International Journal of Environmental Chemistry and Ecotoxicology Research
Vol.4, No.1, pp.36-50, 2022
ISSN: Print: 2399-3464,
ISSN: Online: 2399-3472
Published by European Centre for Research Training and Development UK (www.eajournals.org)

Effects of Slash and Burn Method On Soil Ecosystem and Climate Change Possibility in Ekeya-Okobo, Akwa Ibom State, Nigeria

[1] Ubuoh E. A. , [2]Ejekwolu, C.C. and [3]Onuigbo I. V.
[1]*Department of Environmental Management and Toxicology, Michael Okpara University of Agriculture, Umudike, Abia State Nigeria.*

[2]*Department of Soil Science and Land Resources Management University of Nigeria, Nsukka*
[3]*Department of Environmental Management Technology, Federal College of Land Resources Technology, Owerri, Imo State*

Citation: Ubuoh E. A., Ejekwolu, C.C. and Onuigbo I. V (2022) Effects of Slash and Burn Method On Soil Ecosystem and Climate Change Possibility in Ekeya-Okobo, Akwa Ibom State, Nigeria, *International Journal of Environmental Chemistry and Ecotoxicology Research*, Vol.4, No.1, pp.36-50

ABSTRACT: *Man's environment is under constant threat through slash and burn method which is a traditional way of land preparation for subsistence farming in the study area that has resulted to environmental costs and benefits to farmers with little or no knowledge about the costs such as emission of NO_2, SO_2, SO_3, NO, CO and CO_2 to the atmosphere. To ascertain these, the effect of slash and burn method on soil ecosystem and climate change possibility was evaluated. The study was done through soil survey and literature review. . The study was performed at Ekeya- Okobo during the planting season between December –march, 2016. Burn and un-burn plots were arranged in a RCBD with three replicates. Data were statistically analyzed for variance (ANOVA), and significant means were compared using Duncan multiple range test. Methodologically. soil samples were collected at the depths of 0-15cm and 15-30cm during pre and post slash and burn periods. The soil samples collected were analyzed for physical and chemical characteristics with emphasis on TN, TOC, and Avail. P. for climate change implications. From the results obtained at the depth of 0-15cm from burning, showed pH was moderately acidic to neutral, increase in soil fraction such as clay and TOC, OM, TN, Ca^{2+} , Mg^{2++}, $+Na^{+}$, CEC , Avail.P and Bs while un-burn recorded low values accordingly. Between the two plots sampled, Changes of physical and chemical parameters were significant at the $P :< 0.05$ probability level. An increased in TOC, TN and P at the soil surface through severity of fire alongside the existing CO_2 and heat caused their disappearance via volatilization to the atmosphere leading to the possibility of climate .*

KEYWORDS: slash and burn, soil ecosystem, climate change, volatilization

INTRODUCTION

The world has lost about half of its forests to agriculture and other uses, and 78 percent of what remains is heavily altered, bearing little resemblance to the original forests (EPA 1990; Bryant et al. 1997). About 72 percent of the original 1450 million ha of tropical forests have been converted to other uses (FAO, 1997). Small-scale farmers often are viewed as the primary agents of deforestation (Hauck 1974), accounting for as much as 96 percent of forest losses (Amelung and Diehl 1992; Myers ,1994) . Most studies of slash-and burn document increased soil nutrient availability after burning (Tiessen et al., 1992; De Rouw, 1994). Post-burn increases in soil fertility have been attributed to nutrient-rich ash in nearly all tropical forest types where slash-and-burn has been examined (De Rouw, 1994; Maass, 1995). Apart from the effects of burning on soil (DeBano, 1990; Certini, 2005), it also has a marked increase in global warming due to the emission of NO_2, SO_2, SO_3, NO, CO and CO_2 gases which have tremendous effect on the Ozone layer (Jamala et al, 2012). Lawal, at el (1995) viewed that bush burning causes changes in the micro-climate at the soil - atmosphere interface. McKnight (1992) argued that atmospheric carbon dioxide continues to be increased because, there are fever trees to absorb it and because burning of trees for forest cleaning releases more carbon dioxide to the atmosphere. It is currently believed that the earth's atmosphere is heating up due to increasing amounts of carbon dioxide and other gases resulting from human activities such as bush burning (Ambe et al, 2015). Global carbon emissions have been estimated during the past three decades from slash and burn leading to the mission of CO_2 to the atmosphere (Mouillot et al., 2006; Schultz et al., 2008; van der Werfet al., 2010; Mieville et al., 2010; Wiedinmyer et al., 2011). Forest burning is a net contributor to global warming, global warming results from an atmospheric buildup of greenhouse gases, primarily carbon dioxide. Of the carbon dioxide that we humans contribute, roughly two-thirds is from the burning of fossil fuels and one-third is from the burning of biomass, such as forests, grasslands and agricultural crops **(**Levy, 2004). An Environmental Scientist in her statement observed that:

This statement was reemphasized by Leocadia who observed that in Cameroun :

> *" Rural women understand that slash and burn technique is unsustainable and that the soils are already damaged from this farming method. But they say that for them to change, they need an affordable alternative(Leocadia, 2011).*

In the Southern part of Nigeria, slash and burn method of land clearing is an integral part of the traditional farming system widely used as a means of land clearing to pave way to tillage (Neff et al., 2005; Jamala et al, 2012 ; Edem et al, 2013). As more land is being cleared and prepared for cropping annually in humid tropics for food production , burning has become the easiest and most convenient method quite often employed (Ruddiman, 2003; Edem et al., 2012). Rates of nutrient loss from slash fires are among the highest of any fires (Kauffman et al., 1995), and sustaining site fertility depends on a detailed understanding of the nutrient fluxes and losses that accompany such fires, hence climate change possibility .The study therefore focuses on the susceptibility of soil physical and chemical characteristics to slash and burn method and climate change possibility.

