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EFFECT OF SLASH AND BURN PRACTICES ON CHEMICAL PROPERTIES OF SOIL IN URATTA, OWERRI NORTH LOCAL GOVERNMENT AREA OF IMO STATE, NIGERIA.

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Abstract

This study was conducted in Uratta, Owerri North Local Government Area of Imo State to determine the effect of slash and burn practice on soil chemical properties. The chemical parameters tested were pH, Av.P, TN, OC, OM, Ca^{2+}, Mg $^{2+}$, K^{+}, Na^{+}, TEA, ECEC and BS. A total of twenty four (24) samples were obtained from different locations in the study area using survey method. Twelve samples at 0-15cm and 15-30cm depths of burned field and twelve (12) samples also at 0-15cm and 15-30cm depths of unburned field. The samples collected were air dried and sieved using 2mm sieve preparatory to laboratory analysis. Data generated were analysed using descriptive statistics such as mean, standard deviation and coefficient of variation, t-test was used to compare the means of the soil chemical properties from unburnt and burnt field. The study revealed that pH of the burned soil was higher (6.23) compared to unburned soil (5.78) at 0-15cm depth while at 15-30cm depth both burned and unburned fields had almost similar pH range. Organic carbon, available P and total N had mean value of 1.5%, 21.63mg/kg and 0.082%, and 2.24%, 20.42mg/kg and 0.201% in the burnt and unburnt fields respectively at the depth of 0-15cm.At the depth of 15-3^{0}cm, available P, total N and organic carbon had mean values of 17.9mg/kg, 0.116% and 1.34%, and 18.07mg/kg, 0.047% and 1.01% in unburnt and burnt fields respectively. All the exchangeable base were higher in the burned fields than the unburned field at both depths while total exchangeable acidity was higher in unburned fields compared to burned fields with mean values of 0.54 cmol/kg and 0.89cmol/kg and burned fields at 0-15cm depth were 0.69cmol/kg and 0.53cmol/kg for unburned and burned fields at 15-30cm depth respectively, all the soils were low in ECEC while base saturation was high with the mean values of 93.01% and 96.03% in unburned and burned fields respectively at 0-15cm depth, 87.69% and 91.14% in unburned and burned fields respectively at 0-15cm depth, 87.69% and 91.14% in unburned and burned fields respectively at 15-30cm depths. T-test results showed that no significant ($p<0.05$) difference in chemical properties on the sub-surface soils of burned and unburned fields existed ($P<0.05$) higher in all the chemical properties except for TEA. It was recommended based on the findings that efforts should be made towards enlightening the farmers on the long-term negative impacts of burning in soil chemical properties by extension agent.

Key Words: *Slash and Burn, Effect, Soil and Chemical Properties.*

Introduction

Slash-and-burn agriculture, also known as swidden farming, is one of the oldest farming systems practiced mainly in tropical and subtropical regions of the world. The method involves clearing forests, bushes, and grasses, allowing the vegetation to dry, and then burning it before cultivation begins. The ash produced from the burned vegetation temporarily enriches the soil with nutrients such as potassium, calcium, magnesium, and

phosphorus, thereby improving soil fertility and supporting crop growth. In earlier times, the practice was considered sustainable because farmers cultivated the land for a short period and then left it fallow for many years, allowing natural vegetation and soil nutrients to regenerate.

However, increasing population growth, demand for food, and pressure on available land have significantly shortened fallow periods, resulting in environmental degradation, nutrient depletion, and declining soil productivity (Laurance, 2022). Consequently, slash-and-burn farming has become a major environmental concern in many developing regions due to its negative effects on soil quality, vegetation cover, and ecosystem stability (Lamontel, 2012).

In Uratta community of Owerri North Local Government Area, Imo State, slash-and-burn agriculture remains a widely practiced method of land preparation among rural farmers. Farmers commonly clear secondary forests, shrubs, and grasses during the dry season using simple tools such as cutlasses and machetes. After the vegetation dries, it is set on fire at the onset of the rainy season, making the land ready for immediate planting. The farming plots are usually small, and crops cultivated include cassava, maize, yam, cocoyam, and vegetables. The continued use of this practice in Uratta is strongly influenced by traditional farming knowledge, low financial requirements, and the need for quick soil fertility improvement. Many farmers depend on the system because it is affordable and requires little mechanized input. Indigenous knowledge regarding the timing of burning, vegetation selection, and cropping patterns has been passed from one generation to another, making slash-and-burn farming deeply rooted in the local agricultural culture.

