dried, grinded have to passed through 2mm stainless steel sieve in order to remove materials greater than 2mm and sub samples were used for laboratory analysis.

Heavy Metals Determination in Soil Samples

5g of each of the dried, sieved, and grinded soil samples were placed in 100mm beaker. 15ml of HNO_3; H_2SO_4 and HCL mixture (5:1:1) of tri-acid were added and the content heated and digested gently at low heat on digestion block machine for about 2 hours at 80 – 100^0c until transparent or colourless solution was obtained. After cooling, the digested sample was filtered using Whatman $N_{O.}$42 filter paper. It was then transferred to a 100ml volumetric flask and made to mix with distilled water. The digested sample was transferred into plastic 100ml bottle for the heavy metals determination at their respective wavelengths, using A.A.S. machine (USEPA, 1996).

Statistical Analysis

The data were reported as mean, standard error and coefficient of variability (Cv %). One way analysis of variance (ANOVA) was used to determine significant difference between groups considering a level at significance of 5% (P = 0.05) by using SPSS statistical package.

RESULTS

Total Heavy metals concentration in the studied zones soil

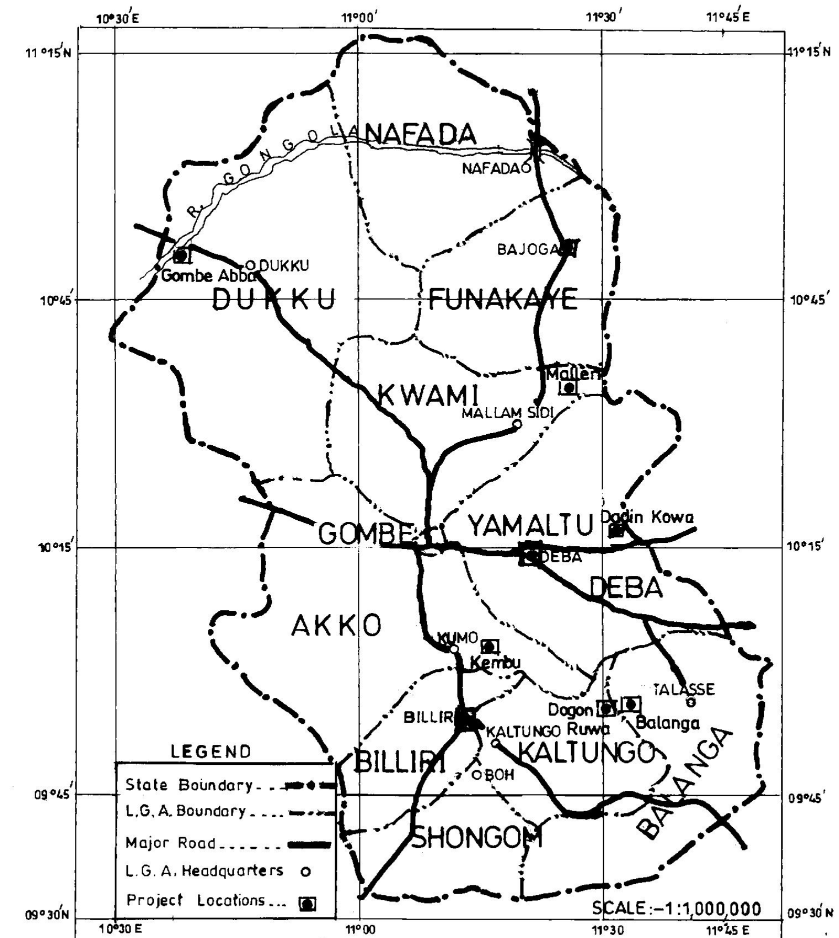
Table 1 above shows that the concentrations of the heavy metals were moderately variable with a Cv % of 32.14% (Zn), 25.93% (Cu), 34.09% (Fe), and 36.32% (Pb) and low variability with a CV% of 14.16% (Cd), 10.86% (Cr), 7.16% (Ni) and 18.98% (As) respectively. Northern zone and central zone recorded significantly (P=0.05) higher difference of Zinc (Zn), copper (Cu), Iron (Fe) and Nickel (Ni) each with a mean of 14.69 and 13.89 (Zn), 6.01 and 5.78 (Cu), 27.01 and 21.09 (Fe), and 0.21 and 0.23 (Ni) respectively, whereas Southern zone recorded mean of 7.6^{-1} (Zn), 8.60 (Cu), 13.14 (Fe) and 0.21 (Ni). The distribution of cadmium (Cd) was presented in table 1. Central zone had significantly (P=0.05) different value of Cd content (0.64 mgkg^{-1}). The other zones were statistically the same each having a Cd mean of 0.54 mgkg^{-1} (Southern zone) and 0.48 mgkg^{-1} (Northern zone) with a Cv % of 14.61%. Also significant difference was observed among the zones with respect to lead (Pb) distribution (mgkg^{-1}). A mean of 5.23 mgkg^{-1}Pb was found in Northern zone and significantly differ with the other zones, each with a mean values of Pb3.20mgkg^{-1}central zone and 2.6 southern zone On the other hand Table 1 chromium (Cr) concentrations in the zones soils decreased significantly from a mean of 0.36 mgkg^{-1}at Northen zone to 0.32mgkg^{-1} at Central zone and to 0.29 mgkg^{-1} Southern zone, with a CV% of 10.86%. Arsenic (As) content shows that there was a significant (P=0.05) difference existed between the zones (Table 1). Northern zone recorded mean 0.03. whereas Gombe central and south zones which among them they did not differ significantly. Both zones have the same mean 0.18.