MATERIALS AND METHOD

Study area:

Ekeya is one of the villages in Odu clean, Okobo Local Government of Akwa Ibom State (Fig1). It is located in Longitude 8° 10' 53" East , Latitude 4° 51' 43" North and with the height of 26m above the sea level. The area is divided into two distinct seasons, the wet and dry seasons. Ekeya -Okobo is in the tropical region and has a uniformly high temperature all the year round with evergreen rainforest (Fig.2), with about 2,878 mm of precipitation falling annually. The average temperatures vary during the year by 2.3 °C (Edem et al., 2012). The two main seasons are the dry which spans between October and April and wet season which starts around May and ends in September. The native vegetation has been almost completely replaced by secondary forests of predominantly wild oil palms, woody shrubs and various grass undergrowth.

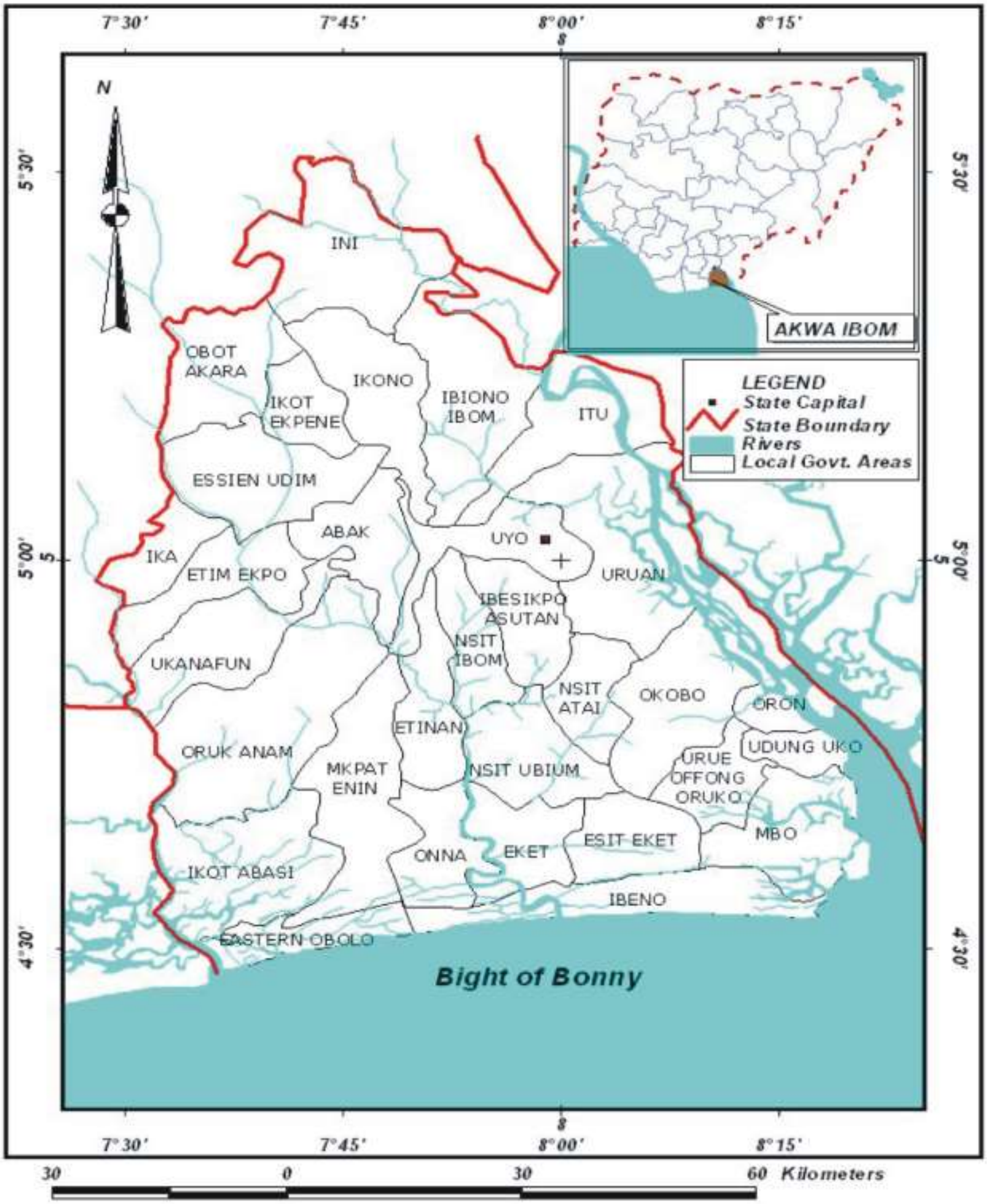
7°30'
7°45'
8°00'
8°15'
5°30'
5°00'
4°30'
N
AKWA IBOM
LEGEND
State Capital
State Boundary
Rivers
Local Govt. Areas
INI
OBOT AKARA
IKONO
IKOT EKPENE
IBIONO IBOM
ITU
ESSIEN UDIM
ABAK
UYO
IKA
ETIM EKPO
URUAN
IBESIKPO ASUTAN
NSIT IBOM
UKANAFUN
NSIT ATAI
OKOBO
ORON
ETINAN
UDUNG UKO
ORUK ANAM
MKPAT ENIN
NSIT UBIUM
URUE OFFONG ORUKO
MBO
ONNA
EKET
ESIT EKET
IKOT ABASI
IBENO
EASTERN OBOLO
Bight of Bonny
30
0
30
60 Kilometers

