# COMPARATIVE ANALYSIS OF *Tectona grandis* AND *Acacia auriculiformis* EFFECTS ON THE TOPSOIL PROPERTIES IN A RAINFOREST ECOSYSTEM OF SOUTHERN NIGERIA

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## ABSTRACT
The study investigated the effects of teak and acacia plantations on topsoil properties in a rainforest ecosystem of Southern Nigeria. The study established ten 10m x 10m quadrats in each plantation and the natural forest which was the control. Ten soil samples were gotten in each plantation Laboratory analysis was done on particle size composition, porosity, water holding capacity, pH, organic C, N, P, K, Ca, Mg, Na, Pb, Cd, Zn, Cu, Mn, and Fe. Results showed that the exchangeable acidity was very high in soils under acacia with mean value of 1.03 cmolkg-1. The concentrations of Ca, Organic C and N were higher in soils under teak and acacia plantations than the natural forest. Moreover, the exchangeable acidity was very high in soils under acacia (1.03 cmolkg-1). The concentrations of Pb, Cd, Cu and Zn were higher in soils under plantation than the natural forest. The study recommended that mulching of soil should be encouraged and the periodic monitoring of the soil fertility status should be done as the plantations grow older.

**Keywords:** Tectona grandis, Acacia auriculiformis, Rainforest ecosystem, Rivers State.

## 1. INTRODUCTION
Tropical forests are disappearing at alarming rates owing to deforestation for extraction of timber and other forests products (Devi and Yadava, 2006; Eludoyin, 2016). As a result, many native trees have been adversely affected. However, establishing forest plantations in the tropics to meet the ever increasing wood requirement of the society has gained acceptance since the beginning of the industrial revolution (Kumar 2011). Most often, exotic tree species are introduced species which are widespread in tropical and subtropical countries because of their ability to be used in a forest degraded environments as reforestation species (Nyland, 1996; Apel, 2004). Exotic trees can adapt easily to variable site conditions while many are considered economically viable because of their fast growth characteristics (Ogbonna et al, 2010); but they were established without prior long term trials to evaluate their effects on the ecosystem especially soil (Aborisade and Aweto, 1990). Plantations have become one of the most important forms of industry development over the decades and gaining popularity in the tropics (Aweto, 2009). In West Africa, most of the plantations are of fast growing exotic trees such as *Tectona grandis*, *Gmelina arborea*, *Pinus sp*., *Eucalyptus sp.* while the indigenous trees include *Nauclea*

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*diderichii*, *Triplochiton scleroxylon*, *Terminalia ivorensis* and *Terminalia superba* (Adekunle *et al*., 2011).

*Acacia auriculiformis* is a fast growing nitrogen fixer and belongs to the family of *Leguminosae* (Ahamd, 2002). *Acacia auriculiformis* is an attractive species for plantation as it grows satisfactorily even on unproductive sites (Awange and Taylor, 1993). *Tectona grandis* is a forest tree with a distinct quality (Egbuchua et al, 2001) from the family Verbenaceae (Ball et al, 1999) which is widely planted in the tropics (FAO, 2010) with a significant economic potential which include exotic timber species used for ship-building furniture and carving (Kaosaard, 1981; (Niskanen, 1998). The functions of the plantation cannot be over emphasized and these include purification of air and water, regulation of water flow, detoxification and decomposition of waste, generation and renewal of soil fertility, carbon sequestration, biodiversity conservation, moderation of temp extreme, climate stabilization, wind break, support for diverse culture and esthetic beauty and landscape enrichment (Daily, 2007). In spite of all these management advantages, plantation as a form of agroforestry especially fast growing single tree species result in modification or soil degradation (Iwara et al, 2013). Studies in Nigeria have reported the influence of the plantation of exotic species like *Tectona grandis*, *Gmelina arborea*, *Pinus caribea* and *Treculia africana* on soil fertility (Eludoyin, 2016). Badejo and Ola-Adams (2000) reported the effects of *Gmelina arborea*, *Pinus caribea* and *Treculia africana* on soil fertility whereby the silt and clay contents showed little or no variation under the three plantations but the soil pH and soil organic matter were higher under *Gmelina arborea*. Aborisade and Aweto (1990) compared the effects of *Tectona grandis* and *Gmelina arborea* on a forest soil in the south-western Nigeria in relation to logged forest soil and it was observed that the concentrations of total nitrogen, exchangeable calcium, magnesium and potassium were greater under forest soil while the concentration of available phosphorus was similar under all the three ecosystems. Akachuku and Amakiri (1992) reported the variations in populations of some soil micro-organisms with age of *Gmelina arborea* plantations in Oluwa Forest Reserve concluding that the highest number of species of micro-organisms was observed in the soil of the oldest stand. Thus, it is evidently reported that several exotic tree species have effects on soil especially in the South western Nigeria but the comparative study on the effects of *Tectona grandis* and *Acacia auriculiformis* on physical and chemical properties of soil is still very rare in the literature especially in the rainforest zone of the South-south Nigeria. This study therefore investigated the physical and chemical properties of topsoil under *Acacia auriculiformis* and *Tectona grandis* in the rainforest region of South-south Nigeria.