DISCUSSION

Heavy metal concentration at the senatorial zones soil

Zinc (Zn)

There was a significant variation with Zn metal concentration between the zones, as well as locations at each zone. Northern zone and central zones recorded significantly higher Zn content than Southern zone, while Gombe-Abba, Malleri and Kuka-Bakwai locations at Northern zone recorded a significantly higher Zn content than control soil. At Central zone, all the three locations (Kembu, Dadin Kowa and Kwadon) had significant Zn content than the control location soil. Gelengu locations at Southern zone have significant variation of Zn content distribution than the other locations within the zone. The values of Zn concentration in all the soil



SOURCE: GEOGRAPHY DEPARTMENT, GOMBE STATE UNIVERSITY GOMBE, MAY 2015

Fig. 3 HEAVY METAL LEVEL CONCENTRATION ON THE IRRIGATION SOIL IN GOMBE STATE NIGERIA

Table 1. Heavy metal concentration at the three zones Mgkg-1

Zone	Zn	Cu	Fe	Cd	Pb	Cr	Ni	As
Northern zone	14.69^{a}	6.01^{a}	27.01^{a}	0.48^{a}	5.23^{a}	0.36^{a}	0.21^{a}	0.23^{a}
Central zone	13.89^{a}	5.78^{a}	21.09^{a}	0.64^{a}	3.20^{b}	0.32^{b}	0.23^{a}	0.18^{b}
Southern zone	7.61^{b}	3.60^{b}	13.14^{b}	0.54^{b}	2.67^{b}	0.29^{c}	0.20^{ab}	0.18^{b}
Mean	12.06	5.13	20.41	0.55	3.70	0.32	0.21	0.19
SET	1.29	0.44	2.32	0.03	0.45	0.01	0.01	0.01
CV %	32.14	25.93	34.09	14.61	36.52	10.86	7.16	18.98

Source, field work 2016

studied were below both standard set by United Kingdom and Germany permissible limits standard. However, the results obtained in this study were higher than the values reported by Ibrahim, *et al*. (2014) of Zn metal in irrigation with wastes water is Kwadon. Dockman, *et al*. (1994) reported that both N. mineralization and nitrification were inhibited at high concentration of Zn. Letunova*, et al.* (1985), observed that a stronger inhibition of Cyanobacteria (autotrophic N_2, fixer) in a Swedish clay soil to which metal contaminated sludge had been applied, resulting in a high concentration of Zn. At high concentration, all the heavy metals have also strong, yielded depression, disorders in plants metabolism and reduced nutrient uptake. The natural range of Zn in soils is 10 – 300 mg/kg^{-1} (Eddy *et al.,* 2004). The concentration of soil Zn in this study was within these natural ranges. Also the result was low when compared with those of several studies (Kebataandpeudias, 1992; Haluschall *et al*, 1998; McGrath *et al*., 2001; Kwami, 2007) reported a higher mean value of Zn in different countries.