Figure 1. Map of Akwa Ibom State showing Okobo Local Government Area
Source: Charles et al, 2014

Fig 2: Satellite Image of Ekeya- Okobo: Google, 2016

Experimental Design: The experiment consisted of two treatments (burned and un-burned plots) arranged in a RCBD with three replicates. Data were statistically analyzed for variance (ANOVA), and significant means were compared using Duncan multiple range test. Paired t-test was used to compare means of the unburnt and burnt plots. For all tests, a threshold of P =0.05 was used to define statistical significance.

Soil sample collection from Slash and Burn and un-burn plots: The study was carried out on vast hectares of farmland traditional prepared during 2016 planting season in Ekeya. The trashes cleared were allowed to dry for about one month to maximize the intensity of the burn, a management objective believed by local farmers to be important for good crop yield. Immediately the land was cleared without burning, soil samples were collected and after indiscriminate burning of debris with the help of kerosene and fuel by farmers, soil samples were equally taken at the depths of 0-15cm, 15-30cm using auger. Soil samples were randomly picked from pre and post

Vol.4, No.1, pp.36-50, 2022
ISSN: Print: 2399-3464,
ISSN: Online: 2399-3472
Published by European Centre for Research Training and Development UK (www.eajournals.org)

burn plot, bagged and labelled for the analyses and particular attention was given to Soil Nitrogen and Carbon Analyses for climate change possibility:

Laboratory analyses of the Physical and chemical : The particle size analysis was determined using hydrometer method in 5 % sodium hexametaphosphate as the dispersing agent (Bouyoucos, 1951**).** The pH of the soil was determined electrometrically using a pH meter in 1:1 soil – 1M KCl and 1:1 soil-water suspensions (Mclean, 1982). Organic matter was determined using Walkley – Black wet oxidation method (Nelson and Sommers, 1982). Total nitrogen of the soil was determined using the macro Kjeldahl method (Bremner and Mulvaney, 1982). Available phosphorus in the soil was determined using Bray P1 method (Olsen and Sommers, 1982). Exchangeable cations ($Ca^{2+,}$ $Mg^{2+,}$ K^+ and Na^+) were determined using 1M NH4OAc (Ammonium acetate) buffered at pH 7.0 as extractant (Thomas, 1982). The K^+ and Na^+ concentrations in soil extracts were read on Gallenkamp flame photometer while Ca^{2+} and Mg^{2+} concentrations in soil extracts were read using Perkin-Elmer Model 403 atomic absorption spectrophotometer (AAS). The exchangeable acidity ($H^{++}Al^{3+)}$ in the soil was extracted with 1M KCl (Thomas, 1982). Solution of the extract was titrated with 0.05M NaOH to a permanent pink endpoint using phenolphthalein as indicator. The amount of base (NaOH) used is equivalent to the total amount of exchangeable acidity ($H^++Al^{3+)}$ in the aliquot taken (Odu *et al.*, 1986). The total sum of exchangeable bases ($Ca^{2+}+Mg^{2++}K^++Na^+$) and total exchangeable acidity ($H^++Al^{3+)}$ gave the effective cation exchangeable capacity (ECEC) (Juo, 1979). Percentage base saturation was calculated as the ratio between the sum of exchangeable bases and effective cation exchangeable capacity multiplied by 100.

$$\text{i.e. Base Saturation} = \frac{Ca^{2+}+Mg^{2+}+K^{+}+Na^{+} \times 100}{ECEC} \qquad \text{-----(Equ.1)}$$

RESULTS AND DISCUSSION

Greenhouse effects and related climate change with the increased atmospheric CO_2 concentrations have been extensively assessed in the IPCC reports (IPCC, 2001b, 2007), which basically indicate warming worldwide. Warming, in contrast, is known to diminish the land carbon sink by enhancing respiration (Cramer et al., 2001; Friedlingstein et al., 2001; Govindasamy et al., 2005 ; Matthews et al., 2005; Thompson et al., 2004; Zeng et al., 2004). This provides some essential information for assessing the climatic effects of fire emissions, which are one of the important sources for atmospheric CO_2 (Yongqiang Liu et al , 2014). Table 1- 2 show Summary of soil Quality under Slash but not burn (Fallow Plot) at the depth of 0-15cm, 15-30cm, Table 3-4 Summary of soil Quality under Slash and Burn plot at the depth of 0-15 cm, 15-30cm and Table 5: Comparative study of the mean values of soil quality under Slash and burn and bush fallow at the depths in the Study Area .

Table 1: Summary of soil Quality under Slash but not burn (Fallow Plot) at the depth of 0-15cm.

