Assessment of Some Selected Physico-Chemical Properties of Soil under Bush Burnt Practice in Kwami Local Government Area of Gombe State, Nigeria

Abstract: This study assess changes in soil properties under bush burn practices under taking by the farmers in Kwami west, Kwami L.G.A, Gombe State. A total of 10 Soil samples that is five from each were collected. The collections were achieved at soil depth, 0-15cm (Top soil) at each site. Standard laboratory techniques were used to determine the various soil parameters: particle size (texture), soil reaction pH, Organic Carbon OC, Total Nitrogen N, Exchangeable bases (Ca, Mg, K and Na). The results obtained were analyzed by using one way analysis of variance (ANOVA) to determine the variability that coexisted among the soil physico-chemical parameters and a T-test was used to compare the variation between soil property for the burned and unburned soils. The results revealed a decrease in the mean values of the following soil parameters at the burned site compared to the unburned site: organic carbon 0.64 and 0.22, total nitrogen 0.29 and 0.006; sodium 0.38 and 0.32. However, an increase was observed in the following soil parameters: Magnesium 1.86 and 3.92; potassium 0.35 and 0.35; and calcium 3.12 and 4.98. These changes were attributed to the application of ash which resulted from burning in the burned site. The study revealed that burning lead to a greater loss in soil fertility and that can ultimately affect optimum crop production and development under a suitable Agricultural Practice.

Keywords: Exchangeable, Properties, Parameters, Unburn Soil, Burn Soil, Nutrients.

INTRODUCTION

Land is under constant threat from human activities which are used annually to prepare for cultivation and this remains one of the largest problems on the quality of environment. Bush burning, whether as a result of wildfire or a controlled burning, affects not only the appearance of the landscape, but the quality of the soil. (Knight 1996). The landscape may quickly recover after a fire, with fresh new growth and emerging seedlings. However, bush burning has a negative effect on soil conditions and soil may take much longer to recover.

Man emerged as a very important geomorphic agent and is capable of changing the environment at a much faster rate than many of the natural processes. (Hamid et al., 2010). Bush burning is a common practice in both savannah and forest zones of Nigeria and has greatly altered the original vegetation. In recent years, our environment which was taken for granted has become a subject of great concern to the society. The biotic and abiotic component of the ecosystem has been shaped over time and continues to do so (Hamid et al., 2010). It is generally believed that the use of fire in Africa started about 50,000 years ago (Adetunj and Onamadu, 2005). Fire is one of the few tools available to an African man for clearing land for cropping and the practice of burning vegetation which are also a shifting cultivation system. In some cases the fire spreads far beyond the confinement of the farmlands uncontrolled and destroys the adjoining forest or wood land areas (Okonkwo et al., 2012).

As more land is being cleared and prepared for crop cultivation, hunting and grazing annually is on the run,
burning has become the easiest and most convenient method quite often employed (Roberts, 2005; Isaac and Hopkins, 2007). All fires, regardless of whether they are natural or human-caused, alter the cycling of nutrients and the biotic, physical, chemical, and temperature characteristics of the soil (Isaac and Hopkins, 2007). Bush burning involves setting of the forest on fire and as forest burns, it goes with huge flame that has thick smoke and layers of ashes are later deposited on the ground. Bush burning is an act that is commonly practiced by farmers in Africa in a process of clearing the forest for planting (Wokocha et al., 2014).

Bush burning affects physical, chemical and biological fertility of the soil. (Knight 1996, Iwuafor et al., 2000) reported decreases in CEC, organic carbon, total Nitrogen and increase in exchangeable K, Mg, Ca, available P, pH, as a results of soil heating. These changes are bound to affect the growth of crops. The growth of crops according to (Cromer 1970) is enhanced by mild heating because of immediate increase in soil productivity. Bush burning is a common practice in Kwami L.G.A. in preparation for crop cultivation, hunting and grazing annually, it has become the easiest and most convenient method quite often employed by the farmers in the area.

There is however, little information on the effects of soil burning, properties and crop performance in the Southern Guinea Savanna. Hence the motivation of this research. The study covered West of Kwami Local Government Area of the State. To evaluate some physico-chemical properties of the soil after burning the bush in preparation for crops cultivation and also to compare the physico-chemical properties between burnt and unburnt plot.