Nevertheless, increasing pressure on land resources has reduced the ability of the soil and vegetation to recover adequately after cultivation (Anaele, et.al, 2020). The combustion process involved in slash-and-burn agriculture produces significant chemical and environmental changes in the soil and atmosphere (Gundale, et.al 2005). Burning vegetation releases ash that contains alkaline nutrients and trace elements capable of temporarily increasing soil pH and enhancing nutrient availability for crops. The ash can improve crop yields during the first few planting seasons, which explains why many farmers continue to adopt the practice. However, alongside these benefits, important nutrients such as nitrogen and sulfur are lost into the atmosphere through volatilization during burning (Gundale, et.al 2005). The heat generated also destroys soil organic matter, weakens soil structure, reduces moisture retention capacity, and lowers the soil's ability to store nutrients over time (Raison, 2007). Incomplete burning may leave partially charred organic materials that contribute carbon compounds to the soil, but the long-term impact often includes soil degradation and declining agricultural productivity (Gonz-Lez-Fereza et.al, 2004).

Additionally, smoke released during burning contains harmful gases such as carbon dioxide, methane, carbon monoxide, nitrogen oxides, and particulate matter, which contribute to air pollution, climate change, and greenhouse gas emissions (Amin, 2008). These environmental consequences negatively affect biodiversity, vegetation cover, and the sustainability of agricultural land in the community (Andreae&Merlet, 2021). Although slash-and-burn agriculture provides short-term agricultural benefits, its long-term effects create serious environmental and socio-economic challenges (Scoone, 2009). Continuous cultivation without sufficient fallow periods leads to nutrient depletion, soil erosion, reduced crop yields, and loss of biodiversity.

As soil fertility declines, farmers are often forced to clear and burn new land areas for cultivation, thereby increasing deforestation and environmental degradation (Nnabuihe et.al, 2024). The persistence of the practice in Uratta is closely associated with poverty, limited access to modern farming technologies, and dependence on traditional agricultural systems. To address these challenges, experts recommend sustainable agricultural alternatives such as agroforestry, conservation agriculture, improved fallow systems, cover cropping, and the use of organic manure or compost. These approaches can help restore soil fertility, reduce

environmental damage, and improve long-term agricultural productivity (Klanna& Raison, 2006). Researchers also stress the importance of integrating scientific agricultural practices with indigenous knowledge to develop solutions that are environmentally sustainable and culturally acceptable to local farmers.

Therefore, understanding the nature, effects, and implications of slash-and-burn agriculture in Uratta is essential for promoting sustainable farming practices, ensuring food security, conserving the environment, and improving the livelihoods of rural farming communities.Therefore, this study seeks to investigate the effects of slash-and-burn agriculture on the chemical properties (Av.P, N, Oc, Om, Ca^{+}, mg^{2+}, Na^{+}, TEA, ECEC and Bs) of soils in Uratta, Owerri North LGA, Imo State, in order to provide scientific evidence that can support sustainable agricultural practices, improve soil management, enhance long-term crop productivity, and reduce environmental degradation in the area.

Methodology

This study adopted a comparative field-based experimental research design aimed at assessing the effects of slash-and-burn agricultural practices on the chemical properties of soil in Uratta, Owerri North LGA, Imo State. The research was structured to compare soil chemical parameters before and after slash-and-burn activities within the same geographical area. The design enabled the collection of empirical data from controlled natural environments where slash-and-burn practices are actively employed. The choice of this design was guided by the need to directly measure the effect of burning on soil chemical properties including pH levels, organic carbon content, organic matter composition, nitrogen and phosphorus concentrations, exchangeable acidity, (Al^{3}+ & H^{+}) and total exchangeable bases (Ca^{2+} , Mg^{2+} , Na^{+} , K^{+}).

Area of Study

The study was carried out in Uratta, a rural community situated in Owerri North Local Government Area (LGA) of Imo State, located in the Southeastern region of Nigeria. Uratta is part of the tropical rainforest belt and lies within the coordinates of approximately 5°27′N to 5°31′N latitude and 7°1′E to 7°5′E longitude. The area is characterized by a humid tropical climate, with an annual rainfall range of 2000 mm to 2500 mm and average temperatures between 27°C and 32°C, making it favorable for agriculture. The soils in the area are mainly formed from Coastal Plain Sand deposits and are generally acidic with low nutrient reserves.

According Nnabuihe et al., (2024), soils found within Owerri and its surrounding communities are prone to nutrient depletion and degradation when exposed to poor land management practices.

Pre-field Studies

Prior to the commencement of fieldwork, a series of pre-field studies were undertaken to ensure the effectiveness and accuracy of the research process. These preliminary activities include reconnaissance surveys, stakeholder consultations, and site selection, all of which are critical in identifying suitable locations for soil sampling and in understanding the local context of slash-and-burn practices in Uratta.