Soil Indicators	Range	Minimum	Maximum	Mean	Std.	CV
pH (H_2O)	0.12	5.51	5.63	5.58	0.6429	0.004
pH (KCI)	2.14	3.85	5.99	4.8633	1.07449	1.155
SAND ($g.kg^{-1}$)	17.00	69.20	77.20	73.01	9.29157	86.333
SILT ($g.kg^{-1}$)	4.00	6.00	10.00	8.0333	2.00083	4.003
CLAY ($g.kg^{-1}$)	6.00	14.80	20.80	18.1333	3.05505	9.333
O.C ($g.kg^{-1}$)	0.86	1.93	2.79	2.3100	0.43863	0.192
O.M ($g.kg^{-1}$)	1.48	3.34	4.82	3.9933	0.75507	0.570
TOTAL N($g.kg^{-1}$)	0.08	0.16	0.24	0.1967	0.04041	0.002
CA (cmol kg^{-1})	0.40	2.40	2.80	2.5333	0.23094	0.053
Mg (cmol kg^{-1})	0.80	1.20	2.00	1.6000	0.40000	0.160
K (cmol kg^{-1})	4.92	0.18	5.10	1.8567	2.80935	7.892
Na (cmol kg^{-1})	0.06	0.90	0.15	0.1300	0.3464	0.001
CEC (cmol kg^{-1})	0.95	4.69	5.64	5.0200	0.53731	0.289
Bs (%)	5.00	80.80	85.80	82.5667	2.80416	7.863
Avail, P (mg kg^{-1})	3.18	0.67	3.85	2.5400	1.66232	2.763

ISSN: Print: 2399-3464,
ISSN: Online: 2399-3472
Published by European Centre for Research Training and Development UK (www.eajournals.org)

Table 2: Summary of soil Quality under Slash but not burn (Fallow Plot) at the depth of 15-30cm.

SOIL INDICATORS	Range	Minimum	Maximum	Mean	Std.	CV
pH (H_2O)	1.34	4.52	5.86	5.1200	0.68088	0.646
pH (KCI)	0.76	3.96	4.72	4.2467	0.41296	0.171
SAND ($g.kg^{-1}$)	2.00	61.20	63.20	62.5333	1.15470	1.333
SILT ($g.kg^{-1}$)	4.00	6.00	10.00	8.0000	2.00000	4.000
CLAY ($g.kg^{-1}$)	6.00	26.80	32.80	29.4667	3.05505	9.333
O.C ($g.kg^{-1}$)	1.03	1.17	2.25	1.5567	0.60178	0.362
O.M ($g.kg^{-1}$)	1.86	2.03	3.89	2.6967	1.03582	1.073
TOTAL N($g.kg^{-1}$)	0.90	0.10	0.19	0.1300	0.05196	0.003
CA (cmol kg^{-1})	1.60	2.00	3.60	2.5333	0.92376	0.853
Mg (cmol kg^{-1})	0.40	1.20	1.60	1.4667	0.23094	0.053
K (cmol kg^{-1})	0.04	0.11	0.15	0.1333	0.02082	0.000
Na (cmol kg^{-1})	0.06	0.14	0.20	0.1633	0.3215	0.001
CEC (cmol kg^{-1})	0.50	4.99	5.49	5.1633	0.28308	0.080
Bs (%)	69.31	8.59	77.90	52.1633	37.94178	1439.579
Avail, P (mg kg^{-1})	0.34	0.15	0.49	0.3133	0.17039	0.029

Table 3 : Summary of soil Quality under Slash and Burn plot at the depth of 0-15 cm

SOIL INDICATORS	Range	Minimum	Maximum	Mean	Std.	CV
pH (H_2O)	0.19	7.10	7.29	7.2200	0.10440	0.011
pH (KCI)	0.74	6.02	6.76	6.5000	0.41617	0.173
SAND ($g.kg^{-1}$)	4.00	65.20	69.20	67.2000	2.00000	4.000
SILT ($g.kg^{-1}$)	4.00	4.00	8.00	6.6667	2.30940	5.333
CLAY ($g.kg^{-1}$)	8.00	22.80	30.80	26.1333	4.16333	17.333
O.C ($g.kg^{-1}$)	0.43	2.46	2.89	2.7333	0.23756	0.056
O.M ($g.kg^{-1}$)	0.75	4.25	5.00	4.7267	0.41429	0.172
TOTAL N($g.kg^{-1}$)	1.44	0.09	0.14	0.6667	0.80928	0.655
CA (cmol kg^{-1})	2.00	1.60	3.60	2.6667	1.00664	1.013
Mg (cmol kg^{-1})	0.60	1.60	2.20	1.9667	0.32146	0.103
K (cmol kg^{-1})	0.14	0.54	0.68	0.5933	0.07572	0.006
Na (cmol kg^{-1})	0.09	0.11	0.20	0.1567	0.04509	0.002
CEC (cmol kg^{-1})	1.73	4.35	6.08	5.3833	0.91282	0.833
Bs (%)	8.00	81.10	89.10	82.2000	4.43058	19.630
Avail, P (mg kg^{-1})	3.10	2.62	4.45	3.45	1.71716	2.949

Table 4 : Summary of soil Quality under burn and slash plot at the depth of 15-30 cm.