Copper (Cu)

There was significant difference of Copper (Cu) concentration between the zones and within the different locations at each zone. Whereby Northern and central zones recorded significant higher Cu content than Southern zone. Also locations wise, Gombe-Abba, Malleri and Kuka-Bakwai locations at Northern zone contained significantly higher Cu content than the control site. At Central zone, the content followed the same pattern with Northern zone. On the other hand, the distribution of Cu content at the southern zone indicated that Dogon-Ruwa and Gelengu contain statistically higher Cu content than Ayaba and control locations. The content and distribution of Cu in all the soil studied were below the UK (1982) and Germany (1992) limits. However, the Cu concentration in this study were higher than the values reported by Ibrahim *et al*., (2014) and Uwah, *et al*., (2011s) of Cu metal in irrigation with waste water in Kwadon and Maiduguri respectively. At higher Cu concentration, toxic effects on plant growth, yield depression, disorders in plant metabolism and reduced nutrient uptake has been reported (ATSDR, 2005). Cu reduces the uptake of NH_4^+in roots at mycorrhizal pinup sentries seeding (Van Tichelen *et al*., 1999). Copper is an essential nutrient that is incorporated in a number of metalloid enzymes involved in hemoglobin formation (ATSDR, 2005a). Although Cu homeostasis plays an important role in the prevention of Cu toxicity, exposure at excessive levels of Cu can results in a number of adverse health effects including liver and kidney damage (ATSDR, 2005)

Iron (Fe)

The levels of iron (Fe) in the soils ranged from 3.33 mgkg^{-1}to 39.20 mgkg $^{-1}$. The concentrations of Fe in soil could not be said to be too high (Gborbani *et al*., 2002). The concentration of soil Fe reported here are higher than the values reported by Ibrahim (2014). Asaolu (1995) reported a total value of Zn ad Fe to range between 7.0mgkg $^{-1}$and 25.0 mgkg $^{-1}$and Fe ranged from 28.5 mgkg $^{-1}$ to 38.5 mgkg $^{-1}$in the basement complex soils at Western Nigeria. Also Akande *et al*., (1999) reported 2.5 mgkg $^{-1}$Zn and 1.2 mgkg $^{-1}$ from Sokoto soil. Fe is essential for chlorophyll formation and for the synthesis of protein contained in the chlorophyll .Fe acts as a catalytic center for a broad spectrum of metabolic functions. That is as a component of various tissue enzymes and essential on copper metabolism (Michael *et al*., 2009). Fe deficiency includes symptoms such as reduced resistance to infection, reduced work productivity, and reduced pHysical fitness and many more pHysiological functions (Beard, 2001).

Cadmium (Cd)

The content and distribution of soil cadmium (Cd) in the studied soil also revealed a significant variation but is below the permissible limits reported by United Kingdom (1989). This value of the study zone areas were lower than those Cd value earlier reported by Ibrahim *et al*. (2014).

Lead (Pb)

Lead (Pb) is one of the more persistent metals and is estimated to have a soil retention time at 150 to 500 years (Premarathna *et al*., 2011). This study reported a mean level ranging from 0.52 mgkg $^{-1}$to 7.42 mgkg $^{-1}$. This shows lower ranges of soils studies by Premarathna *et al*. (2011) who reported a range of 15 to 311 mgkg $^{-1}$. Similarly. Haluschak *et al*. (1998), McGrath *et al*. (2001) a reported higher Pb values of 189 mgkg $^{-1}$, 55 mgkg^{-1}, 80 mgkg^{-1} and 34.5 mgkg^{-1}, respectively in uncontaminated soils. The Pb values were within the permissible levels for agricultural soils (United Kingdom, 1982 and Germany, 1992). Pb is a toxic element that can be harmful to plants, although plants usually show ability to accumulate large amounts of Pb without visible changes in their appearance or yield (ATSDR, 2006). In many plants, Pb accumulation can exceed several hundred times the threshold of maximum level permissible for human. It has been suggested that Pb on a cellular and molecular level may permit or enhance carcinogenic events involved in DNA damage, DNA repair and reputation of tremor suppressor and promoter genes (Silveira, 2003). The significantly difference with Pb content distribution across the study areas could be attributed to the geologic precursors of soil and other anthropogenic activities. Singh and Kumar in 2004 concluded that soil, irrigation water and some vegetables from peri-urban sites are significantly contaminated by the heavy metals. It was concluded that Cd and Pb were of more concern than Cu and Zn. Mostly; the concentrations of heavy metals are higher in soils than vegetables grown on the same soils. This revealed that only small portion of soil heavy metals is transferred to the vegetables and roots acts as a barrier to the transaction of heavy metals within plant (Davis and White, 1981).