## 2. MATERIALS AND METHODS

### Study Area

The study area was Songhai Initiative Farm, Tai Local Government Area, Rivers State, Nigeria. The study area lies between latitudes 4º 43'N and 4º 43' 56''N and longitudes 7°18' E and 7° 18' 55''E. The study location is found in the sub-equatorial region. It has a tropical climate with a mean temperature of $30^0$C a relative humidity of 80% - 100%, and a mean yearly rainfall of about 2,300mm. The rainfall is always high but varies with seasons (Mmom and Fred-Nwagwu, 2013). The type of vegetation found in the study area is tropical rainforest. The vegetation represents the most luxuriant, the most complex, and the most diverse terrestrial ecosystem the world has known (Ojeh, 2011). The plantations of teak and acacia stands of about 15 years were the experimental plots while the adjoining natural forest was the control plot. All the plots were within the same climatic region, soil and relief. This made comparison of soil properties in acacia plantation, teak plantation and control plot possible.

**Research Design and Sampled Plots**

The research design employed was experimental research design. There were a total of two experimental units (plots) namely acacia stands, and teak stands while the adjoining natural forest served as the control. A block of 100m by 100m quadrat was established in each plantation and natural forest within which ten quadrats of 10m x 10m were laid randomly in a complete randomised block design. The sample plots were delimited with pegs tagged with red coloured ribbon for easy identification of the boundaries.

**Acquisition of Soil Samples and Laboratory Analysis**

Soil samples were collected from three plots which included Acacia plantation, Teak plantation and natural forest in each 10m x 10m quadrats. Five soil samples were collected in each quadrat (one at the center and the other at the four corners) at the topsoil (0.15cm) with the use of soil auger. The soil samples were bulked together in a basin and properly mixed together within which a composite sample was collected into a well-labelled polythene bags to prevent loss of moisture and brought to laboratory for various analyses. A total of ten soil samples were collected each plantation and natural forest. The soil samples were air-dried and carefully sieved with 2mm diameter mesh after which standard laboratory techniques were used to determine the selected physical and chemical properties of soil. Soil samples were analysed for particle size composition using the hydrometer method of Bouyoucous (1926), bulk density and total porosity using core method (Igwe, 2001). Exchangeable bases which include calcium (Ca), Potassium (K) and Sodium (Na) were determined by flame photometry and exchangeable magnesium (Mg) by atomic absorption spectrophotometer. Cation Exchange Capacity (CEC) was determined using ammonium acetate method (Vazques et al, 2008) and total Nitrogen (N) was determined by Kjeldahl steam distillation (Aweto and Enavrube, 2010). Available phosphorus (P) was extracted with Bray P solution using Murphy and Riley Method (Uye and Matsuda, 1988). Soil pH was measured potentiometrically in 0.01M calcium chloride solution using 1:2 soil/water solutions while organic carbon was determined by Walkey and Black's rapid titration method (Walkey and Black, 1934).

