Assessment of Heavy Metals in Roadside Soil along Gamboru Ngala Road, Borno State, Nigeria

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***Abstract*: This study was aim at assessing the level of pollutants in agricultural environment along Gamboru Ngala in Borno state of Nigeria. Soil samples of varying depth, were collected in five LGA along Gamboru Ngala Road, Borno state. At each of the sample sites, roadside soil were collected for a period of three months, at different distance from the edge of the main road 30, 60 and 90metre as well as varying depth of 0-5cm, 5-10cm and 10-15cm respectively, 200 metres serves as control points. heavy metals were determine using Perkin-Elmer Analyst 300 Atomic Absorption Spectroscopy (AAS). The concentration of all the metals in the five sampling sites decreased exponentially with distance from the road and drooped to the level at about 90metres. Similarly, mean concentration of Fe, Cu, Mn and Zn were significantly higher around Jere, Mafa and Dikwa L.G.A than in Marte and Ngala L.G.A. The mean concentration of heavy metals in soil sample for different location was showed significantly in manganese (1.6011mg/kg), chromium (4.1106mg/kg), zinc (1.9127mg/kg) and copper (1.3069mg/kg).**

***Keywords:* Heavy Metals; Roadside Soil**

I. INTRODUCTION

Soil is a natural body which comprise of solids minerals and organic matter, liquid and gases that occur on the land surface, occupy space, and is characterized by one or both of the following; horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers and transformations of energy and matter or the ability to support rooted plants in a natural environment (Chatsworth, 2008). Organic matter is an organic compounds obtained from the remains of living organisms such as plants, animals and their waste products in the environment. Organic matter is present throughout the ecosystem. After degrading and reacting, it can then move into soil and mainstream water via water flow. Organic matter forms molecules that contain nutrients as it passes through soil and water. It provides nutrition to living plant and animal species (James *et al*., 2004).

The term toxic metals are metals that form poisonous soluble compounds, while heavy metal refers to any metallic chemical element that has relatively density and is toxic or poisonous at high concentration. Heavy metals include mercury (Hg), cadmium (Cd), Arsenic (As), chromium (Cr) and Thallium (Ti), while some heavy metals are essential to maintain the metabolism of human body, such as copper (Cu), Zinc (Zn) and selenium (Se) (Dartmouth toxic metals). Heavy metals are agricultural pollutants because they tend to bio accumulate. Bio accumulation means an increase in the concentration of a chemical in biological organism overtime, compared to the chemical concentration in the environment, compounds accumulation in living things any time they are taken up and stored faster than they are broken down (metabolized) or excreted as a result, they became harmful to the natural ecosystem and human health (Botkin and Killer 1995). The effect of these heavy metals depends on the particular element cadmium (Cd) for example derives its toxicological properties from its chemical similarly to Zinc (Zn) an essential micronutrient for plants, animal and humans. Cadmium is biopersistent and once absorbed by an organism remains resilient for many years (over decades for humans). (Chaney *et al* 2003). The presence of these heavy metals in the soil and grass makes other nutrients in accessible for plants uptake which results in stunted growths yellowing of the leaves, prone to diseases and other deficiencies, they also have effects on soil which result in the degradation of soil fertility, unproductive destroys soil microorganisms (Eric, 2007).

Accumulation of heavy metals in roadside soil may not only result in heavy metals contamination of soils, but also an increase to human exposure to the heavy metals. Heavy metals in roadside soil can be harmful to the roadside vegetation, wildlife, agricultural and neighboring human settlement. Gamboru Ngala Road consists of heavy human and vehicular activities which contribute to the pollution of the roadside soil. The investigation of soil metals distribution and their influencing factors in topsoil could offer an ideal means to monitor and assess the pollution of soil itself and the overall environmental quality as reflected in soil, hence the need for this study. The aims of this study are to assess the level of pollutants in agricultural environment along Gamboru Ngala in Borno state of Nigeria. While the specific objectives of the study are to:

I. Determine the concentration of some heavy metal such as Pb, Cd, Mn, Fe, Cr, Zn and Cu. In roadside soil along gamborungala Road.

II. LITERATURE REVIEW

Roads are important infrastructure that plays a major role in stimulating social and economic activities. However, road construction has also resulted in heavy environmental pollution (Bai *et al*., 2008).Several researchers have indicated the need for a better understanding of trace metal pollution of roadside soils (DeKimple and Morel, 2000; Manta *et al*., 2002). Trace metals in roadside soils may come from various, human activities, such as industrial and energy production, Construction, vehicle exhaust, waste disposal, as Well as coal and fuel combustion (Li *et al*., 2001).

According to Adefolalu (1980) and Mabogunje (1980), in developing countries like Nigeria, improved road accessibility creates a variety of ancillary employment which range from vehicle repairs, vulcanizes and welders to auto-electricians, battery chargers and dealers in other facilitators of motor transportation. These activities send trace metals into the air and the metals subsequently are deposited into nearby soils, which are absorbed by plants on such soils. Trace metals in the soils can also generate airborne particles and dusts, which may affect the air quality (Gray *et al*., 2003). Among the numerous environmental pollutants, an important role is ascribable to heavy metals whose concentration in soils, water and air are continuously increasing in consequence of anthropogenic activity (Francek, 1992).

Soil is a natural body comprised of solids (mineral sand organic matter), liquid, and gases that occurs on the land surface, occupies space, and is characterized by one or both of the following; horizons, or layers, that are distinguishable from the initial material as a result of additions, losses, transfers, and transformations of energy and matter or the ability to support rooted plants in a natural environment (Patricia, 2003). Soil formation, is the combined effect of physical, chemical, biological and anthropogenic processes on soil parent material. Soil is said to be formed when organic matter has accumulated and colloids are washed downward, leaving deposits of clay, humus, iron oxide, carbonate and gypsum's, as a result, horizons form in the soil profile. These constitutions are moved (translocated) from one level to another by water and animal activity, the alteration and movement of materials within a soil causes the formation of distinctive soil horizons, the soil formation proceeds influenced by at least five classic factors that are intertwined in the evolution of a soil, they are parent material, climate, topography (relief), organisms and time. When reordered to climate, relief, organisms, parent material and time, they form the acronym (Milford *et al*., 2001).