Chromium (Cr)

The mean concentrations of chromium (Cr) in the examined soil were also within the permissible limits according to United Kingdom (1982) and Germany (1992) and also soils examined by Roychowdhury *et al*. (2002). Cr ranges between 0.29 mgkg $^{-1}$at Gombe north zone, 0.04 mgkg $^{-1}$to 0.51 mgkg $^{-1}$at Gombe central zone and 0.06 mgkg $^{-1}$to 0.74 mgkg $^{-1}$at Gombe south zone respectively. Cr is present in the environment in several forms. The common forms are chromium (O), III and VI but the most stable form are Cr (III) and Cr (VI) (Alloway, 1995). Cr (III) occur naturally in the environment and is an essential nutrient requirement by human body to promote the action of insulin but Cr (VI) and Cr (0) are generally produced by industrial process (ATSDR, 2006). In air Cr compounds are present mostly a as fine dust particle

Table 2. Heavy metal concentration at Northern zone Mgkg^{-1}

Location	Zn	Cu	Fe	Cd	Pb	Cr	Ni	As
Gombe-Abba	13.44^{a}	6.26^{a}	21.93^{ab}	0.52^{a}	9.42^{a}	0.35^{b}	0.22^{b}	0.26^{b}
Malleri	13.51^{a}	7.34^{a}	32.76^{a}	0.61^{a}	5.98^{b}	0.40^{b}	0.24^{b}	0.24^{b}
Kuka-Bakwai	17.11^{a}	7.92^{a}	39.20^{a}	0.72^{a}	5.00^{b}	0.62^{a}	0.34^{a}	0.37
Control	4.11^{b}	2.50^{b}	4.15^{b}	0.05^{b}	0.53^{c}	0.06^{c}	0.03^{c}	0.06^{c}
Mean	14.69	6.01	27.01	0.48	5.23	0.36	0.21	0.23
SET Cv %	1.39	0.61	3.92	0.07	0.06	0.03	0.03	

Source. field work 2016

Table 3. Heavy metal content in Central zone Mgkg-1

Location	Zn	Cu	Fe	Cd	Pb	Cr	Ni	As
Kembu	17.42^{a}	7.53^{a}	31.92^{a}	0.64^{ab}	3.28^{c}	0.32^{ab}	0.22^{b}	0.25^{b}
Dadin/Kowa	14.56^{a}	5.93^{a}	19.10^{b}	0.98^{a}	4.74^{b}	0.51^{a}	0.24^{b}	0.35^{a}
Kwadon	18.77^{a}	7.74^{a}	29.17^{a}	0.87^{a}	6.33^{a}	0.42^{a}	0.45^{a}	0.18^{c}
Control	4.80^{b}	1.87^{b}	3.33^{c}	0.10^{c}	0.54^{d}	0.04^{c}	0.07^{c}	0.08^{d}
Mean	13.89	5.78	21.09	0.64	3.20	0.32	0.23	0.18
SET	1.58	0.68	3.23	0.09	0.47	0.05	0.05	0.02
CV %	45.42	47.18	61.24	59.52	58.64	63.16	78.18	60.25