## 2. METHOD OF DATA ANALYSIS

Descriptive statistics was used to describe the mean values of each soil property. The variations in the soil properties between acacia and teak plantations were tested using the pairwise t-test while the variations in soil properties among acacia, teak and natural forest were tested using analysis of variance (ANOVA).

## 3. RESULTS AND DISCUSSION

**Effects of Teak and Acacia Plantation on Soil Physical Properties**

The effects of soil teak and acacia plantations on the particle size composition (clay, silt and sand), bulk density, porosity and porosity are discussed under soil physical properties.

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The particle size composition is presented in Table 1 whereby it is discovered that the mean value of clay was 14.20% in soils under teak plantation with a range between 10.2% and 16.8%, 17.80% under acacia plantation ranging between 14.8% and 24.8% while the clay content was 21.20% under the natural forest with a range between 16.8% and 26.8%. The silt content was highest under teak plantation with a range between 5.4% and 9.4%; and mean value of 6.80% while the least was discovered under the natural forest with a mean value of 2.80%. The sand content was the highest among the particle size composition and it was observed that sand content in soils under teak plantation was 79.00% ranging between 75.8 % and 81.8 %. The mean value was 76.50% under acacia with a range between 71.8% and 73.8% while the sand content under natural forest ranged between 73.8% and 81.8% with a mean value of 76.00%. Although, the highest sand content was observed under teak plantation but there was slight variation in the concentration.

The analysis on bulk density reveals that the mean value of bulk density in soils under teak plantation was 1.48 $g/cm^3$, 1.57$g/cm^3$ in acacia and 1.52$g/cm^3$ in natural forest. The bulk density ranged between 1.41$g/cm^3$ and 1.52$g/cm^3$, 1.51$g/cm^3$ and 1.62$g/cm^3$, and 1.41 and 1.65$g/cm^3$ in soils under teak plantation, acacia plantation and natural forest respectively. There was a slight variation in the bulk density levels between teak plantation and acacia plantation but the bulk density in soils under acacia was higher than that of teak plantation. The higher bulk density under acacia plantation may be attributed to the increase in the soil erosion as the leaf size of acacia tree is less broad and compact than that of teak tree.

The analysis of porosity in soils under teak plantation, acacia plantation and natural forest shows that the porosity ranged between 41.29% and 46.51% with a mean value of 43.27 % in teak plantation. Porosity also ranged between 40.36% and 42.76 with a mean value of 41.33 % in acacia plantation while the range of porosity in natural forest was between 40.53% and 46.46% with a mean value of 42.74%. It is discovered in the analysis that porosity was higher in the teak plantation than acacia plantation. In addition, porosity was highest in the teak plantation in the study area. The higher porosity level in the teak may be attributed to the higher sand content which might have larger pore spaces to enhance higher porosity. There was a slight variation in the porosity level between teak and acacia plantation.

The analysis of water holding capacity shows that the mean value of water holding capacity in soils under teak plantation was 27.32 %, 27.36 % under acacia plantation while it was 26.33 under natural forest. The water holding capacity ranged between 24.33% and 29.71 % under teak planation, 21.08 % and 29.63% under acacia plantation and 21.37% and 29.38% under natural forest. The water holding capacity level was highest in acacia plantation and the least was found in the natural forest. This is due to a fine-textured soil under acacia plantation such as a clay loam, which has mainly micropores which hold water tightly.