**MATERIALS AND METHOD**

**Study Area.**

Kwami West is located in Kwami local Government Area of Gombe State in North Eastern part of Nigeria. With total land of 1,787 km² (690 Sq/m), and lies between 10°30′N 11°15′E/10.500°N 11.250°E Coordinates in Nigeria. The climate of the study area is characterized by two distinct seasons that is the wet and dry seasons. The wet season start from April to October while the dry season commence from November and ends in March. The total average of rainfall ranges from 600-850mm per annum, with mean annual temperature of 26°C-32°C and relative humidity of 17%-90% (Wokocha et al., 2009).

**Experimental Design, Samples Collection and Treatment**

The experiment was carried out in an arable crops farmland that was not disturbed by fire for the preceding five years. The plot were divided into two each measuring 50x50m in size. One part of the plot, were tagged as Treatment A (tA), which are left intact, while the other part as Treatment B (tB) in which a fire was set on the vegetation. Five Soil samples each were collected at random from the burned and unburned crop farmland respectively and labeled as treatment A that have not been disturbed by fire and another that has been disturbed by fire as treatment B respectively.

Sub-samples from the bulk soil samples were collected and air-dried in the laboratory for two-three days. The sub-samples were gently crushed with porcelain pestle and mortar and pass through a 2mm sieve to remove debris and coarse fragments. The fine earth separates (<2mm soil portion) were labeled and stored in a polythene bags ready for laboratory analyses.

**Soil pH**

20g of soil was weighted and 20ml of distilled water measured put together into a 50ml glass beaker i.e. (1:1) soil to water ratio. This was used to determine the soil pH. The suspension was vigorously stored several times within a period of 30 minutes. The suspension was then allow to stand undisturbed, using standard buffer solution of pH 7.0 and 4.0 the pH meter electrode was then fully immerse into the soil suspension and the pH value was taken within 30 seconds, after immersion.

**Organic Carbon (OC)**

The organic carbon was determined using the chromic acid oxidation method of (Walkey and Black 1934), using 1g of soil which oxidized in 250ml flask with 10ml of normal potassium dichromate solution (NK₂Cr₂O₇) and 20ml concentrated sulphuric acid (Η₂SO₄). The flask was swirled and allowed to stand for 30 minutes, after which 100ml of distilled water was added follow by 5ml of orthophosphoric acid and few drops of diphenylamine indicator. The flask content then titrated with 0.5N ferrous ammonium sulphate and few drops of diphenylamine indicator. A blank determination was also carried out as outlined above except that no soil sample was added.

**Calculations**

\[
\text{Organic carbon } \% = \frac{(Bv - Sv) \times 0.003 \times M \times P}{Wt}
\]

Where \( Bv \) = Blank Value
\( Sv \) = Sample Value
0.003 = Constant
\( M \) = Concentration of ferrous ammonia sulphate
\( Wt \) = Weight of soil sample (1g)
\( P \) = Percentage 100

**Total Nitrogen (N)**

The regular macro-kjedahl was used to determine total nitrogen of the soil samples. 1g of the soil sample was mixed with 20ml concentrated sulphuric acid and tablets of copper sulphate and mixed
catalyst was dropped, after which the mixture was heated in a fume cupboard, for up to 3 hours or until the fume becomes whitish. 10ml of the digest was then distilled in a hoskin distillation unit with 10ml of 40% sodium hydroxide (NaOH) solution. The distillate was then trapped into a flask containing 10ml of 2% boric acid and mixed indicator.

**Calculation:**

Total Nitrogen % = \(0.014 \times \text{VD} \times NA \times 100 \times (TV - BV)\)

Where BV = Blank Volume (Blank titration value)

VD = Volume Digest

NA = Normality of acid mixed in titration

AD = Aliquot of digest distilled

TV = Titre Value (Titration value of sample)

Wt = weight of sample taken.

**Exchangeable Bases (Ca, Mg, K and Na)**

The exchangeable bases were extracted using 1N NH_4 AOC, buffered at pH 7.0. About 10g of 2mm sieved soil sample was weighted into shaking bottle, and 40ml of 1N NH_4 AOC was added and the sample mixture was allowed to stand overnight. Then the sample filtered using whatman No: 2. Another 40ml of 1N NH_4 AOC was added and shake for 30ml filtered, repeated adding another 40ml of NH_4 AOC, finally the volume is made into 150ml with NH_4 AOC. The leached was then stored for the determination of the Bases Ca and Mg, K and Na was read using A.A.S at various wavelength (model VGP 210) Buck scientific.