Source. Field work 2016

Table 4. Heavy metals concentration in Southern zone

Location	Zn	Cu	Fe	Cd	Pb	Cr	Ni	As
Dogon-Ruwa	7.40b	5.42a	11.52b	0.18b	1.16b	0.14b	0.16b	0.13b
Ayaba	5.61b	2.14b	7.16b	0.35b	3.91a	0.20b	0.18b	0.17b
Gelengu	13.63a	4.47a	29.46a	1.45a	5.09a	0.74a	0.38a	0.29a
Control	4.06bc	2.35b	4.44b	0.18b	0.52b	0.06b	0.06c	0.03c
Mean	7.61	3.60	13.14	0.54	2.67	0.29	0.20	0.16
SET	1.05	0.40	2.82	0.15	0.55	0.08	0.03	0.03
CV%	54.69	38.52	85.69	113.32	81.76	108.32	68.74	69.34

Source. Field work 2016

that eventually settles over land and water. In water, although most of the Cr in waters binds to dirt and other minerals and settles to the bottom, only small amounts may dissolve in the water. In soil most of the Cr does not dissolve easily in water and can attach strongly to the soil, however, the soluble part can move deeper in the soil to ground water (ATSDR, 2006 and Singh *et al*. (1997) determined the concentration of Cr in recently deposited surface sediments at Gomti River in the Luck now urban area and found out higher concentration at these metals in the sediments. The average values of Cr analyzed in the soils of over study area were lower (CV % = 230.00mgkg^{-1}) than the values reported by Awode, *et al*. (2008) for Challawa river bank soil samples used for irrigation.

Nickel (Ni)

There is evidence at uptake and accumulation on certain plants. Nickel (Ni) is an essential trace element in animals, although the functional importance of Ni has not been clearly demonstrated. It is considered essential based on reports at Ni deficiency in several animal spp (Beyersman, 2002). Ni deficiencies is manifested primarily in the liver; effects include abnormal cellular morphology, oxidative metabolism and increased and decrease in lipid levels. The essentiality of Ni in humans has not been established and Ni dietary recommendation have not been established for human (ATSDR, 2003b). Ni compounds are known carcinogeus in both human and animal's models. Ni can indirect attracts the inhibition of DNA repair systems (Beyersman, 2002; ATSDR, 2005a).

Arsenic (As)

The mean values of As metal in soil studied were less permissible limits by UK (1982) and Germany (1992). The ranges from 0.03 mgkg $^{-1}$As to 0.35 mgkg $^{-1}$As Mehang and Rahman (2015) studied the As levels in paddy soil varied between 3.5 mgkg $^{-1}$to 4.25mgkg $^{-1}$from Bangladesh. Alan and Satter (2000) found that As in soils (depth 0.15cm) ranged from not detectable level to 31.8 mgkg $^{-1}$. They found that As content in soils was positively corrected with As content in irrigation water. Roychoudhurry *et al.* (2002) reported that the mean value of 10.7^{-1}. In this study the As content of the soils studied was lower compared to the reported values above. As level in soils may thus, very throughout the year, as levels in this study were lower compared to the other studies and permissible limits.

Northern zone comprised of four different locations namely: Gombe-Abba, Malleri, Kuka-bakwai and control respectively. The levels of heavy metals of the zone were presented in table 2 High variability was found with heavy metals concentrations Cr= 46.16% (Zn), 60.70% (Cu), 52.67% (Fe), 62.08% (Cd), 70.01 (Pb), 64.48% (Cr), 62.39% (Ni) and 52.52% (As) respectively. A none significant difference at P=0.05 was existed between mean of concentration of Zn,Cu,Fe, and Cd at Gombe-Abba, Malleri and Kuka-Bakwai whereas significant differences is observed between the above mentioned zones and the control which recorded the lowest mean for Zn, Cu, Fe, and Cd respectively and recorded mean. Table 2 also shows that a significant different at (P=0.05) observed between the means of Pb content of the studied zones, where as a non-significant existed between the means of content of Pb at Malleri and Kuka-Bakwai soils location, means ofPb content in the soil of Gombe-Abba, Mallaeri, Kuka-Bakwai and control was 9.42, 5.98 and 0.53 respectively. The content of chromium (Cr), Nickel (Ni) and Arsenic (As) observed in table 2 also show that there was significant difference at P=0.05 between means Kuka-Bakwai location (Soil) had higher Cr (Mean = 0.62), Ni (Mean= 0.34) and As (Mean = 0.37.). A none significant different at P=0.05 existed between Ni Cr As metals content at Gombe-Abba and Malleri locations soil recorded higher Ni, Cr, As, Metals than the control soil.