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**Table 1: Physical Properties of Soil Properties under Teak, Acacia and Natural Forest**

| Soil Properties | Teak | | Acacia | | Natural Forest | | | |
|---|---|---|---|---|---|---|---|---|
| | Range | Mean±SD | Range | Mean±SD | Range | Mean±SD | F Value | pValue |
| Clay (%) | 10.8-16.8 | 14.20±2.11 | 14.8-24.8 | 17.80±2.87 | 16.8-26.8 | 21.20±3.37 | -3.375 | .008 |
| Silt (%) | 5.4-9.4 | 6.80±1.35 | 3.4-11.4 | 5.80±3.10 | 1.4-5.4 | 2.80±1.64 | 1.168 | .273 |
| Sand (%) | 75.8-81.8 | 79.00±2.35 | 71.8-79.8 | 76.50±2.58 | 73.8-81.8 | 76.00±3.32 | 2.298 | .047 |
| Bulk Density ($g/cm^3$) | 1.41-1.52 | 1.48±0.04 | 1.51-1.62 | 1.57±0.03 | 1.41-1.65 | 1.52±0.06 | .147 | .365 |
| Porosity (%) | 41.29-46.51 | 43.27±2.17 | 40.36-42.76 | 41.33±0.67 | 40.53-46.46 | 42.74±2.03 | 1.245 | .251 |
| Water Holding Capacity | 24.33-29.71 | 27.32±2.24 | 21.08-29.63 | 27.36±3.40 | 24.37-27.10 | 26.33±2.70 | -.031 | .976 |

**Effects of Teak and Acacia Plantation on Chemical Properties of Soil**

The effect of teak and acacia plantation on soil chemical properties is displayed in Table 2. The analysis of pH levels shows that the mean value of pH in soils under teak plantation was 5.95, and 5.76 under acacia plantation consequently 6.03 under natural forest. This analysis reveals that the soil in the entire study area was acidic and it was more acidic in soils under acacia plantation. However, the acidic level under plantation was higher than the natural forest. This indicates that the uptake by plants was high and the biological system was contaminated by the micronutrient metals.

The analysis also reveals that the organic C in soils under teak plantation ranged between 5.135% and 6.142% with a mean value of 5.573%. In acacia plantation, it is revealed that Organic C ranged between 4.956 % and 6.019 % with a mean value of 5.604% while the range of Organic C in natural forest was between 3.260% and 4.068% with a mean value of 3.622%. The highest organic C was discovered in soils under acacia plantation. Generally, the organic C under plantation was higher than the natural forest. This may be due to addition of fertilizers, and Teak and Acacia leaves and branches into the soil.

Total N analysis showed that soils under teak plantation and acacia plantation showed little variation with mean value of 0.556% and 0.559% while there was a significant decline in the Total N of the Natural forest with mean 0.352%. Generally, the Total N under Acacia plantation was higher than the Teak plantation and Natural Forest. This might be attributed to Symbiotic nitrogen fixation and N concentrations in the litterfall of *Acacia*

Natural forest depicts a 1-2% greater Available P concentration in the analysis presented in table 4.8 with mean value 0.6329g $kg^{-1}$ while the available Phosphorus in soils under teak plantation and Acacia showed little variations with mean value 0.6023g $kg^{-1}$ and 0.6232g $kg^{-1}$. . However, the available Phosphorous under Acacia plantation soil was slightly higher than that of Teak plantation. In general available phosphorus in the Natural forest soil showed highest content.

The analysis presented in Table 4.9 reveals that the Exchangeable Acidity in soils under teak plantation ranged between 0.40Cmol$kg^{-1}$ and 0.85Cmol$kg^{-1}$ with a mean value of 0.61Cmol$kg^{-1}$. In acacia plantation, it is revealed that exchangeable acidity ranged between 0.75Cmol$kg^{-1}$ and 1.40Cmol$kg^{-1}$ with a mean value of 1.03Cmol$kg^{-1}$ while the range of Exchangeable Acidity in natural forest was between 0.50Cmol$kg^{-1}$ and 0.92Cmol$kg^{-1}$ with a mean value of 0.73Cmol$kg^{-1}$. The highest exchangeable acidity was discovered in soils under acacia plantation. Generally, the exchangeable acidity under acacia plantation was significantly higher than the teak plantation and natural forest.