**Particle Size Distribution Determination Dispersion**

20g of soil sample was transferred in 1L bottle, after then 20ml of dispersing agent was added making the volume to about 400ml with water and the bottle was cap. The bottle was shake overnight for 16hrs on an end-over shaker at a speed of about 30rpm.

**Separation of fraction**

The suspension was passed through 50µm sieve which is placed in a tunnel positioned above a sedimentation cylinder with a stared and clamp. The suspension was then made to 1L with water. The remaining sand fractions on the sieve were washed in to porcelain dish, evaporate on water bath and dried at 105°C for at least an hour.

**Determination of sand fraction**

The dried sand separated was transferred to the top sieve of stacked set of sieves of the following mesh sizes 50µm, 20µm, and 2µm respectively. The sample was sieved for about 10minute on the sieving machine at the settings: Amplitude of 7.0 and interval of 4. Each sieve sand were empty in to a tarred weighing dish by tapping it upside down on the brass tunnel placed above the dish and weighed with 0.01 accuracy (net weight for individual sand fraction).

**Determination of silt and clay fraction**

**Determination of fraction**

**50µm**

50µm fraction sieve was added in to an empty cylinder and covered with a rubber stopper and then shaken well. The cylinder was placed on the table and the stopper was removed, 20ml of the suspension was pipette from the centre of the cylinder. Aliquot was then transferred to tared moisture tin and evaporate on water bath, then dried overnight at 105°C. The tin was removed from drying oven and closed with the lid and cooled in desiccators. Then weighed with 0.001g accuracy (net weight for fraction <50µm).

**20µm**

20µm sieve fraction was placed in to an empty cylinder, then closed and shake. The cylinder was then placed on a vibration free table under the pipette-assembly. After exactly 5minute 20ml of the suspension was pipette and transfer the aliquot to tarred moisture tin, then evaporate on water bath and dried overnight at 105°C. The tin was removed from drying oven, closed with lid and cooled in desiccators. The tin was weighed with 0.001g accuracy (net weight for fraction <20µm).

**<2µm**

After 51/2 hours, 2µm fraction was placed in a cylinder and 20ml of cylinder content was pipette and transfer the aliquot to tared moisture tin as described above for <50µm and <20µm fractions. Evaporate on water bath, then weighed with 0.001g accuracy (net weight for fraction <2µm).

**Blank determination**

A blank cylinder was pipette as described for silt and clay fraction. (Net weight for dispersing agent.)

**Calculation:**

The basis of the calculation is the oven-dry sample weight after all treatments. It is obtained by summation of all individual fractions:

Clay (<2µm) = \((H \times 50) - (Z \times 50)\)

Silt (2-20µm) = \((G \times 50) - (Z \times 50)\)

Silt (20-50µm) = \((F \times 50) - (Z \times 50)\)

Sand (>50µm) = \(A + B + C\)
Sample weight = K + L + M + N.....................................................(all weights in gram)

Where
A through C = weight individual sand fractions
F = weight 20ml pipette aliquot of fraction <50µm
G = weight 20ml pipette aliquot of fraction <20µm
H = weight 20ml pipette aliquot of fraction <2µm
Z = weight 20ml pipette aliquot of blank
The proportional amount of the fractions is now calculated as:
%Clay (<2µm) = K x 100
Sample wt.
%Silt (20µm) = L x 100
Sample wt.
%Sand (>50µm) = N x 100
Sample wt.

Statistical Analysis
The results obtained was analyzed using SPSS of version 20.0, ANOVA and T-test was employed to describe the variation among the burn and unburned soil of the study area. The significance difference was tested at 0.05 level.

RESULTS AND DISCUSSION
This chapter presents results and data that are analyzed in tables. The results obtained from the burned and unburned soils in the study area. Were presented in Table 1–4.

Table 1: Descriptive Statistics of Particle Size Distribution of Soils under investigation.