The Central zone comprised of four locations namely, Kembu, Dadin-Kowa, Kwadon and control Table 3 The distribution of Zn, Cu, Cd and Cr in Table 4.7 shows that no significant (P = 0.05) difference between the locations, and recorded mean content of the mentioned metals higher than the control. The means of metal concentration were Zn (18.77 to 4.80), Cu (1.87 to 7.74), Cd, (0.10 to 0.98) and Cr (0.04 to 0.51). Each having a Cv% of 45.52, 47.18, 59.52 and 63.16 respectively. Table 3 above also show that significant at P=0.05 observed among the content of Fe at the locations studied. A none significant difference at 0.05 existed between Akko and Kwadon location mean content of soils. This means of Fe content in soil of Akko, Dadin Kowa and kwadon were here was also significant difference of Fe content distribution table. Where by Kembu and Kwadon were 31.92, 19.10 and 29.77 whereas the control recorded the lowest of the content (3.33).
The mean values of heavy metals content at the South zone was presented in table 4. There was higher variability of the metal concentration across the locations studied. Whereby Zn, Cu, Fe, Cd, Pb, Cr, Ni and As recorded a coefficient of variability percentage of 54.69, 38.52, 35.69, 113.32, 81.74, 108.32, 68.74 and 69.34 respectively. Gelengu soil had significantly (P= 0.01) different higher metal content than at other locations (Table 4.). The heavy metals ranged between 4.06 to 13.63 (Zn), 2.14 to 5.42 (Cu), 11.52 to 29.46 (Fe), 0.18 to 1.45 (Cd), 0.52 to 5.09 (Pb), 0.06 to 0.74 (Cr), 0.06 to 0.38 (Ni) and 0.03 to 0.29(As) accordingly.

Conclusion

(1) The research reveals that significant difference existed in the heavy metal concentration in soils.
(2) The metals shows that they were below the permissible limit of heavy metal in soil according to international standards.
(3) However, all these metal have toxic potential, but the detrital impact becomes apparent only after decade of exposures.

Recommendation

(1) It is therefore recommended that regular monitoring of heavy metal in the soil should be conducted in order to monitor future build-up of the metals in the soil.
(2) The soil can be use for irrigation purpose without any hazardous.
(3) This finding can be used as baseline so that further study can be built on this to ascertain the level of heavy metals in both soil and irrigation water in the state

REFERENCES

Adeleken, B. and Abegunde, K. 2012. Heavy metal contamination of soil and ground water at automobile mechanic village in Ibadan, Nigeria. *International Journal of The Physical Sciences,* 6:1045:1058.

Alloway, B.J. 1995. Heavy metals in soils, Blackie Academic and Professional, London, UK, 2ND EDITION, 1995.

Asaolu, S.S. 1995. Lead content of vegetables and tomatoes at Erekesan market. *Pakistan J. SciInd, Res*, 38: 399 – 401

ATSDR, 2005. Toxicological profile of Zinc. Atlanta, Georgia, united states. US department of health and human services. Agency for toxic substances and disease registry.

Basta, N.T., and Gradwoh, R. 1998. "Remediation of heavy metal- contaminated soil using rock phosphate, "Better Crops, vol. 82, no. 4, pp. 29-31.

Basta, N.T., Ryan, J. A., and Chaney. R. L. 2005. "Trace element chemistry in residual- treated soil: Key concepts and metal bioavailability," *Journal of environment Quality,* Vol. 34, no. 1, pp. 49-63. View at Scopus.

Beard, J.I 2001. Iron biology in immune function muscle metabolism and neuronal functioning. *Journal of Nutrition,* 131 (2s – 2), 5685 – 5795.

Beryersmann, D. 2002. Effects of careinogenic metals on gene expression. *Toxicological letters*, Ile 77-80.

Bjuhr, J. 2007. Trace Metals in soils irrigated with waste water in a peri urban Area Downstream Hanoi City, Vietnam, Seminar Paper, Institution for makevetenskap, Sverigeslantbruks universities (SLU), Uppasala, Sweden.