Soil indicators	Range	Minimum	Maximum	Mean	Std	CV
pH (H_2O)	0.39	6.10	6.49	6.3500	0.21703	0.047
pH (KCI)	0.18	5.81	5.99	5.8900	0.09165	0.008
SAND ($g.kg^{-1}$)	6.00	61.20	67.20	64.5333	3.05505	9.333
SILT ($g.kg^{-1}$)	4.00	4.00	8.00	6.0000	2.00000	4.000
CLAY ($g.kg^{-1}$)	6.00	26.80	32.80	29.4667	3.05505	9.333
O.C ($g.kg^{-1}$)	0.08	1.93	2.01	1.9633	0.04163	0.002
O.M ($g.kg^{-1}$)	0.45	3.34	3.79	3.5367	0.23029	0.053
TOTAL N($g.kg^{-1}$)	1.93	0.07	0.09	0.7200	1.10856	1.229
CA (cmol kg^{-1})	0.40	2.00	2.40	2.2667	0.23094	0.053
Mg (cmol kg^{-1})	0.70	1.40	2.10	1.7667	0.35119	0.123
K (cmol kg^{-1})	0.02	0.59	0.61	0.6000	0.01000	0.000
Na (cmol kg^{-1})	0.12	0.15	0.27	0.2033	0.6110	0.004
CEC (cmol kg^{-1})	0.72	4.56	5.28	4.8367	0.38786	0.150
Bs (%)	6.20	79.20	85.40	82.8000	3.21870	10.360
Avail, P (mg kg^{-1})	1.30	1.20	1.50	1.4	0.68981	0.476

Table 5: Comparative study of the mean values of soil quality under Slash and burn and bush fallow plots at different depths in the Study Area

Soil Indicators	Fallow Plot 0-15cm	Slash and Burn 0.15cm	Fallow Plot 15-30cm	Slash and Burn 15-30cm
pH (H_2O)	5.58	7.2200*	5.1200	6.3500*
pH (KCI)	4.8633	6.5000*	4.2467	5.8900*
SAND ($g.kg^{-1}$)	73.01	67.2000	62.5333	64.5333*
SILT ($g.kg^{-1}$)	8.0333	6.6667	8.0000	6.0000
CLAY ($g.kg^{-1}$)	18.1333	26.1333*	29.4667	29.4667
O.C ($g.kg^{-1}$)	2.3100	2.7333*	1.5567	1.9633*
O.M ($g.kg^{-1}$)	3.9933	4.7267*	2.6967	3.5367*
TOTAL N($g.kg^{-1}$)	0.1967	0.6667*	0.1300	0.7200*
CA (cmol kg^{-1})	2.5333	2.6667*	2.5333	2.2667
Mg (cmol kg^{-1})	1.6000	1.9667*	1.4667	1.7667*
K (cmol kg^{-1})	1.8567	0.5933	0.1333	0.6000*
Na (cmol kg^{-1})	0.1300	0.1567*	0.1633	0.2033*
CEC (cmol kg^{-1})	5.0200	5.3833*	5.1633	4.8367
Bs (%)	82.5667	82.2000	52.1633	82.8000*
Avail, P (mg kg^{-1})	2.5400	3.45*	0.3133	1.4*
*	*Highest values of physical and chemical parameters recorded* ***Change significant at the P : <0.05 probability level.***			

DISCUSION

From the results in Table 1-4, the surface soil pH of burnt plots increase in the pH scale from the sub-surface ranging from 6.10 and 6.49 with a mean of 6.35 to that of the surface from 7.10 to 7.29 with a mean of 7.22 and the fallow plots decreased from pH 5.51 to 5.63 with a mean of 5.58 of the top soil, to pH 4.52 to 5.86 with a mean of pH 5.12 of the sub-surface(Table 1-4). .

The soil reaction of the fallow plots was extremely acidic to moderately acid and the burnt plots were moderately acid to neutral . This suggested ashes released during burning. The ash thus serves as liming and fertilizing material while reducing soil acidity(Adeyolanu et al. 2013). The result is consistent with the finding (Ulery et al, 1993), This increase in pH of slash and burn plots was essentially due to the production of K and Na oxides, hydroxides and carbonates immediately after burning (Arocene and Opio, 2003), also increased soil pH would increase the affinity of Ca^{2+} for P and the potential for precipitation of Ca phosphate minerals during the fractionation procedure (Giardina, et al, 2000). The mean values of sand, silt, clay of the surface (0-15) and sub-surface (15-30) soil samples of fallow plot recorded 73.2, 8, 18.1% and 62.5, 8, 29.5% while that of the burnt plot recorded 67.2, 6.7, 26.1 % respectively Table (1-4). The decrease of silt in the burn plot was reported by Kattering et al (2000), which was served to be due to high temperature fussing the silt fractions hence reduction. The result also recorded an increase in the sand fraction of burn area due to an increase in temperature that lead to the breaking of the soil particles causing the soil to be coarse. The finding was consistent with the finding of Ulery et al (1993),the increase in the percentage of clay of the burn plot was due to fire severity that lead to the fusion of clay fractions in the soil .