Soil Sampling

The study adopted a systematic survey method for soil sample collection to assess the effects of slash-and-burn practices on soil chemical properties. Soil samples were collected from both burnt and unburnt sites using a soil auger at two depth levels of 0–15 cm and 15–30 cm to examine nutrient distribution within the soil profile. A total of 24 soil samples were obtained, consisting of 12 samples from burnt sites and 12 from unburnt sites. Six randomly selected sampling points were used in each site, with paired samples collected from both soil depths. To preserve sample quality and prevent contamination, the collected soils were stored in properly labeled airtight polythene bags and transported carefully to the laboratory. Standard procedures were maintained throughout the sampling process to ensure uniformity

in sampling depth, timing, and collection methods, while GPS coordinates of each sampling point were recorded for accurate location reference and future monitoring purposes.

Soil Samples Preparation Before Laboratory Analysis

After collection, the soil samples were transported to the laboratory in clean, labeled polythene bags, air-dried for 5–7 days, gently crushed, and sieved through a 2 mm mesh to obtain uniform particles for chemical analysis. The prepared samples were then carefully labeled with their sampling date and plot identification to ensure proper organization and prevent contamination.

Laboratory Analysis of Soil Samples

The prepared soil samples underwent standard laboratory procedures to determine their chemical properties, using analytical methods recommended by the Soil Science Society of Nigeria (SSSN) and other internationally accepted protocols.The following soil chemical parameters analyzed; include, soil PH, exchangeable acidity (H^+ and Al^{3+}), exchangeable bases ($Ca^{2+,}$ Mg^{2+}, K^+& N^{a+}), organic carbon, organic matter, available phosphorus and total Nitrogen.

Chemical Properties

In this study, the chemical properties of the soil were analyzed to evaluate the effect of slash-and-burn practices on soil fertility and health. The selected chemical properties are indicators of soil nutrient status, acidity, and organic content, which are critical for sustainable agricultural productivity.

Soil pH: Using Thomas (1996) the pH was determined in a 1:1 soil-water suspension using a calibrated pH meter. Changes in pH due to slash-and-burn practices may reflect alterations in nutrient dynamics and biological activity.

Exchangeable Acidity (Al^{3+} and H^+): The exchangeable acidity was determined using a 1 M KCl extraction method followed by titration. High exchangeable acidity often results from nutrient leaching or burning of organic material (Mclean, 1982). Exchangeable bases calcium and magnesium were determined using Atomic Absorption Spectrophotometer, while sodium and potassium were analyzed using flame photometer.

Organic Carbon: Organic carbon was analyzed using the Walkley and Black wet oxidation method as modified by Alison, (1982).

Organic Matter (OM): Organic Matter was estimated from organic carbon values using a conversion factor (typically 1.724) (Nelson & Sommers, 1996).

Total Nitrogen: The Kjeldahl digestion method was used to quantify total nitrogen, which involves converting organic nitrogen into ammonium, followed by distillation and titration (Bremner, 1996).

Available Phosphorus: Available Phosphorus was determined by Bray II method (Bray and Kurtz, 1945).

Determination of Cation Exchange Capacity: The Cation Exchange Capacity was determined through ammonium acetate extraction procedure ([ISO], 2023).

Statistical Analysis

The following statistical methods were applied:

Descriptive Statistics: Mean, standard deviation, and coefficient of variation were calculated for each soil chemical parameter to summarize the data and identify general trends.

T-test: T-test was used to compare the means of unburnt and burnt field soil samples for each parameter (e.g., pH, organic carbon, nitrogen) to determine if the differences observed are statistically significant at $p < 0.05$.

Discussion of Findings

The results of the chemical properties of burnt and unburnt fields at the depths of 0-15cm and 15-30cm are presented in table 1.

The soil pH in the surface layer (0–15 cm) ranged from 5.70 to 5.79 with a mean of 5.78 in the unburnt soils, while the burnt soils ranged from 5.99 to 6.50 with a mean of 6.23, indicating higher pH values after burning. In the subsurface layer (15–30 cm), pH values ranged from 5.3 to 5.6 in both burnt and unburnt soils, with mean values of 5.47 and 5.43 respectively, showing little difference between the two conditions. The higher pH observed in the burnt surface soils supports findings by Tufekcioglu et al. (2010), which stated that burning generally increases soil pH due to ash deposition.

Overall, both burnt and unburnt soils at the two depths were classified as moderately acidic according to Landon (1991), while the limited effect observed in subsurface soils may be because fire mainly affects the upper soil layer.