In addition, organic and inorganic fertilizers pesticide and sewage slued (Biosolides), heavy metals in bio-solid may be found in the organic form, or may be organically completed, which could affect these chemical reactions in soil. Many studies have been made on lead; little attention has been focus on the contamination of other trace metals in the roadside environment (Lagerwerff and Specht, 1970). Metals such as Fe, Cu and Zn are essential component of many alloy, pipe, wire and tyre in motor vehicles and are released into the roadside environment as a result of mechanical abrasion and normal wear and tear (Harrrison *et al*., 1981). Soil tends to accumulate metals on a relatively long term basis since many metals in the soil are so mobile. These explain the overall higher contamination level of metal in the soil and why in sampling the top layer of soil should be taken (Ho and Tai, 1988). Although, there have been considerable number of studies on the concentrations of heavy metals in roadside soils, vast majority have been carried out in developed countries with long histories of industrialization and extensive use of leaded gasoline since1935 (Otte *et al*., 1991; Mateu *et al*., 1995), studies carried out in developing countries such as Nigeria and data on pollutant metal concentrations and distribution in such country is extremely scarce. The environment mobility and bioavailability of metals in soil is dependent upon the physiochemical forms in which the metal is associated with the soil. Wilson *et al*., 2003 reported that the chemical association Pb, Cd, Mn, Cu, and Zn in soil as investigated by a sequential extraction procedure showed that Pb and Zn are predominantly associated with carbonate and Fe, Mn oxide. Cu is largely present in organic association, only Cd is found in exchangeable fraction. (Chaney *et al*, 2003)

The source of heavy metals in the soil is the deposition of atmospheric aerosol particles but in the urban environment, these particles originate mainly from traffic emission from industrial construction activities and from the flaking of paint. (Radjevic and Bashin, 1999). Dust in urban environment is of great concern because of the presence of much toxic substances like heavy metals some heavy metals are pollutant with harmful influence on natural ecosystem and human health. Although others are essential nutrients heavy metal pollution of terrestrial ecosystem is of great concern. Among the major heavy metal that poses as hazard to the natural ecosystem and human health are Hg, Pb, Cd, Ni, As, Se, Cr, Co, Cu, Zn, and Fe (Botkin and Killer, 1995). It was observed that soil samples appeared to exhibit little Ni and Cr. The concentration of Cu, Pb, Cd, and Zn were also analyzed Atomic absorption spectrophotometry (AAS) in surface soils and plants samples taken from both sides of the major high way connecting Amman with the southern part of Jordan. Elevated level of the study element was found in both soil and plants on the east side and on the west side of the road compared with the background levels. Some of the more common soil contaminations are chlorinated hydrocarbons (CFH) heavy metals (such as Cr and Cd found in rechargeable batteries and lead paint, awaiting fuel and still in some countries, gasoline, zinc, arsenic and benzene). A series of press reports in (2001) culminating in a book called fateful Harvest unveiled a widespread practice of recycling industrial by products into fertilizers resulting in the contamination of soil with various metals (Sakagami, *et al.*,1982).

The effect of heavy metals pollution on terrestrial systems, bacteria are frequently isolated from such environments and metal tolerance of metal salts, further many soil bacteria are intrinsically resistant to high concentration of heavy metals. Thereby precluding the need to adapt to metal concentration of heavy metals, regards of whether or not the soil were contaminated with metals (Cheney, *et al.*,, 1993).

Heavy metal pollution can arise from many sources but most commonly arises from the purification of metals, e.g., the smelting of copper and the preparation of nuclear fuels. Electroplating is the primary source of chromium and cadmium. Cadmium, lead and zinc are released in tiny particulates as dust from rubber tires on road surfaces; the small size allows these toxic metals to rise on the wind to be inhaled, or transported onto topsoil or edible plants (Abdul-Wahab, *et al.,* 2011). Motivations for controlling heavy metal concentrations in gas streams are diverse. Some of them are dangerous to health or to the environment (e.g. mercury, cadmium, lead, chromium), some may cause corrosion (e.g., lead), some are harmful in other ways (e.g. arsenic may pollute catalysts) Within the European community the eleven elements of highest concern are arsenic, cadmium, cobalt, chromium, copper, mercury, manganese, nickel, lead, tin, and thallium, the emissions of which are regulated in waste incinerators (John H. Duffus, 2002).

Some of these elements are actually necessary for humans in minute amounts (cobalt, copper, chromium, manganese, nickel) while others are carcinogenic or toxic, affecting, among others, the central nervous system (manganese, mercury, lead, arsenic), the kidneys or liver (mercury, lead, cadmium, copper) or skin, bones, or teeth (nickel, cadmium, copper, chromium).Through precipitation of their compounds or by ion exchange into soils and mud's, heavy metal pollutants can localize and lay dormant, which can have severe effects on the environment. Unlike organic pollutants, heavy metals do not decay and thus pose a different kind of challenge for remediation. Plants, mushrooms, or microorganisms are occasionally successfully used to remove some heavy metals such as mercury. Plants which exhibit hyper accumulation can be used to remove heavy metals from soils by concentrating them in their bio matter. Some treatment of mining tailings has occurred where the vegetation is then incinerated to recover the heavy metals (Lan).

One of the largest problems associated with the persistence of heavy metals is the potential for bioaccumulation and biomagnifications causing heavier exposure for some organisms than is present in the environment alone. Coastal fish (such as the smooth toadfish) and seabirds (such as the Atlantic Puffin) are often monitored for the presence of such contaminants (Ron Zevenhoven, PiaKilpinen, 2001)

III. METHODOLOGY

Study area

Borno State is located at latitude 13,00^{0}E and 11,30^{0}N. Its population is 4,588,668. It has an area of 69,435 sq km^2 (wikipedia). The samples were collected from five different locations along east central region of the state namely Jere, Mafa, Marte, Dikwa and Ngala local government area.

Sample Collection Point

Soil Samples were collected using Per-cleaned plastic container into polythene bags to minimize sample contamination. Samples were collected from five different sites associated with heavy traffic and labelled as (A, B, J, D and M) along Gamboru Ngala Road, Borno State, Nigeria. **A** represents Ngala local government area, **B** represents Marte local government area, **D** represents Dikwa local government area, **J** represents Jere local government area and **M** represents Mafa local government area. Surface soil samples were collected at various depths of (0-5cm, 5-10cm and 10-15cm) as well as of distance of 30, 60 and 90meters from the main road, while samples at 2000meter from main road serve as control.

Sample Preparation

All roadside soil samples were dried and sieved using mesh sizes 2mm in diameter, the samples were then placed in clean plastic bags, sealed and labeled.