<table>
<thead>
<tr>
<th>Soil</th>
<th>Sample</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>St. Error Mean</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>Unburn</td>
<td>5</td>
<td>49.00</td>
<td>7.64853</td>
<td>3.42053</td>
<td>58.500</td>
</tr>
<tr>
<td>Burn</td>
<td></td>
<td>5</td>
<td>51.00</td>
<td>2.34521</td>
<td>1.04881</td>
<td>5.500</td>
</tr>
<tr>
<td>Silt</td>
<td>Unburn</td>
<td>5</td>
<td>26.00</td>
<td>4.30116</td>
<td>1.92354</td>
<td>4.30116</td>
</tr>
<tr>
<td>Burn</td>
<td></td>
<td>5</td>
<td>25.00</td>
<td>4.30116</td>
<td>1.92354</td>
<td>18.300</td>
</tr>
<tr>
<td>Clay</td>
<td>Unburn</td>
<td>5</td>
<td>25.40</td>
<td>4.27785</td>
<td>1.91311</td>
<td>18.500</td>
</tr>
<tr>
<td>Burn</td>
<td></td>
<td>5</td>
<td>24.00</td>
<td>1.58114</td>
<td>0.70711</td>
<td>2.500</td>
</tr>
</tbody>
</table>

Table 2: Comparison between burned and unburned Physical Property of Soil

<table>
<thead>
<tr>
<th>Soil property</th>
<th>Burned Mean</th>
<th>Burned S.D</th>
<th>Unburned Mean</th>
<th>Unburned S.D</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>51</td>
<td>2.34521</td>
<td>49</td>
<td>7.6485</td>
<td>0.044</td>
</tr>
<tr>
<td>Silt</td>
<td>25</td>
<td>4.30116</td>
<td>26</td>
<td>4.3011</td>
<td>0.604</td>
</tr>
<tr>
<td>Clay</td>
<td>24</td>
<td>1.58114</td>
<td>25</td>
<td>4.2778</td>
<td>0.084</td>
</tr>
</tbody>
</table>

(P <0.05)

Particle Size Distribution
The soils of the study area are characterized by a texture dominated by sand content followed by silt and clay content (Table 2). The results shows that the mean value obtained for sand content in burned site is 51 which is slightly higher compared to the unburned site 49. Therefore, there is no significant difference at (P<0.05). The results shows that both silt and clay content in the burned and unburned are affected in the studied sites, and shows that there is a significant difference at (P>0.05). This finding agree with work of (Ulery and Graham 1993), who reported that after fire reddened soil layers had significantly less clay content than unburned soils. Similarly, (Chandler et al., 1983), reported that Intense fires (>400°C) may also permanently alter soil texture by aggregating clay particles into stable sand-sized particles, making the soil texture more coarse and erodible. But this finding was in variance with (Garren 1943) who reported that single prescribed burns may have not significant effects on soil, the high frequency of fires can have cumulative effects on the soil physical properties. The soil is unlikely to be affected by the kind of low grass fires prevailing in study area, because for the soil particles to be disintegrated, high temperatures (>500°C) lasting for long period of time as reported by (Giovanni et al., 1988; Hunerford et al., 1990).

The implication of this finding is that soils in the study area have been destructed and this resulted
into a decreased in silt and clay content which are essential in agricultural soil for cereal crops production.

### Table 3: Descriptive Statistics of the Various Soil Chemical Properties in an unburned plot

<table>
<thead>
<tr>
<th>Sample</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviat.</th>
<th>Std.Err. Mean</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>Unburn</td>
<td>5</td>
<td>6.8060</td>
<td>0.45796</td>
<td>0.20481</td>
</tr>
<tr>
<td></td>
<td>Burn</td>
<td>5</td>
<td>7.8480</td>
<td>0.21811</td>
<td>0.09754</td>
</tr>
<tr>
<td>Carbon</td>
<td>Unburn</td>
<td>5</td>
<td>0.6440</td>
<td>0.07765</td>
<td>0.03473</td>
</tr>
<tr>
<td></td>
<td>Burn</td>
<td>5</td>
<td>0.2240</td>
<td>0.16165</td>
<td>0.07229</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>Unburn</td>
<td>5</td>
<td>0.2900</td>
<td>0.28662</td>
<td>0.12818</td>
</tr>
<tr>
<td></td>
<td>Burn</td>
<td>5</td>
<td>0.0620</td>
<td>0.11077</td>
<td>0.04954</td>
</tr>
<tr>
<td>Exch.</td>
<td>Unburn</td>
<td>5</td>
<td>3.1200</td>
<td>0.58788</td>
<td>0.26291</td>
</tr>
<tr>
<td>Calcium</td>
<td>Unburn</td>
<td>5</td>
<td>4.9800</td>
<td>0.44604</td>
<td>0.19947</td>
</tr>
<tr>
<td>Exch. Magnesium</td>
<td>Unburn</td>
<td>5</td>
<td>1.8600</td>
<td>0.17132</td>
<td>0.07662</td>
</tr>
<tr>
<td>Exch. Potassium</td>
<td>Unburn</td>
<td>5</td>
<td>0.3320</td>
<td>0.10803</td>
<td>0.04831</td>
</tr>
<tr>
<td>Exch.</td>
<td>Unburn</td>
<td>5</td>
<td>0.3760</td>
<td>0.08444</td>
<td>0.03776</td>
</tr>
<tr>
<td>Sodium</td>
<td>Unburn</td>
<td>5</td>
<td>0.3200</td>
<td>0.07000</td>
<td>0.03130</td>
</tr>
</tbody>
</table>