The exchangeable Ca in soils under teak plantation has the highest concentration of exchangeable Ca with mean value 2.01Cmol$kg^{-1}$ which ranged between 1.13Cmol$kg^{-1}$ and 2.22 Cmol. In acacia plantation, shows a decline in the amount of Ca concentration with mean value 1.90Cmol$kg^{-1}$ with range between 1.82Cmol$kg^{-1}$ and 1.99Cmol$kg^{-1}$. However, Exchangeable Cain natural forest was between 1.10Cmol$kg^{-1}$ and 1.88Cmol$kg^{-1}$ with a mean value of 1.54Cmol$kg^{-1}$. Generally, the highest exchangeable Ca was discovered in soils under teak plantation. However, the natural forest soil showed the least content exchangeable Ca. The higher content in the plantation was attributed to the active role the plantation plays in pedogenesis. This is in line with the observation of Rathod and Devar (2003).

Table 4.11 shows that the natural forest recorded the highest content of exchngeable K with mean value of 0.26Cmol$kg^{-1}$ while the concentration of K in soils under teak and acacia was 0.17 Cmol$kg^{-1}$ and 0.25 Cmol$kg^{-1}$ respectively.

The exchangeable Mg in soils under teak plantation ranged between0.28 Cmol$kg^{-1}$ and 0.41 Cmol$kg^{-1}$ with a mean value of 0.33 Cmol$kg^{-1}$. In acacia plantation, it is revealed that exchangeable Mg ranged between 0.20 Cmol$kg^{-1}$ and 0.39 Cmol$kg^{-1}$ with a mean value of 0.31 Cmol$kg^{-1}$ while the range of exchangeable Mg in natural forest was between0.26Cmol$kg^{-1}$ and 0.48 Cmol$kg^{-1}$ with a mean value of 0.35 Cmol$kg^{-1}$. The highest exchangeable Mg was discovered in soils under natural forest. According to the results, exchangeable Na concentration of soils under teak plantation, acacia and natural forest ranged from0.48Cmol$kg^{-1}$ to 0.78 Cmol$kg^{-1}$, 0.22 Cmol$kg^{-1}$ to 0.61 Cmol$kg^{-1}$, 0.37 Cmol$kg^{-1}$to 0.57 Cmol$kg^{-1}$ respectively. It was found that the mean value of exchangeable Na concentration in soils under teak, acacia and natural forest were 0.62 Cmol$kg^{-1}$, 0.38Cmol$kg^{-1}$, 0.46 Cmol$kg^{-1}$ respectively. The exchangeable Na level was highest in teak plantation and the least was found under the acacia plantation.

Table 4.14 reveals that the mean value of the concentration of CEC under teak plantation was 3.72 Cmol$kg^{-1}$, while it was 3.86 Cmol$kg^{-1}$ under acacia plantation and 3.36 Cmol$kg^{-1}$ in soils under natural forest. CEC were significantly higher in the plantation soils than the natural forest soil.

The natural forest in the analysis recorded the lowest content of Pb at about 13.00mg $kg^{-1}$ ranging between 10.4mg $kg^{-1}$ to 15.5mg $kg^{-1}$. However, the mean value of the concentration of