Digestion of soil samples

One gram (2g) of the sieved samples was being weighed in to a 125ml flask. The samples were digested using conc. Perchloric acid (4ml), conc. Nitric acid (10ml) and sulphuric acid (2ml). The content were thoroughly mixed and digested on hot plate and heated gently at low temperature of 55^{0}C, while heating continued until white dense fume is observed. The solutions were allowed to cool and 40ml of distilled water were added to it, then it was further boiled for about 1 minute at a moderate temperature of 55^{0}C. The solution were allowed to cool finally and then filtered into a 100ml volumetric flask and made up to the mark with distilled water. The digested samples were kept in plastic bottle with cover and refrigerated.

Elemental Analysis of samples

Determination of Pb, Cd, Mn, Fe, Ni, Cu, Zn, Na, K and Ca. were made directly on each final solution using Perkin – Elmer Analysis 300 Atomic Absorption Spectrophotometer (AAS).

Calibration solution

Standard solution of Fe, Zn, Cu, Mn, Cd, Ni, Pb, Na, Ca and K. were prepared according to Sc 2000 manufacturer procedure for Atomic Absorption Spectrophotometer to be used. A known 1000mg/L concentration of the metal solution was prepared from their salts.

Determination of Organic Carbon and Organic Matters

1g of air-dried (passed through 0.5 mm sieved) soil samples was weighed into a 250ml conical flask. 10ml of 1N potassium dichromate was added with help of a clean pipette, using a clean measuring cylinder. 20ml of concentrated sulphuric acid was added, after cooling, 100ml of distilled water was added followed by 10ml of orthphosphoric acid and 0.2g of NAF (sodium fluoride) and 5 drops of diphenylamine indicator was added which turned the colour to deep violet. The excess chromic acid was then titrated with 0.5 N ferrous sulphates. The end point was recorded as the colour changed from deep violet to deep green, the samples procedure was repeated on the blank (without soil). The amount of soil sample was then recorded and the strength of the $FeSO_4$ was determined and finally, the %OC oxidized by potassium dichromate was calculated using formulae below; %OC = B-T*F/W *0.39s

Where;

B= Amount of 0.5N $FeSO_4$ solution required in blank titration of samples.

T= Amount of 0.5N $FeSO_4$ solution required in the titration of samples.

F= Strength of ferrous sulphate.

W= Weight of soil sample used.

Data Handling

Data collected were subjected with one-way analysis of variance (ANONA) to assess whether heavy metals varied significantly between location and distances from the road, possibilities less than 0.05 ($p<0.05$) will be considered statistically significant.

IV. RESULTS

Figure 4.1present Lead concentration of soil sample collected from Jere, Mafa, Dikwa, Marte and Ngala local government areas in Borno state at different distance and depth. Jere has a high concentration in all the depth and Mafa has a lowest concentration at all the depth while Marte has a high concentration in the depth of 5cm and least conc. 5-10 and 10-15cm. Dikwa also a high concentration in 5-10 and 10-15cm, while a least concentration in 0-5cm. Ngala has a lowest concentration in the depth of 10-15cm. At distance of 60 metres the concentration of lead in Jere has a high concentration in the depth of 5-10 and 10-15cm followed by Dikwa, and the lowest concentration was Marte at the depth of 0-5 and 10-15cm. while Ngala has a high concentration in the depth of 5cm and least concentration was at a depth of 5-10cm and 10-15cm. At distance of 90metre the concentration of lead was determining the highest concentration in all the depth at all local governments. While at distance of 2000metre which serves as control, the concentration of lead in all the local government are very low, Marte and Dikwa has a high concentration in all the depth followed by Ngala and Jere, Mafa has a lowest concentration in all the depth.

Figure 4.2 present Cadmium (Cd) concentrations which have the lowest concentration in all the distance and depth, at 30metre only Ngala has a high concentration at the depth of 5-10cm, the followed by Marte at a depth of 5cm and 10cm, while Dikwa and Jere has a lowest concentration in all the depth. At distance of 60metre Mafa, Marte and Dikwa has a high concentration in the depth of 10-15cm, and lowest concentration in 0-5cm depth, while Jere and Ngala has a lowest concentration in all the depth. At distance of 90metre the concentration was very low at Jere and Ngala in all the depth, while Mafa, Marte and Dikwa has a high concentration in all the depth. At distance of 2000metre which serves as control point, Ngala and Marte has a lowest concentration in all the depth, while Jere and Mafa has a high concentration at depth of 10cm, Dikwa has a high concentration at depth of 0-5cm.

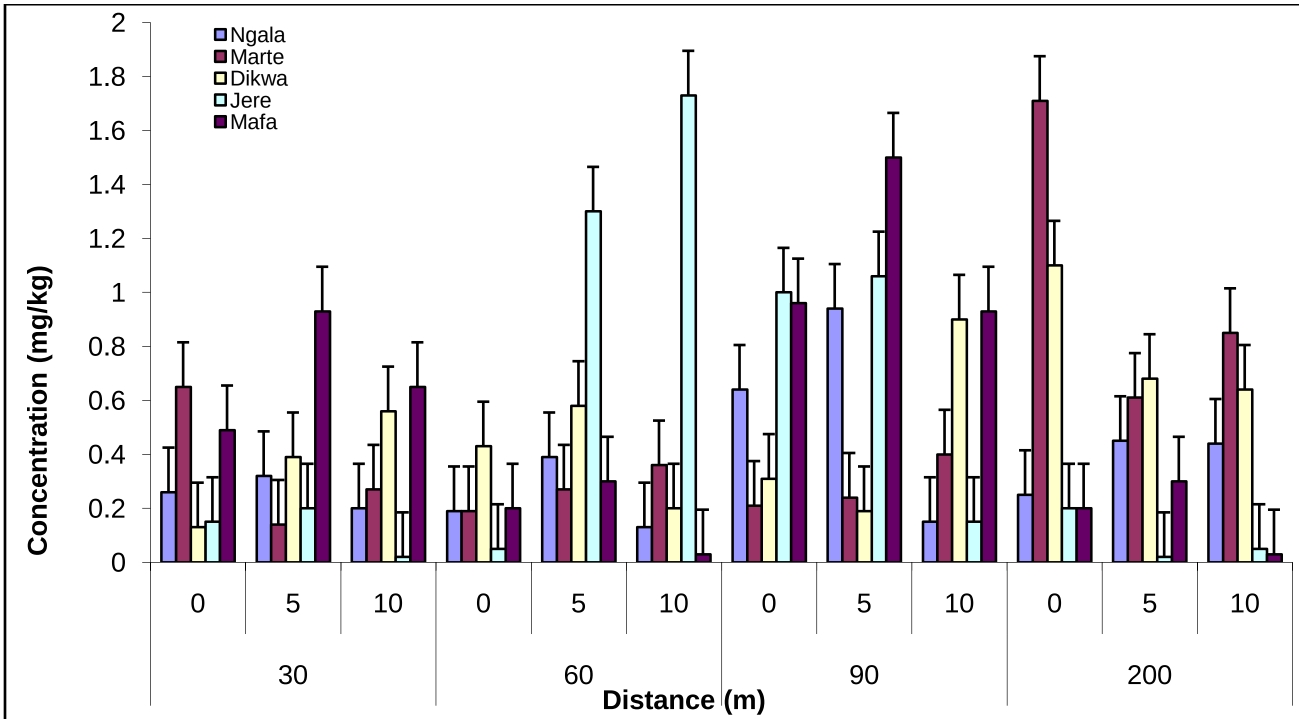

Fig. 1: Lead concentration (mg/kg) in soil samples along Gamboru Ngala Raod, Borno State.