The organic carbon content of the fallow plot ranged from 1.93 to 2.79 $g.kg^{-1}$ (mean 2.31 $g.kg^{-1}$) at the surface soil and 1.17 $g.kg^{-1}$ to 2.25 $g.kg^{-1}$ (Mean 1.56 $g.kg^{-1}$) at the sub-surface . The burnt plot ranged between 2.46 – 2.89 $g.kg^{-1}$with the mean values (2.73 $g.kg^{-1}$) at the soil surface and 1.93 – 2.01 $g.kg^{-1}$ with mean value at the sub – surface being 1.96 kg^{-1} (Table 1-4). Soil fertility is closely linked to organic matter, whose status depend to bio-mass input and management., mineralization, leaching and erosion. The soil organic matter increase structure stability, resistance to rainfall impact rate of infiltration and faunal activities (Rose and Barthes, 2001). Fire induced transformation of humic-acid into alkali-insoluble compounds (Almendros et al, 1990).

The total nitrogen status of the soil is closely related to the organic matter. The total N of the fallow plot ranged from 0.16 to 0.24% (mean 0.19) at the surface soil 0.10 to 0.19% (mean 0.13) at the sub – surface which is moderate to moderately high. Burn plots ranged from 0.90 to 0.12% (mean 0.11) at the surface soil and 0.70 to 0.90 (mean 0.08) at the sub-surface which is very low (Table 1-4). The reduction in TN is suspected to be caused by the severity of fire and disappearance to the atmosphere (Ubuoh et al, 2016) . At the plot, the negative effect of burning on N supply may have been partially offset in the short term by the thermal release of N from organic matter (Kauffman et al., 1995). The result of the burn plot shows the repercussion of fires or burning on the biogeochemical cycle of nutrient especially N and P. the immediately response of soil organic N to heating is a decrement because of some losses through volatilization (Fisher and Binkely, 2000; Ubuoh et al, 2016).

The burnt plot P ranging from 2062 to 4.45 ppm (mean 3.54) at surface soil and 1.20 to 1.5 ppm (mean 1.4ppm) at sub-surface. The fallow ranging from 0.67 to 3.85 ppm (mean 2.54) at surface soil and 0.15 to 0.49 (mean 0.31 ppm) at the sub-surface(Table 1-4).

CEC is an inherent soil characteristic and is difficult to alter significantly. It influences the soil's ability to hold onto essential nutrients and provides a buffer against soil acidification**.** The five most abundant exchangeable cations in the soil are calcium (Ca^{++}), magnesium (Mg^{++}), potassium (K^{+}), sodium (Na^{+}) and aluminium (Al^{+++}) . The CEC of the fallow plots of surface soil ranged from 4.69 – 5.64 (mean 5.02 $Cmol.kg^{-1}$) and 4.99 – 6.49 (mean 5.16 $Cmol.kg^{-1}$) of sub-surface. The burn and slash plot ranged from 4.35 – 6.08 (mean 5.38 $Cmol.kg^{-1}$) of the surface soil 4.56 – 5.28 (mean 4.84$Cmol.kg^{-1}$) of the sub-surface .The exchangeable K burnt plot was moderate to high in level of both horizons Ca and Mg were low Na moderate. The fallow exchangeable K, Ca, Na and Mg were low at various surfaces (Table 1-4)

Closely related to cation-exchange capacity is the **base saturation (Bs)**, which is the fraction of exchangeable cations that are base cations (Ca, Mg, K and Na). It can be expressed as a percentage, and called percent base saturation. From the result, fallow plot recorded Bs between 80.8-85% at topsoil with the men value of 82.6%, at subsoil, it recorded between 8.6-77.9% with the mean

ISSN: Print: 2399-3464,
ISSN: Online: 2399-3472
Published by European Centre for Research Training and Development UK (www.eajournals.org)

value of 52.2%. Within slash and burn plot, Bs ranged between 81. 10-89.10% with the mean value of 82.2% on the topsoil, while the subsoil ranged 79.20-85.40% with the mean value of 82.8% (Table1-4).The results observed that percentage concentration of base saturation was more in slash and burn plot that fallow plot.

CONCLUSION

From the observation, cultural practice such as slash and burn method have both beneficial and detrimental effects on soil quality and atmospheric compositions. Farmers believed that burning is a cheap method of land clearing which is a common practice in Ekeya. According to Niemeyer et al (2005), most farmers believed that burning with ashes could be a source of lime and other soil nutrients(Mg, Ca, available phosphorus) for crops use, prevent weeds infestation Babalola(2000), prevent parasitic insects (Auld and Denham (2006) and increased the percentage macro-aggregate stability of surface soil vertisols (Obale-Ebang, et al, 2003). But during the burning, much of the nitrogen, and carbon are volatilized as oxides of nitrogen into the atmosphere likewise the oxides of carbon as carbon dioxide, have adverse effect on the structure of tropical soils and the atmospheric compositions (Judge, 1991; Ambe et al, 2015).

Among the approaches that could be used to reduce impact of climate change is reduction of fossil based land cleaning (slash and burn) and tillage. Leaving plant residues on soil surface in forms of conservation tillage enhances carbon sequestration (Ubuoh et al, 2016). Presence of trees also reduces ambient temperature, carbon loss and mineralization . Total land clearing is not environmentally friendly with attendant high rainfall intensity and temperature in the topics (Line, 2011) . Aina (2011), Ohu (2011), Oni (2011) dealt extensively with types of conservation tillage. The mixed cropping provides ground cover which improves temperature and moisture regime. Meanwhile, for now awareness should be created among farmers in villages and urban periphery who are key players in slash and burn method of farming on the negative environmental implications of their act. As stated by William et al, (1971), that, education and community awareness material needs to focus especially on the threat to the environment and property of inappropriate use of fire, particularly burning which is too frequent, extensive in area, of excessive intensity, badly timed or carelessly implemented Furthermore, effects of biomass burning on carbon sequestration and ambient air quality under slash-and-burn in agriculture should be researched on for scientific clarity.