Chaney, R.L. and Oliver, D.P. 1996. "Sources potential Adverse effects and remediation of agricultural soil contaminatuions", in contaminants and the soil environments in the Australia- Pacific Region, R. Naidu, Ed., pp. 323-359, Kluwer Academic publishers, Dodrecht, The Netherlands.

D: Amore, J. J, Abed, S. R, Scheckel, K. G and Ryan, J. A 2005. "Method for speciation of metal in soils: a review" *Journal of Environmental Quality*, vol 34 no. 5, pp 1707-1745.

Devolder, P. S, Brown, S.L, Hesterberg, D., and Pandya, K. 2003. "Metal bioavailability and speciation in a wetland tailings repository amended with biosolids compost, wood ash, and sulfate, "*Journal of environmental Quality*, vol. 32, no. 3, epp. 851-864, View at Scopus.

Doelman; P.G, Jansen, E, Micheal, M and Van til, 1994. Effects of heavy metal in soil on microbial diversity and activity as shown by the sensitivity resistance index. *Boil fertile soils*, 17; 177-184

Eddy, N.O., Odoemelem, S.A and Mbaba, A. 2004. Elemental composition of soils in some dumpsites. *Journal of Environmental Agricultural Food Chemistry,* 5, 1349 – 1365

Fong, F., Seng C., Azan, A. Tahir, M. 2008. Possible source and pattern distribution of heavy metals content in urban soil at kuala Terengganu Town Centre. *The Malaysian Journal of Analytical Sciences,* 12:458-467.

Gborbani, N.R., Salehrastin, N. and Moeini, A. 2002. Heavy metal affects the microbial populations and their activities. Symposium no. 54. At 17th world congress of soil science, 14 – 21. August 2002. Thailand, Pp: 2234: 1 – 11.

Haluschal, P., Ellers, R.G., Mills G.F and Grift, S. 1998. Status of selected trace elements in agricultural soils of southern Manitoba. Canada: Agriculture and Agric – Food Canada.

Ibrahim A.K: Yakubu, H. and Askira, M.S. 2014. Assessment of heavy metals Accumulated in waste water irrigated soils and lettuce (Lactucasativa) in kwadom, Gombe state Nigeria. American – Eurasian. *J. Agric of EnvinnSci.,* 14 (6): 502 – 508.

Jia, L., Yonghua, L. and Yang, L. 2010. Heavy metals in soil and crops of an intensively farmed area: case study in Yucheng City, Shandong province, china International *Journal of environmental research and public health*; 7:395-412.

Jones, C , Jacobsen, J 2003. Nutrient management modute No. 7 Testing and fertilizer recommendation available of http://msvertension.Org/publication/agandaNatural Resources/449/44497 pdf 13. 12. 2008.

Jones, L.H.P and Jarvis, S. C, 1981. "The fate of heavy metals, " in The Chemistry of soil processes, D. J. Green and M. H. B. Hayes, Eds., p. 593, John Wiley and Sons., New York, NY,

Kar, D.; Sur, P.; Mandal S.; Saha T. and Kole, R 2008. Assessment of heavy metal pollution in surface water. *International Journal of science and technology*; 5:119-124.

Ketaba – Pendius, A and pendias, A. 1992. Trace metals in plant and soils. Boc Raton. CRC press inc. London

Letunova, S.V.; Umar PV, M.M., Niyazora, G.A. and Melekin Y.I. 1985. Nitrogen fixation activity as a possible criterion for determining permissible concentration of heavy metals in soil. *Soviet soil science*, 17: 88 – 92.

Mamtaz, R. and Chowdhury, H. 2006. Leaching characteristics of solid waste at an urban solid waste dumping site. *Journal of civil Engeering;* 34:71-117.

Maslin, P. and Maier, R.M., Rhamnolipid, 2000. Enhanced mineralization of phenatherene in organic- metal co-contaminated soils," *Bioremediation Journal*, vol. 4, no. 4, pp. 295-308. View at Scopus.

Mattigod S. V. and A. L. 1983. "Assessment of metal pollution in soil, "in Applied Environment Geochemistry, pp. 355-394, Academic Press, London, UK.