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Pb under teak plantation was 53.47mg $kg^{-1}$ while the concentration was 51.62mg $kg^{-1}$ under acacia plantation. The concentration of Cd in the teak and acacia plantations presented in Table 4.16 was 6.60mg $kg^{-1}$ and 7.82mg $kg^{-1}$respectively. However, the concentration of Cd in the natural forest was 2.16 mg $kg^{-1}$. Generally, Cd concentration in the plantation is higher than that in the natural. The analysis presented in Table 4.17 reveals that the concentration of Fein teak plantation exhibited a higher mean value of 365.7mg $kg^{-1}$ rangingfrom308mg $kg^{-1}$ to 345mg $kg^{-1}$ while in acacia plantations the concentration was 352.5mg $kg^{-1}$ which ranging between 319mg $kg^{-1}$ and390mg $kg^{-1}$.In natural forest the concentration of Fewas260.0mg $kg^{-1}$ ranged between 224mg $kg^{-1}$ to 301mg $kg^{-1}$. The result of concentration of Mn in teak plantation recorded the least mean value of 311.5mg $kg^{-1}$ which ranged from 260mg $kg^{-1}$ to 375mg $kg^{-1}$ while in acacia plantation, concentration of Mn was 322.1mg $kg^{-1}$ ranging between250mg $kg^{-1}$ and410mg $kg^{-1}$.In natural forest the mean value of the concentration of Mn was 355.4mg $kg^{-1}$ which ranged between 290mg $kg^{-1}$ and 414mg $kg^{-1}$. Generally, concentration of Mn in the natural forest was higher than the concentration of Mn in the plantation.

The concentration of Cu in teak plantation was 6.29 $mgkg^{-1}$ ranging between 5.36mg $kg^{-1}$ and 7.14mg $kg^{-1}$ while in acacia plantations, concentration of Cu was slightly lower than that of teak with a mean value of 5.88mg $kg^{-1}$.In the natural forest the concentration of Cu was 2.51mg $kg^{-1}$ ranging between 1.56 mg $kg^{-1}$ and 3.90mg $kg^{-1}$.Concentration of Cu in the teak was higher than that in the natural forest and acacia. The analysis reveals that the concentration of Cu was higher in the plantation than the natural forest. The concentration of Zn under teak, acacia and natural forest shows that the concentration of Zn in teak plantation was 5.51mg $kg^{-1}$ ranging between 5.09 mg $kg^{-1}$ to 6.66mg $kg^{-1}$, however, the concentration of Zn in soils under acacia plantation was 3.18 mg $kg^{-1}$ while in the natural forest, the mean value of Znwas1.38mg $kg^{-1}$ ranging between 1.09mg $kg^{-1}$ and 1.79mg $kg^{-1}$.

**Table 2: Chemical Properties of Soil Properties under Teak, Acacia and Natural Forest**

| Soil Properties | Teak | | Acacia | | Natural Forest | | | |
|---|---|---|---|---|---|---|---|---|
| | Range | Mean±SD | Range | Mean±SD | Range | Mean±SD | F Value | pValue |
| pH | 5.8-6.2 | 5.95±0.13 | 5.6-5.9 | 5.76±0.11 | 5.9-6.2 | 6.03±0.09 | 0.241 | .854 |
| Organic C (%) | 5.1-6.1 | 5.8±0.28 | 4.9-6.1 | 5.6±0.36 | 3.3-4.1 | 3.6±0.24 | -.182 | .860 |
| Total N (%) | 0.528-0.635 | 0.556±0.34 | 0.485-0.611 | 0.559±0.37 | 0.315-0.396 | 0.352±0.23 | -.145 | .888 |
| Avail P. (g $kg^{-1}$) | 0.52-0.68 | 0.60±0.54 | 0.53-0.76 | 0.62±0.63 | 0.51-0.81 | 0.63±1.04 | -.684 | .511 |