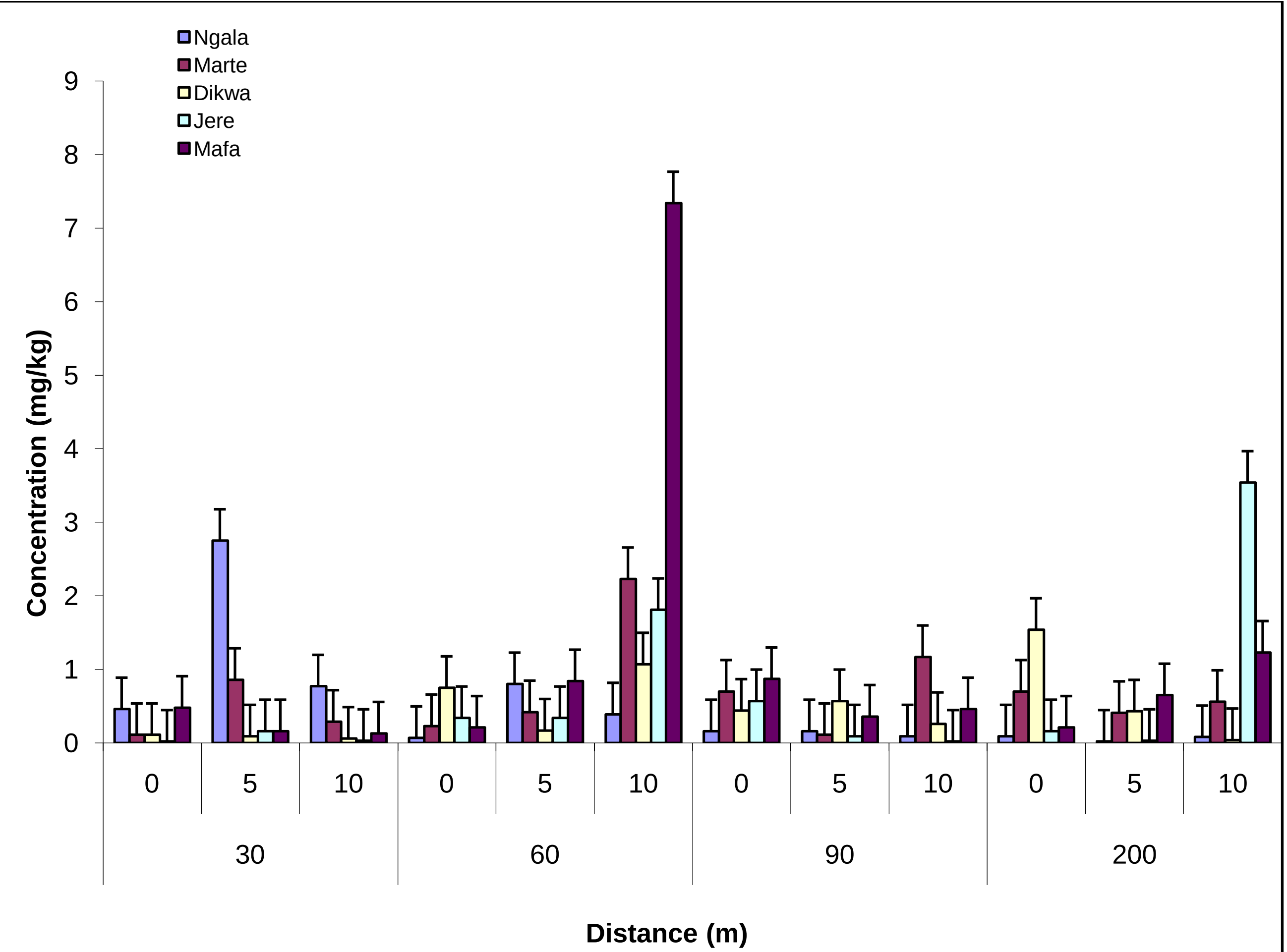

Fig 2:Cadmium concentration (mg/kg) in soil samples along Gamboru Ngala Raod, Borno State.

Figure 4.3 present manganese (Mn) concentrations which have a highest concentration in Mafa in all the depth. At 30metre the highest concentration manganese was at Jere and Mafa, Ngala and Dikwa has a high concentration in the depth of 0-5cm, while Marte the high concentration was in the depth of 10-15cm. At 60metre, Ngala, Mafa and Jere has a highest concentration in all the depth, Marte has a high concentration in depth of 5-10cm and 10-15cm, while Dikwa has the lowest concentration in all the depth. At 90metre, Marte has a highest concentration in all the depth, Jere and Dikwa has a high in the depth of 0-5cm, while Ngala has a high concentration in the depth of 10-15cm and Marte in the depth of 5-10cm. At 2000metre as control point has a highest concentration at Jere and Mafa in all the depth, Dikwa has a high concentration at depth of 5-10cm and 10-15cm,while Ngala and Marte has a lowest concentration in all the depth.

Figure 4.4 present iron (Fe) concentrations which show the lowest concentration in all the local government area, at 30metre only Marte has a high concentration at depth of 0-5cm, Ngala and Mafa has a high concentration in all depth, while Dikwa and Jere has a lowest concentration in all depth. At 60metre Jere has a high concentration in depth of 10-15cm; Mafa has a lowest concentration in all depth. At 90metre, Mafa has a highest concentration in depth of 5-10 and 10-15cm, Jere also has a high concentration in depth of 5-10cm, while Marte has a lowest concentration in all depth. At 2000metre the control point Dikwa has a high concentration in depth of 0-5cm and 10-15cm, Mafa has a lowest concentration in all depth.