McLaughlin, M. J, Zarcinas, B.A, Stevens, D.P, and Cook, N., 2000. Soil testing for heavy metals, communications in soil science and plant Analysis, vol. 31, no. 11-14, pp. 1661-1700, 2000. View at scopus.

Michael, J.G., Susan, A.L., Aedin, C and Hester, H.V (eds) 2009. Introduction to human Nutrition, Great Britain: A john wiley and sons Ltd., Publication Wiley – black well.

Misra, S. and Mani, D. 2009. Soil pollution. New Delhi, India: S. B Nangia APH publishing corporation. Pp29-59.c

Murray, K .S, canvett. D. Lybees, M. Thomas, J.C. 1999. particle size and chemical control of heavy meals in bed sediment from the rouge river, southeast Michigan environ, *Sci Tech.,* 33: 987-992.

Naidu R., Oliver, D and Mc Connell S. 2003. Heavy metal phytotoxicity in soils proceeding of the fifth national workshop on the assessment of the site contamination. National environmental protection council, Australia pp235-241.

Olofin, E.A. 1987. Some Aspect of the physical Geography of Kano and its related Human responses. Departmental lecture series No-1

Osu C. and Okoro J. 2011. Comparative evaluation of physical and chemical parameter of sewage water from selected areas in port Harcout Metropolis, Rivers, state, Nigeria. *Continental Journal of Water, Air and Soil Pollution,* 2:1-14.

Pierzynsiki, G.M, Sims, J.T, and Vance G.F. 2000. Soils and Environmental Quality, CRC Press, London, UK, 2nd edition.

Reed, S. C. Rites, R. W. middle brooks, E. J. 1995. Natural system for waste management and treatmen, mc graw hill, New York, Nyusa 2nd edition.

Rozen, T.F., Tailtefert, M., Trowborst R.E., Glazer, B.T., Ma., S., Heazage, J., Valdes, L.M., Price., K.S., Luther, I.G.W 2002. Iron sulfur – phosphate cycling in the sediment of a shallow coastal bay implications for sediment nutrient release and benthic macrogoal blooms Limmology and oceongrphy 47: pp 1346 – 1354.

Sadia Q., Ibrar K., Farhana M., Yangguo Z., Qingbao G and Changsheng P. 2016. Isolation and Characterization of Heavy Metal Resistant Fungal Isolates from Industrial Soil in China. *Pakistan J. Zool.,* 48(5), pp. 1241-1247

Scragg, A. 2006. Environmental Biotechnology, Oxford University Press, Oxford, UK, 2nd edition.

Shayley, H., McBride M. and Harrison E. 2009. Sources and impacts of contaminants in soils. Cornall Waste management Institute. Pp, 1-6.

Silveira, M. L. A.Alleoni, L. R. F and, GuilhermeL. R. G, 2003. "Biosolids and heavy metals in soils," Scientia Agricola, vol. 60, no. 4, pp. 64-111.

Singh, M.A and Kumar, M. 2004. Heavy metal load of soil water as vegetables in Peri-urban Delhi environmental merit and assessment. 120:79-91.

Sumner, M. E, 2000. Beneficial use of effluents, wastes, and biosolids, " Communications in Soil Science and plant Analysis, vol. 31, no. 11-14, pp. 1701-1715. View at Scopus.

Umar, Y.A. 2003. Problems of water scarcity consequences and possible solutions in Gombe metropolis, Gombe state. Poeing a B.ScDessertation submitted to department of Geology, Bayero University Kano (unpublished)

USEPA, 1996. Report: recent Development for In Situ Treatment of metals contaminated Soils, US. Environmental Protection Agency, Office of Solid Waste and Emergency Response.

Uwah, E.I Ndah, N.P., Abdurrahaman F.I and Ogughuage, B.O 2011. Heavy metal levels in spinassh (Amaranthuscaudatus) and lettuce (lactucasativa) growth in Maiduguri, *Nigeria Journal at Environmental Chemistry and Ecotoxicology*, 3(10), 264-271

Vantichelen, K.,TVanstraelen and Colpaert, J.V. 1999. Nutrient Uptake by intact myconhizalpinussylvestri seedlings; a diagnostic tool to defect copper toxicity. *Tree Physiol*., 19; 189-196

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