### Table 4: Comparison between burned and unburned Chemical Properties of Soil.

<table>
<thead>
<tr>
<th>Soil property</th>
<th>Burned Mean</th>
<th>S.D</th>
<th>CV%</th>
<th>Unburned Mean</th>
<th>S.D</th>
<th>CV%</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.8</td>
<td>0.2181</td>
<td>0.048</td>
<td>6.8</td>
<td>0.4579</td>
<td>0.272</td>
<td>0.272</td>
</tr>
<tr>
<td>carbon</td>
<td>0.22</td>
<td>0.1616</td>
<td>0.012</td>
<td>0.64</td>
<td>0.0776</td>
<td>0.082</td>
<td>0.013</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0.06</td>
<td>0.1107</td>
<td>0.026</td>
<td>0.29</td>
<td>0.2866</td>
<td>0.006</td>
<td>0.106</td>
</tr>
<tr>
<td>Exch. Ca</td>
<td>4.98</td>
<td>0.4460</td>
<td>0.199</td>
<td>3.12</td>
<td>0.5878</td>
<td>0.029</td>
<td>0.182</td>
</tr>
<tr>
<td>Exch. Mg</td>
<td>3.92</td>
<td>0.1593</td>
<td>0.025</td>
<td>1.86</td>
<td>0.1713</td>
<td>0.029</td>
<td>0.948</td>
</tr>
<tr>
<td>Exch. K</td>
<td>0.35</td>
<td>0.0844</td>
<td>0.014</td>
<td>0.35</td>
<td>0.1080</td>
<td>0.012</td>
<td>0.728</td>
</tr>
<tr>
<td>Exch. Na</td>
<td>0.32</td>
<td>0.0700</td>
<td>0.005</td>
<td>0.38</td>
<td>0.0844</td>
<td>0.007</td>
<td>0.358</td>
</tr>
</tbody>
</table>

(P <0.05)

### Chemical Properties of Soil

#### Soil (pH)

Table 4, shows the mean value of the soil pH in the study area. The results revealed that the mean value 6.8 in unburned site lower compared to the 7.8 in burned site, which is not significantly difference at (P>0.05) as observed. The soil can be classified as moderately acidic. This finding agreed with the work of (Owensby and Wyrill 1973) who reported that larger increase in pH from winter and mid-spring burning than after late-spring burns. (Ulery and Graham 1993) also found that the topsoil pH increased as much as three units immediately after burning; this rise was essential due to the production of K and Na oxides, hydroxides, and carbonates. (Hicks et al., 2005) also reported that burning releases nutrient to fertilizer the soil, ash from burning also increases the pH of the soil, a process that makes certain nutrients, (especially phosphorous) more available in the short term. (Smith, 1970) reported soil pH was found to increase non-significantly (P<0.05), as a results of burning within both the lowland and upland areas. But this results does not agrees with finding of (Hubbert et al., 2006) who found out that pH of the soil significantly decreased after burning the plot as compared to the unburned plot at (p<0.05).

### Organic Carbon

From Table 4, shows the results of the burned site with a low value of 0.22molkg⁻¹ compared to the unburned site 0.64molkg⁻¹, which are both rated low in terms of soil fertility. With Significant difference at (P<0.05). (Jones 1975) reported and quoted the values of 1.05% for most African Savannah soils. This implies that the value obtained in the study area is low in soil fertility. However, the decrease noticed could be attributed to the removal of crop residues after harvest by local farmers which are used for making local mattress, large number of wild and domesticated animals feed. This finding does not agree with (Ulery and Graham 1993) who observed increase in organic carbon from 0.32% to 0.7% indicating an increase of 0.38%. (Neff et al., 2005) also found that, organic carbon significantly at (P<0.05) increased after burning compared to the unburned plot. But (Aduayi, 1981) reported that loss of organic carbon in soil occurs as a result of fire depleting the litter on the surface. Also (Hosking 1938) found out that carbon content was reduced in burned site intensely compared with unburned site.
The implication of these finding is that there is need to apply fertilizers containing carbon in the study area. Adequate carbon in the soil is vital for the optimal growth of plants; for their functional processes which are related to the presence of carbon (Aduayi, 1981).