Figure 4.5 present chromium (Cr) concentration Mafa has a highest concentration in all depth; at 30metre the highest concentration was observed in Mafa and Jere at all depth, while Ngala, Dikwa and Marte has the lowest concentration in all depth, at 60metre Jere and Mafa has a high concentration in all depth, Ngala, Marte and Dikwa has a lower concentration in all the depth. At 90metre also Jere and Mafa has a high concentration in all depth, Dikwa has a high concentration at 10-15cm depth, while Ngala and Marte observed to be the lower concentration in all depth, at 2000metre control point Dikwa, Jere and Mafa has a highest concentration in all depth, while Ngala and Mafa has a low concentration in all depth.

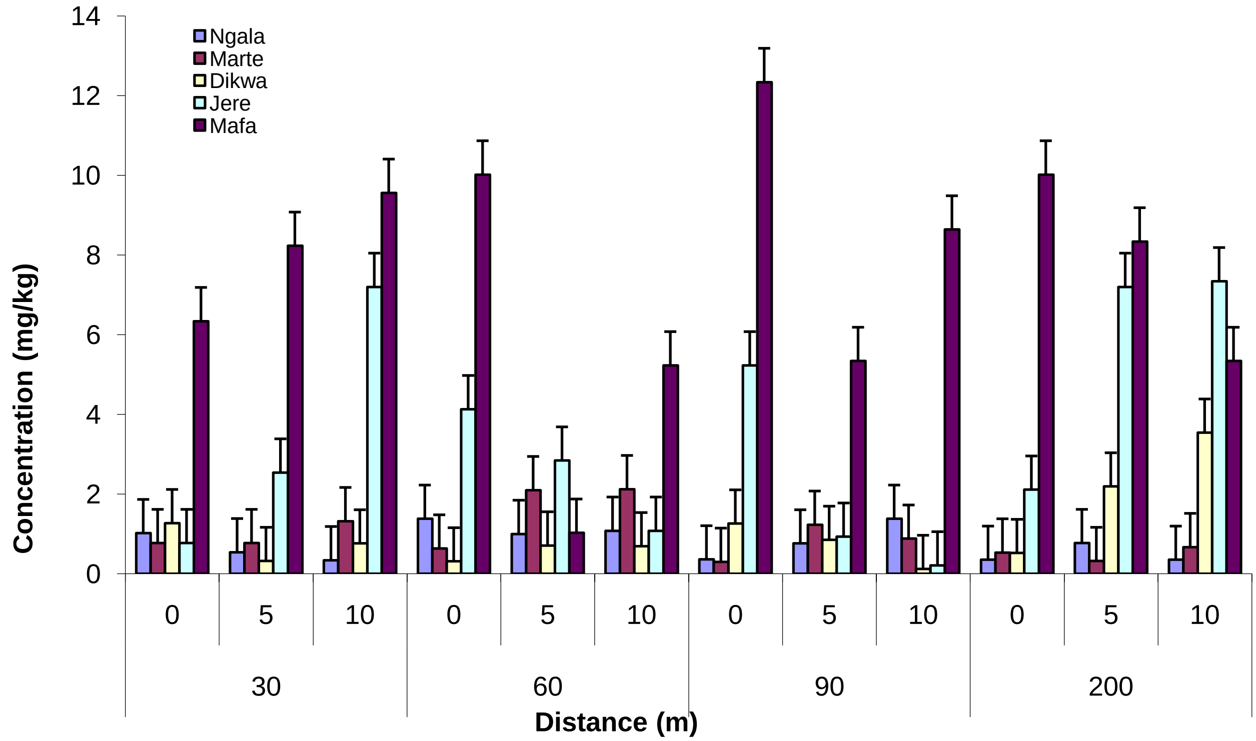

Fig. 3: Manganase concentration (mg/kg) in soil samples along Gamboru Ngala Raod, Borno State.

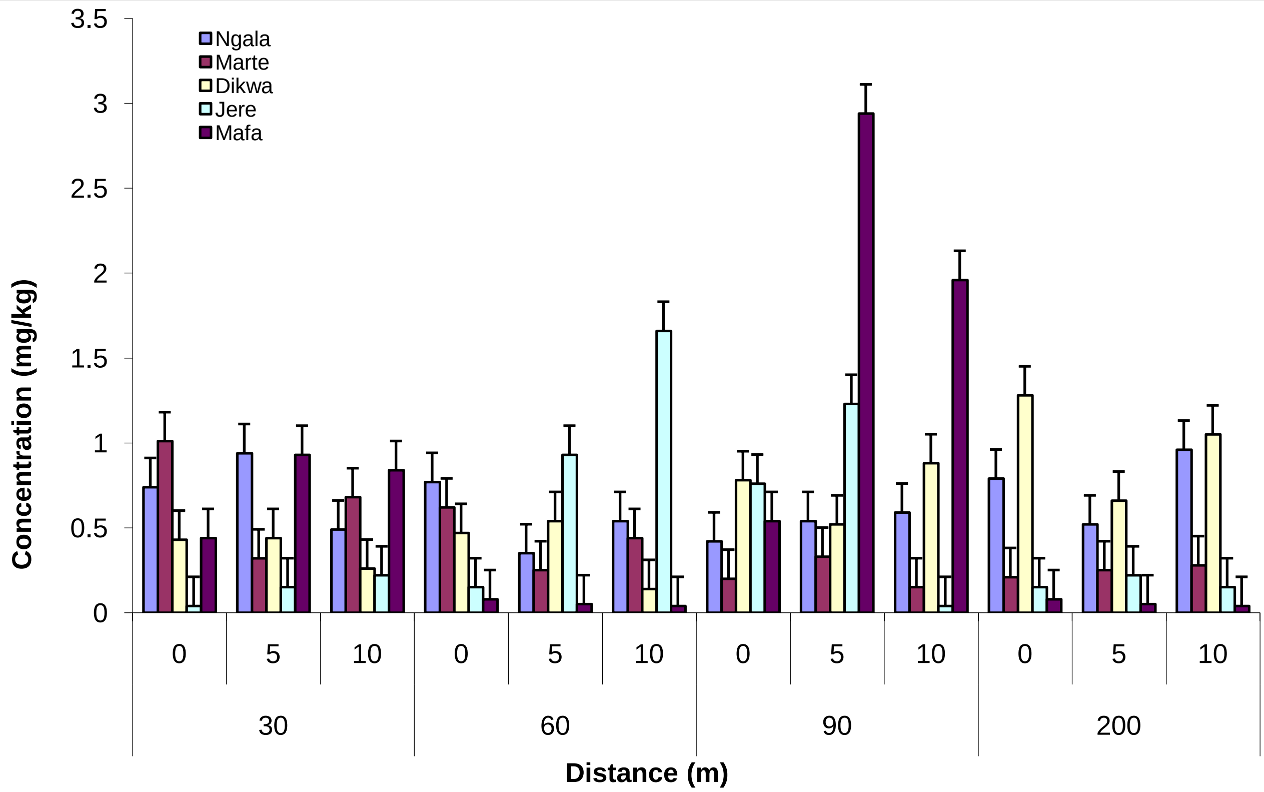

Fig. 4:Iron concentration (mg/kg) in soil samples along Gamboru Ngala Raod, Borno State