REFERENCES:

Adeyolanu, O. D., Are, K. S.,Oluwatosin, G. A.,Ayoola,O. T. and Adelana, A. O. 2013. Evaluation of two methods of soil quality assessment as influenced by slash and bur in a tropical rainforest ecology of Nigeria. *Archives of Agronomy and Soil Science*, 59 (12): 1725 – 1742.

Aina, P.O. 2011. Conservation tillage for sustainable agricultural productivity. In Proceedings of Nigerian Branch of International soil Tillage Research Organization p1-10.

Ambe, B. A. Eja, lwara, E. Agbor, C. E. (2015). Assessment of the Impacts and People'S Perception of Bush Burning on the Grasslands and Montane Ecosystems of the Obanliku Hills/Plateau, Cross River State, Nigeria. *Journal of Natural Sciences Research www.iiste.org* Vol.5, No.6,

Amelung, T., and Diehl, M. (1992). *Deforestation of tropical rain forests*: Economic causes and impact on development. Kieler Studien no. 241. Inst. für Weltwirtschaft, Kiel, Germany.

Babalola, O. (1996).Soil conservation plan for small holder farm project of the Ondo State,National Agricultural Land Development Authority (NALDA), The Presidency, Abuja. 78p.

Bryant, D., D. Nielsen, and L. Tangley. (1997). The last frontier forests: Ecosystems & economies on the edge. World Resources Inst., Washington, DC.'

Charles, U. Roberto O. and Abasi-Ifreke S. E. (2014). Geospatial *Application in Mapping Gully Development for Effective Remediation and Control, Journal of Geography and Geology*; Vol. 6, No. 4; 153

Cramer, W., Bondeau, A., Woodward, I., Prentice, I. C., Betts, R. A., Brovkin, V., Cox, P. M., Fisher, V., Foley, J. A., Friend, A. D., Kucharik, C., Lomas, M. R., Ramankutty, N., Sitch, S., Smith, B., White, A., and Young-Molling, C(2001). Global response of terrestrial ecosystem structure and function to CO_2 and climate change: results from six dynamic global vegetation models, *Glob. Change Biol*., 7, 357–373, 2001

De Rouw, A.(1994). Effect of fire on soil, rice, weeds and forest regrowth in a rain forest zone (Cote d'Ivoire). Catena 22:133–152

Edem I. Dennis, Uduak C. Udo-Inyang and Ifiok. R. I (2012).Erodibility of Slash-and-Burn Soils along a Toposequence in Relation to Four Determinant Soil Characteristics. *Journal of Biology, Agriculture and Healthcare*. ; (2)5:93-102.

Edem I. D., and Alphonsus D. U, (2013).soil properties dynamics induced by passage of fire during agricultural burning. Russian Journal of Agricultural and Socio-Economic Sciences, 5(17)

FAO (Food and Agriculture Organization). 1997. State of the world's forests. FAO, Rome

Friedlingstein, P., Bopp, L., Ciais, P., Dufresne, J. L., Fairhead, L., LeTreut, H., Monfray, P., and Orr, J.: Positive feedback between future climate change and the carbon cycle, *Geophys. Res. Lett.*, 28, 1543–1546, 2001.

Giardina, C. P. Sanford, R. L. Jr., and Døckersmith I. C. (2000). Changes in Soil Phosphorus and Nitrogen During Slash-and-Burn Clearing of a Dry Tropical Forest. *Published in Soil Sci. Soc. Am. J. 64:399–405* (2000).

Govindasamy, B., Thompson, S., Mirin, A., Wickett, M., Caldeira, K., and Delire, C.(2005). Increase of carbon cycle feedback with climate sensitivity: results from a coupled climate and carbon cycle model, Tellus B, 57, 153–163, 2005.

Hauck F.W. (1974) . Shifting cultivation and soil conservation in Africa. *FAO Soils Bull*. 24: 1–4.

Jamala, G. Y. Boni, P. G. Abraham P. and Teru C. P.(2012). Evaluation of Environmental and Vulnerability Impact of Bush Burning in Southern Guinea Savanna of Adamawa State, Nigeria. *American Journal of Experimental Agriculture 2(3): 359-369, 2012*

Judge Colling. (1991). *Global ecology,* By nature history museum., pp: 86

Kauffman, J., D. Cummings, D. Ward, and R. Babbitt. (1995). Fire in the Brazilian Amazon: I. Biomass, nutrient pools, and losses in slashed primary forests. *Oecologia* 104:397–408.

Ketterings, Q., Bigham J. and Laperche, V.. Changes in soil mineralogy and texture caused by slash-and –burn fire in Sumatra, Indonesia. Soil Science Society of America journal, 2000; (64):1108-1117.

Levy, D.(2004*).Forest burning is a net contributor to global warning Scientist* say, August 12, 2004.News Service.

Maass, J. (1995).Conversion of tropical dry forest to pasture and agriculture. p. 399–422. *In* S.H. Bullock, H.A. Mooney, and E. Medina. Cambridge Univ. Press, Cam-bridge.