**Total Nitrogen**

The results obtained shows that, the burned site has lower value 0.06molkg\(^{-1}\) compared to an unburned site with 0.29molkg\(^{-1}\) (Table 4). The results was not significant at (P>0.05), as total nitrogen was found to be low, which could be attributed to the low level of organic matter in the soils due to burning. There is linear relationship between organic matter, organic carbon and total nitrogen (Jones, 1975). This may have resulted to reason why the burned site has low value compared to the unburned site. This findings agreed with (Neff et al., 2005) who reported that burned soils have lower nitrogen than unburned soils. But (Weston and Attiwill 1990) found out that there is no difference in nitrogen among the burned and unburned areas. Also (Caldwell et al., 2002) reported that Nitrogen volatilization during certain prescribed fire is the dominant mechanism of Nitrogen loss from these systems.

**Exchangeable Calcium**

Table 4, shows the results obtained for exchangeable calcium. The unburned site has a lower mean value 3.12molkg\(^{-1}\) compared to 4.98molkg\(^{-1}\) of burned site which is not significantly different at (P>0.05), the soils are rated as moderate in calcium. This finding was in concord with (Opara-Nadi et al., 2010) who reported that burned surface soils tend to have higher concentrations of non-combustible elements such as Ca, K, Mg and Na compared with unburned. Similarly, (Goh and Phillips 1991) also found that in forest 80–90% of Ca\(^{2+}\), Mg\(^{2+}\), and K\(^{+}\) released from the litter layer because of a light to moderate fire were retained on negative charges of the intact humus of the underlying soil. (Iwuafor et al., 2000) found out that available K, Ca and Mg increased after fire. Similarly, (Goh and Phillips 1991) also found that in forest 80–90% of Ca\(^{2+}\), Mg\(^{2+}\), and K\(^{+}\) released from the litter layer because of a light to moderate fire were retained on negative charges of the intact humus of the underlying soil. (Iwuafor et al., 2000). However, reported increased in potassium at all soil heating temperatures.

**Exchangeable Sodium [Na]**

In (Table 4), the results obtained indicates that Sodium (Na) significantly at (p<0.05) decreased after burning with the mean of 0.32molkg\(^{-1}\)compared to 0.38cmolkg\(^{-1}\) before burning, therefore, was no significant difference at (P<0.05) observed. The potassium level is rated very low. This finding agreed with (White et al., 1973) who found out that available K, Ca and Mg increased after fire. Similarly, (Goh and Phillips 1991) also found that in forest 80–90% of Ca\(^{2+}\), Mg\(^{2+}\), and K\(^{+}\) released from the litter layer because of a light to moderate fire were retained on negative charges of the intact humus of the underlying soil. (Iwuafor et al., 2000). However, reported increased in potassium at all soil heating temperatures.

**Conclusion**

The research on the soil nutrient status at Kwami West, Gombe State were investigated. The two sites selected for the study that is burned and unburned sites revealed some variation in particle size (texture), soil reaction (pH), Organic Carbon (OC), Total Nitrogen (N), Exchangeable bases (Ca, Mg, K and Na) were ascertained. The two study sites were compared, and the results revealed that the study area is dominated by sand particles with appreciable amount of clay and silt at top soils. However, no significant increase was observed. Most soil physical and chemical fertility are mainly dependent on organic matter. Thus, the depleted soil organic matter during soil burning affects both soil physical and chemical fertility of soil. The low amount of clay in the study area implies that the soil is slightly loamy with low level of organic matter. The soil requires addition of organic matter to enhance its
fertility and appropriate agricultural management practices.

Most of the chemical soil parameters investigated indicates a general decrease in their mean values at the burned site compared to the unburned sites. However, an increase was observed in exchangeable potassium (K), and calcium (Ca) at the burned site. The exchangeable bases (Ca, Mg, K and Na) and other macro elements such as Organic Carbon (OC), Nitrogen (N) have been affected in one way or the other by fire in the study area, which off course these are nutrients that are essential for plant growth and development under suitable Agricultural practice.

REFERENCES