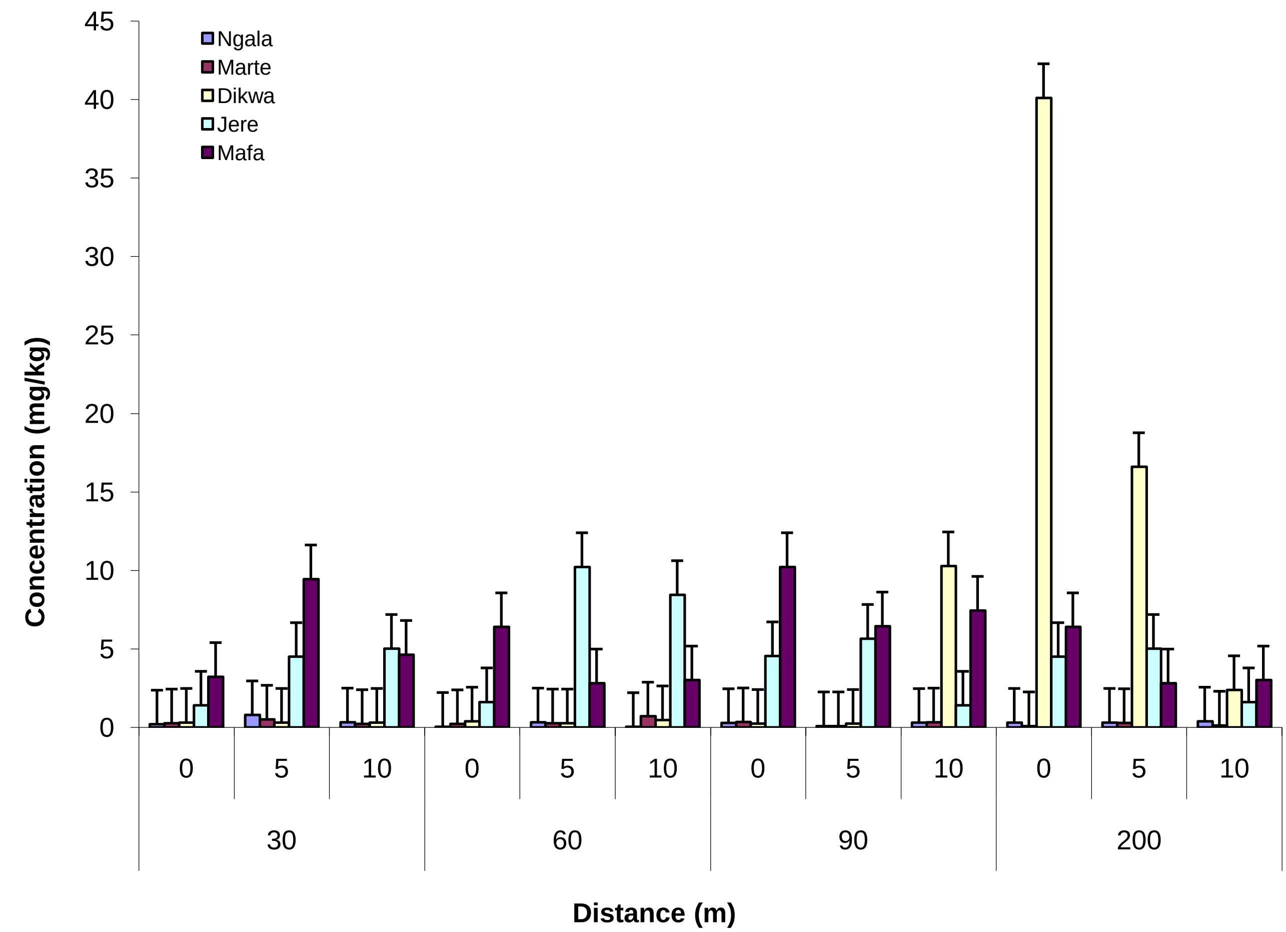

Fig. 5: Chromium concentration (mg/kg) in soil samples along Gamboru Ngala Road, Borno State.

Figure 4.6 present zinc (Zn) concentrations, which observed to be highest at Jere and Mafa in all depth, at 30metre the concentration of Zinc in Mafa and Jere is very high at all depth, while at Ngala, Marte and Dikwa was observed to be low at all depth, 60 meter also Jere and Mafa has a high concentration while Dikwa, Ngala and Marte has a lower concentration in all depths. At 90metre also Jere and Mafa has a high concentration in all depth, Dikwa has a high concentration at 10-15cm depth, while Ngala and Marte observed to be the lower concentration in all depth, at 2000metre control point Dikwa, Jere and Mafa has a highest concentration in all depth, while Ngala and Marte has a low concentration in all depth.

Figure 4.7 present copper (Cu) concentration, which observed to be highest at Jere and Mafa in all depth, at 30metre the concentration of Cupper in Mafa and Jere is very high at all depth, Dikwa has a high concentration in depth of 5-10cm, while Ngala and Marte has a lower concentration in all depths, at 60metre Jere and Dikwa has a high concentration in all depth, Ngala and Jere has a high concentration in depth of 5-10cm, while Marte has a lowest concentration in all depth. At 90metre also Jere and Mafa was observed to have highest concentration in all depths, Dikwa and Marte has a high concentration in depth of 10-15cm, while Ngala has a lowest concentration in all depths, at 2000metre control point Dikwa, and Mafa has a highest concentration in all depth, while Ngala and Jere has a low concentration in all depth, Marte has a high concentration in depth of 0-5cm.