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|---|---|---|---|---|---|---|---|---|
| Exchangeabl Acidity (Cmolkg$^{-1}$) | 0.40-0.85 | 0.61±0.14 | 0.75-1.40 | 1.03±0.22 | 0.50-0.95 | 0.73±0.15 | -6.599 | .000 |
| Ex Ca | 1.13-2.31 | 2.01±0.33 | 1.82-1.99 | 1.90±0.06 | 1.10-1.88 | 1.59±0.23 | 1.066 | .314 |
| Ex K | 0.07-0.31 | 0.17±0.07 | 0.07-0.41 | 0.25±0.14 | 0.08-0.46 | 0.26±0.15 | -2.088 | .046 |
| Ex Mg | 0.28-0.41 | 0.33±0.04 | 0.20-0.39 | 0.31±0.06 | 0.26-0.48 | 0.35±0.07 | 1.447 | .182 |
| Ex Na | 0.48-0.78 | 0.62±0.09 | 0.22-0.61 | 0.38±0.13 | 0.37-0.57 | 0.46±0.08 | 4.261 | .002 |
| CEC | 2.65-4.21 | 3.72±0.44 | 3.52-4.43 | 3.86±0.29 | 3.01-3.99 | 3.36±0.36 | -.722 | .488 |
| Pb | 46.5-63.3 | 53.47 | 47.5-58.3 | 51.62±3.79 | 10.4-16.7 | 13.0±2.13 | 1.150 | .280 |
| Cd | 4.9-8.1 | 6.60±1.13 | 6.8-9.3 | 7.82±0.87 | 1.4-3.5 | 2.16±0.72 | -2.357 | .043 |
| Fe | 308-436 | 367.7±45.9 | 319-390 | 352.5±23.2 | 219-320 | 260.0±35.4 | .789 | .450 |
| Mn | 260-375 | 311.5±44.8 | 250-410 | 322.1±49.9 | 290-414 | 355.4±43.4 | -.546 | .598 |
| Cu | 5.36-7.14 | 6.29±0.64 | 5.01-6.36 | 5.88±0.40 | 1.56-3.90 | 2.51±0.81 | 1.446 | .182 |
| Zn | 4.37-6.66 | 5.51±0.86 | 2.14-5.96 | 3.18±1.26 | 1.09-1.79 | 1.38±0.22 | 4.863 | .001 |