Matthews, H. D., Weaver, A. J., and Meissner, K. J.(2005). Terrestrial carbon cycle dynamics under recent and future climate change, *J. Climate.*, 18, 1609–1628, 2005.

McKnight, T.L (1992). *Essentials of Physical Geography.* New Jersey: USA.

McLean, E. O. (1982). Soil pH and lime requirement. In Page, A. L., R. H. Miller and D. R. Keeney (eds.) Methods of soil analysis. Part 2 - Chemical and microbiological properties. (2nd Ed.). Agronomy, 1982, 9, 199-223.

Mieville, A., Granier, C., Liousse, C., Guillaume, B., Mouillot, F., Lamarque, J.F., Grégoire, J.M., Pétron, G., (2010). Emissions of gases and particles from biomass burning during the 20th century using satellite data and an historical reconstruction. *Atmos. Environ*. 44, 1469–1477.

Mouillot, F., Narasimha, A., Balkanski, Y., Lamarque, J.-F., Field, C.B., (2006). Global carbon emissions from biomass burning in the 20th century. *Geophys. Res. Lett. 33*. http://dx.doi.org/10.1029/2005GL024707.

Myers N. (1994). Tropical deforestation: Rates and patterns. In K. Brown and D.W. Pearce (eds.). The causes of tropical deforestation. UCL Press, London

Neff, J. C., Harden, J. w. Gleixner, G..(2005). Fire effects on soil organic matter content composition, and Nutrients in boreal interior Alaska. *Can. J. Forest Res.* 2005; 35 (9-10): 2178-2187.

Niememeyer. T. Niemeyer, S. Mohammed , A. Fottner, S. and Hardle, W. (2005)> Impact of prescribed burning on the nutrient balance of the heartlands with particular reference to nitrogen and phosphorus. Applied vegetation science 8. 183-192.

Obale-Ebanga F. Sevink, J. degroot, W. Nolte, C. (2003). Myths of slash and burn on the physical degradation of savanna soils impacts on vertisols in Noth Cameroun. Soil use and Mangement, 19, 83-86.

Ohu, J.O. 2011, Tillage for environmental sustainability. In Proceedings Nigerian Branch of International soil Tillage Research Organization p1-10.

Olsen SR, Sommers LE *(*1982)*.* Phosphorus*. In:* Pace AL, Miller RH, Keeney DR, *eds.* Methods of soil analysis. Part 2. Chemical and microbiological properties. Madison, WI, USA*: American Society of Agronomy, Inc.,* 403–430

Oni, K.C. 2011. Tillage in Nigerian Agriculture In proceedings Nigerian Branch of International soil Tillage Research Organization p12-26..

Ruddiman, W. F. (2003). The anthropogenic greenhouse era began thousands of years ago. *Clim. Change.*, 2003; (61): 261-293.

Schultz, M.G., Heil, A., Hoelzemann, J.J., Spessa, A., Thonicke, K., Goldammer, J.G., Held, A.C., Pereira, J.M.C., van het Bolscher, M., (2008). Global wildland fire emissions from 1960 to 2000. *Global Biogeochem.* Cycles 22, GB2002.

Thompson, S. L., Govindasamy, B., Mirin, A., Caldeira, K., Delire, C., Milovich, J., Wickett, M., and Erickson, D.(2004). Quantifying the effects of CO_2-fertilized vegetation on future global climate and carbon dynamics, *Geophys. Res. Lett*., 31, L23211,

Tiessen,H., I. Salcedo, and E. Sampaio.(1992) .Nutrient and soil organic matter dynamics under shifting cultivation in semi-arid northeast.

Ubuoh E. A., Nwankama, C. and Ejekwolu, C.C. (2016): The Effect of Selected Land Uses on Soil Organic Carbon (Soc) and Total Nitrogen (Tn) Dynamics in Imo State, Nigeria (Carbon Sequestration Implications) *Academia Journal of Environmental Scienc*e 4(11): 220-226.

van der Werf, G.R., Randerson, J.T., Giglio, L., Collatz, G.J., Mu, M., Kasibhatla, P.S., Morton, D.C., DeFries, R.S., Jin, Y., van Leeuwen, T.T.,(2010). Global fire emissions and the contribution of deforestation, savanna, forest, agricultural, and peat fires (1997–2009). *Atmos. Chem. Phys*. 10, 11707–11735.

William, H., Mathews. William W Killogy, G.D Robinson, (1971). *Man's impact on the climate*. By the manssachusette institute of technology, pp: 84

Wendi B. (2011). *Rural women want alternatives to 'slash and burn. conservation, environment, farming, livelihoods, Panos London achieved visit* **panos.org.uk.**

Wiedinmyer, C., Akagi, S.K., Yokelson, R.J., Emmons, L.K., Al-Saadi, J.A., Orlando, J.J., Soja, A.J., (2011). The Fire INventory from NCAR (FINN): a high resolution global model to estimate the emissions from open burning. *Geosci.* Model Develop. 4 (3), 625–641..

Yongqiang. L, Scott, G. Warren, H, (2014). Wild land fire emissions, carbon, and climate: Wildfire–climate interactions. *Forest Ecology and Management* 317 (2014) 80–96

Zeng, N., Qian, H. F., Munoz, E., and Iacono, R. (2004). How strong is carbon cycle-climate feedback under global warming? *Geophys. Res. Lett.,* 31, L20203, , 2004.