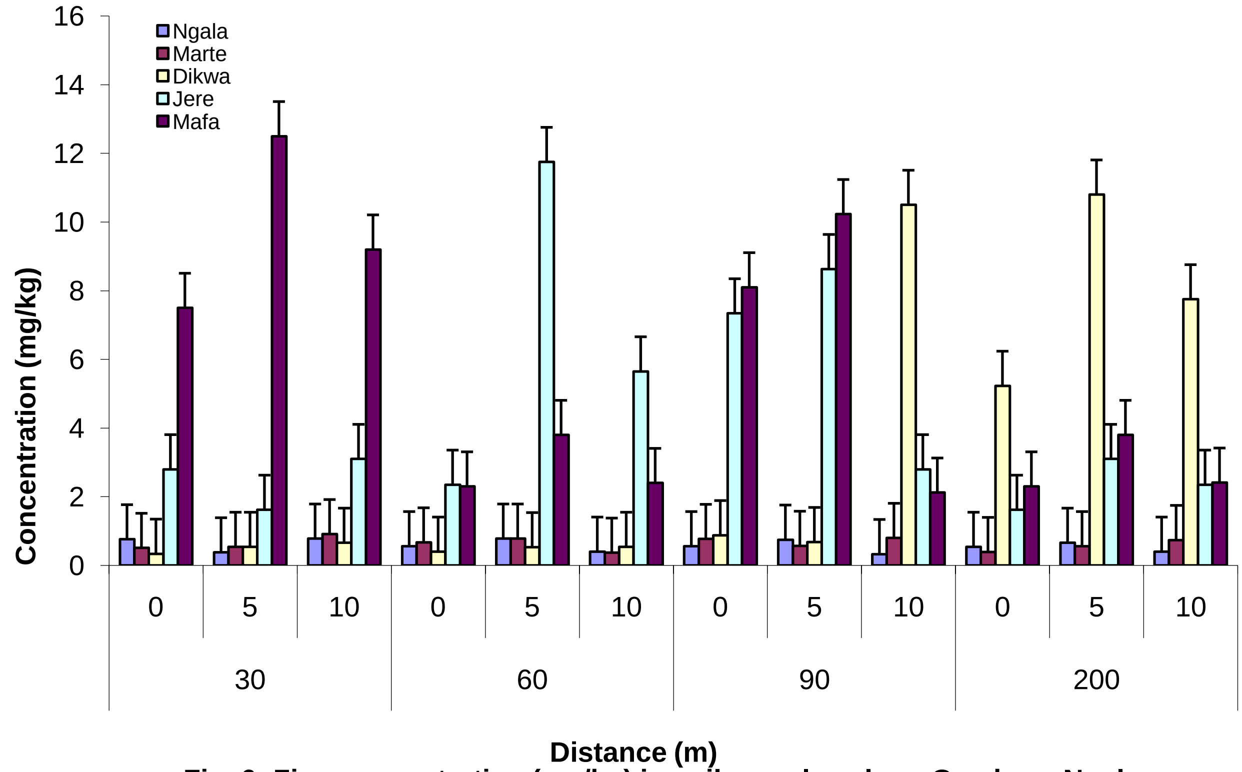

Fig. 6: Zinc concentration (mg/kg) in soil samples along Gamboru Ngala Raod, Borno State.

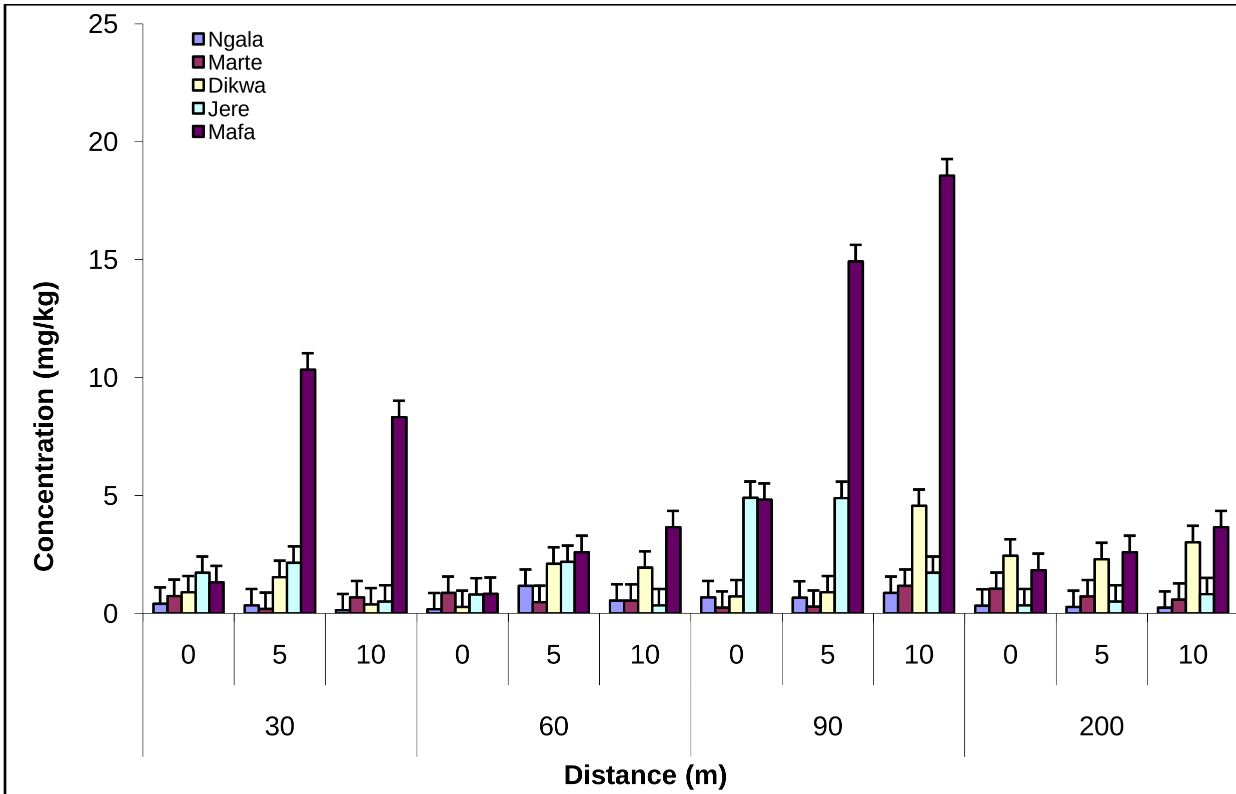

Fig. 4.7: Copper concentration (mg/kg) in soil samples along Gamboru Ngala Raod, Borno State.