N=10

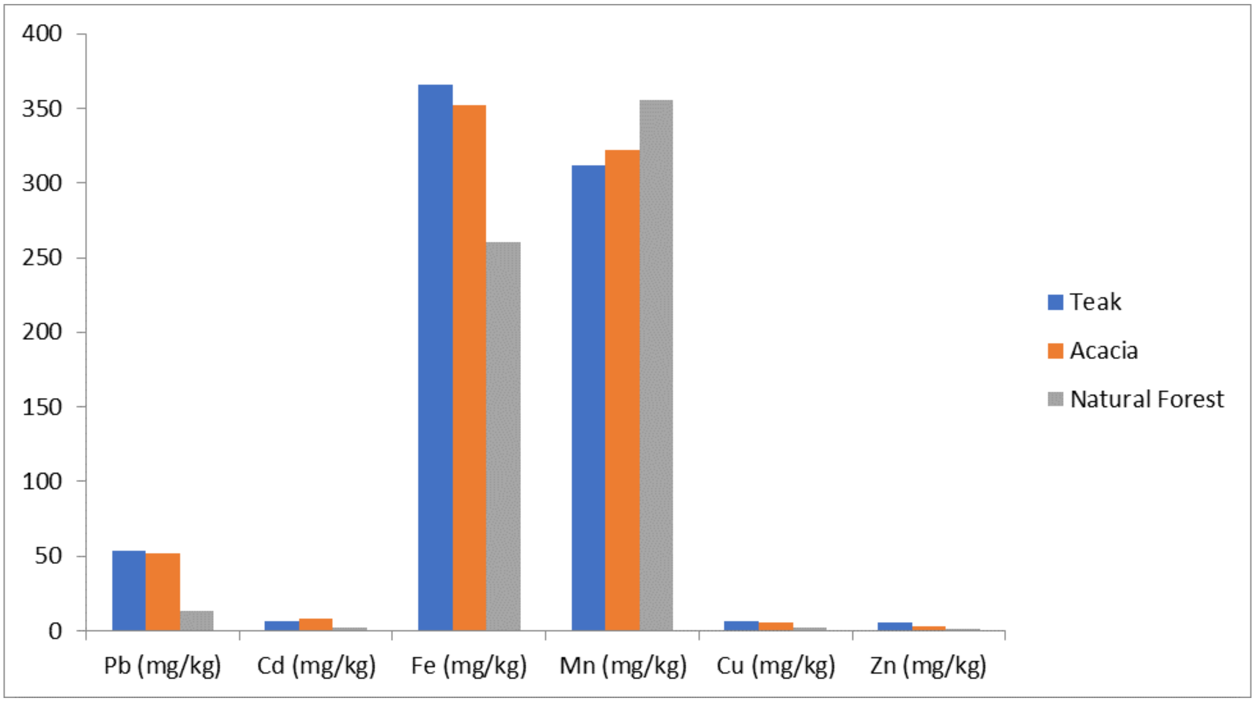


**Figure 1:** Concentration of heavy metals

## 4. DISCUSSION OF FINDINGS

The study area was predominantly sandy and this may be attributed to the parent rock materials derived materials deposited as regolith and the depositional sequence which exhibits massive continental sandstones overlying an alternation of sandstones and clays. The silt under teak plantation was observed to be the highest in the entire study area. This is possible because of the broader nature of the leaf which can protect the incoming sunlight and rainfall droplets that can lead to the breakdown of the soil compactibility and cohesion. The bulk density under acacia plantation was higher than that of teak plantation. The increase in the acacia plantation may be due to the thinner nature of the leaf which may allow more rain droplets which can cause soil erosion and remove soil nutrients. The bulk density level also has might have increased the water holding capacity under acacia plantation because more pore spaces are opened due to soil erosion. The bulk density might have also affected the porosity level because it was reported that high bulk density is an indicator of low soil porosity (Arshad et al, 1996). The lower in the acidity level of pH in the natural forest may be due to the uptake of basic cations in tree biomass (Gebralibanos and Assen, 2013). The organic C and total N increased in the plantations. This is not in consonance to the report given by Aborisade and Aweto (1990) where it was noted that the concentrations of organic carbon, and total N were greater in the 0-15 cm layer of forest soil. The increase in the Organic C and N in the teak and acacia plantations may be due to the litterfalls which may contribute to the increase of the nutrient strenght of soil. The available P reduced in plantations than the natural forest. This may be due to reduction in the litterfall decomposition and mineralization (Awotoye et al, 2011). The concentration of Ca in the plantation was higher than the natural forest. The higher concentration of exchangeable Ca in the plantations in the topsoil may be due to the fact that the teak and acacia plantations take up Ca rapidly for growth. The higher concentration of exchangeable K in natural forest may be due to the low nutrient demand by natural forest trees as compared with fast-plantations (Michelsen et al, 1996). The study showed that Fe and Mn were higher in concentration than other micro nutrients in the study area. This is similar to the findings of Oku et al (2012) who showed that iron is one of the most abundant elements in the earth's crust. Adefemi et al (2007) also reported that Fe has been found to occur at high concentrations in Nigerian soils. The relatively low concentration of zinc in the study area could be linked to the sandy nature of soil (Oku et al, 2012). The higher tree stand per plot in the plantation may be due to the fact that trees in the plantation are grown in a regular distance interval and it may also be due to the forest management methods which include thining and weeding.

## 5. CONCLUSION AND RECOMMENDATIONS

The study has revealed the effects of growing acacia and teak plantations on the soil properties of the South south region of Nigeria. The study has shown that sand content, silt, water holding capacity, organic C, N, Ca, CEC, Pb, Cd, Cu, Zn and Fe have been increased due to plantation while pH, available P, K, Mg and Mn were depleted due to teak and acacia plantation. However, the porosity increased under teak plantation and decreased in acacia plantation while the exchangeable acidity increased in the acacia plantation while it decreased in teak plantation. The study recommended that the levels of heavy metals like Pb and Fe should be closely monitored and reduced to a level that will be useful to both plantations; mulching should be encouraged to reduce the rate of soil erosion in the plantation and periodic study on the soil status in the teak and acacia plantation is highly essential as they grow older.

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