4.2 Electrical conductivity (EC mscm^{-1}), Organic carbon (%OC) and Organic matter (%OM) of Roadside soil sample

The figure 4.2.1 presents the mean value of electrical conductivity (EC mscm^{-1}) and percentage of organic carbon and organic matter with respect to depth and distance from the road within NgalaL.G.A in Borno state. The value of electric conductivity (ECmscm^{-1}) of 0.09 to 0.8, Organic carbon of 0.1 to 2.1% and Organic matter of 0.2 to 3.78%. Figure 4.2.2 present the mean value of electrical conductivity (EC mscm^{-1}), and percentage of Organic carbon and Organic matter with respect to distance and depth from the road within Marte L.G.A in Borno state. The mean value of electrical conductivity (EC mscm^{-1}) ranged between 0.07 to 1.2mscm^{-1}, organic carbon 0.5 to 0.8% and organic matter 0.8 to 1.4%. Figure 4.2.3 present the mean value of electrical conductivity (EC mscm^{-1}), and percentage of Organic carbon and Organic matter with respect to distance and depth from the road within Dikwa L.G.A in Borno state. The mean value of electrical conductivity (EC mscm^{-1}) ranged between 0.04 to 0.3mscm^{-1}, organic carbon 0.1 to 0.3% and organic matter 0.2 to 0.6%. Figure 4.2.4 present the mean value of electrical conductivity (EC mscm^{-1}), and percentage of Organic carbon and Organic matter with respect to distance and depth from the road within Jere L.G.A in Borno state. The mean value of electrical conductivity (EC mscm^{-1}) ranged between 0.04 to 0.4mscm^{-1}, organic carbon 0.1 to 0.5% and organic matter 0.2 to 0.8%. Figure 4.2.5 present the mean value of electrical conductivity (EC mscm^{-1}), and percentage of Organic carbon and Organic matter with respect to distance and depth from the road within Mafa L.G.A in Borno state. The mean value of electrical conductivity (EC mscm^{-1}) ranged between 0.2 to 1.7mscm^{-1}, organic carbon 0.3 to 0.5% and organic matter 0.5 to 1.0%.

V. DISCUSSIONS, CONCLUTION

Lead is a toxic element (Arsalan *et al.*, 2004) the highest Pb concentration of 1.73mg/kg was detected at Jere local government area with huge vehicular activities. Lead which is the most concern in environmental heavy metals pollution exhibited high level as we got closer to the high way. The most probable source of lead is the lead particular matter emitted from gasoline vehicles which settles not far from high way. As the distance from the road increased the Pb levels in all the sampling point fall sharply not significantly in all the location, distance and depth. However, some researchers found that lead contamination of soil may reach 100m from the main road (Benerjee, 2003). Zhang (2005) reported lower concentration of Pb in urban soils of Galway in comparisms to present study, also lower concentration of Pb (0.03 and 0.2mg/kg) were found in surface soil of Damuscus and Vietrian (Molter *et al.*, 2005 and Thuy*et al.*, 2000).

Iron was found to be the dominant metals as compared with other heavy metals in the roadside soil. iron supplement are used to treat iron deficiency and anemia parental iron can also be used to treat functional iron deficiency, where requirements for iron are greater than the body's ability to supply iron such as in inflammatory state (Charted, jean-claude *et al*,. 1995), the concentration of iron as the distance from the road increased the iron levels in all the sampling point fall sharply not significantly in all the location, distance and depth, but highly concentrated in Ngala, Marte, Dikwa and Mafa. The variation of Fe in all the sampling point might be due to the differences in traffic density. Result of analysis of variance (ANOVA) confirms not significant difference in the concentration of Fe within the sampling points.

Cadmium is mostly encountered in cadmium-nickel battery production, although it continues to be used in paint as well as in plastics production where it is an effective stabilizing agent. The concentration of cadmium is not significant in all the location, distance and depth in the present study. Cadmium (Cd) concentrations found in this study are higher than dust samples reported by other literature such as 2.9mg/kg in Aqaba, Jordan (Alkhashman 2007). Cadmium (Cd) exhibited high levels at a distance of 90metre which is closer to the high way and decreases data from the present study. It was reported that the cadmium level in car ties is in range of 20 to 90 ug/g as associated with Cd contamination in the process of vulcanization (zhongre*et al*,. 2006). However results defected in the present study shows that Cd was higher than those found in Berltimore (1.06ug/g) Cadmium and Zinc are found in lubricating oils as part of many activities. Result of analysis of variance (ANOVA) confirms not significant difference in all the location, distance and depth within the sampling points.

The highest concentration of manganese (Mn) in the roadside sample of result analysis of variance (ANOVA) confirmed significant differences in the location but statistically not significant in distance and depth. At Mafa and Jere L.G.A (heavy traffic area), high doses of manganese produce adverse effect primarily on the longs and the brain. The deficiency of manganese in the human body can produce several skeletal and reproductive abnormalities in mammals.

Zinc in the roadside soil close to the highway, exhibited elevated of all the sampling point studies the result of analysis of variance (ANOVA) confirmed a significant differences in all the location but statistically not significant in distance and depth. The traffic situation in this area of study might be regarded as a source of Zinc in the roadside soil. Wear and corrosion of vehicle parts (brakes, tiers, radiation and engine parts) might also be one of the potential sources of Zinc in this area of study. The major source of Zinc is probably the attraction of motor vehicle tier rubber excreted by poor road surface and the lubricating oils in which Zinc is found as part of many activities such as Zinc dithiophosphates the concentration of Zinc found in the present study are lower than that of the roadside dust sample reported by other literature such as 499.20mg/kg in Delhi (Benerjee, 2003), 123.2mg/kg in Karak, Jordan (Al-khashmam 2004).

In general, Chromium (Cr) concentration in soil samples of roadside soil in different location, the result of analysis of variance (ANOVA) confirmed that there are no significant differences in distance and depth while in the location, there is highly significant in Dikwa, Mafa and Jere, but significantly in Ngala and Marte. The variation of iron in all the sampling points might be due to differences in traffic density.

Conclusion

From the study carried out it was observed that in all the sampling points, Fe, Zn, Cu and Mn showed the highest concentrations in the roadside soil. The concentration of all the metals in the five sampling sites decreased exponentially with distance from the road and drooped to the level at about 90metres. Similarly, mean concentration of Fe, Cu, Mn and Zn were significantly higher around Jere, Mafa and Dikwa L.G.A than in Marte and Ngala L.G.A, the pHof the roadside soils from all the sampling points ranged from 6.33 to 7.77 which give rise to metal solubility down the soil profiles. The values of the metals in the present study suggest that traffic activities are major source of these metals in the roadside soil.

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