Available phosphorus (Av.P) in the surface soil layer (0–15 cm) ranged from 19.8 mg/kg to 21.9 mg/kg with a mean of 20.42 mg/kg in the unburnt soils, while the burnt soils ranged from 20.9 mg/kg to 22.5 mg/kg with a mean of 21.63 mg/kg, indicating higher phosphorus content in the burnt fields. In the subsurface layer (15–30 cm), available phosphorus ranged from 16.9 mg/kg to 18.1 mg/kg with a mean of 17.9 mg/kg in the unburnt soils, whereas the burnt soils ranged from 16.9 mg/kg to 19.8 mg/kg with a mean of 18.07 mg/kg. The higher phosphorus levels observed in the burnt soils may be due to the increase in soil pH toward neutrality after burning, which enhances phosphorus availability as reported by Shaeplay (2000). According to Landon (1991), available phosphorus levels were rated high (>20 mg/kg) in the surface soils of both burnt and unburnt fields, while the subsurface soils were rated moderate (8–20 mg/kg).

Total Nitrogen: Unlike the pH and available P and, total N was generally higher in the unburnt soil than the burnt soils. It ranged from 0.188% to 0.221%, 0.072% to 0.088% with mean and CV values of 0.221%, 6.50%, and 0.082% to 8.17% for the urburnt and burnt fields respectively at 0-15cm depth. In the 15-30cm depth, total N varied from 0.103% to 0.131%, 0.039% to 0.062% with the mean and CV values of 0.116% and 10.09% and 0.047% and 17.22%. The findings of this study is also contrary to that of Amin (2008) who stated that there was no significant ($p>0.05$) difference between total N in a burnt and unburnt field respectively.

Organic Carbon: Organic carbon content was higher in the unburnt soils than in the burnt soils, following a trend similar to that observed for total nitrogen. At the surface layer (0–15 cm), organic carbon ranged from 1.89% to 2.44% with a mean of 2.24% in the unburnt fields, while the burnt fields ranged from 1.23% to 1.72% with a mean of 1.50%, indicating a reduction in organic carbon after burning. In the subsurface layer (15–30 cm), organic carbon ranged from 1.17% to 1.53% with a mean of 1.34% in the unburnt soils, whereas the burnt soils ranged from 0.78% to 1.12% with a mean of 1.01%, showing that organic carbon was lower and more variable in the burnt fields. The reduction in organic carbon may be due to the destruction of soil organic matter during burning, as explained by Gonzalez-Rerez et al. (2004), while Wells et al. (2009) also noted that repeated burning reduces soil organic carbon; according to Landon (1991), organic carbon levels were rated high in the unburnt surface soils, moderate in the burnt surface soils, and low in both burnt and unburnt subsurface soils.

Calcium (Ca^{2+}): Calcium had mean and CV values of 4.58cmol/kg and 2.9% in the unburnt fields, 5.48cmol/kg and 5.81% in burned fields at 0-15cm depth while in subsurface (15-30cm) depth, it have mean and CV values of 3.05cmol/kg and 5.39% in unburnt site, 3.24cmol/kg and 6.61% in burned site. Ca^{2+} was higher at both depths of burnt fields them the unburnt fields. The concentration of Ca^{2+}, Mg^{2+}, K^{+} and Na^{+} increased after burning (Allen, 2006). The burned field Ca^{2+} values obtained are similar to 4.37cmol/kg and 5.08cmol/kg obtained in burnt forest and fallow land after 25 days of burning at the depth of

0.15cm obtained by Okonkwo, (2010). Ca^{2+} was moderate in burnt site at 0-15cm (5-10cmol/kg) and low in the unburned sites at both depths and burned site at the depth of 15-30cm (Landon, 1991)

Magnesium (Mg^{2+}): At 0-15cm depth, Mg^{2+} had mean values of 1.93cmol/kg and 3.08cmol/kg with CV of 6.26% and 9.71% in the unburned and burned fields respectively while for 15-30cm depth, it has mean values of 1.38cmol/kg and 1.51cmol/kg with CV of 16.11% and 11.18% in unburnt and burnt sites respectively. Christensen (2006) and Raison (2007) stated that $Mg^{2+}$and potassium (K^{+}) increased after burning. Amin (2008) also recorded a difference in Mg^{2+} values of 4.95cmol/kg and 460cmol/kg in control and burned field respectively.

Mg^{2+} was low in the unburned soils at 15-30cm depth (<1.5cmol/kg), moderate in 15-30cm depth of burned field and unburned field at 0-15cm (1.5-3.0cmol/kg) and high in the burnt site of 0-15cm depth (>3.0cmol/kg) (Landon, 1991).

Potassium (K^{+}): Potassium was more variable (16.89%) in 15-30cm depth of the unburned site than all other soils. It had means of 0.395cmol/kg and 0.473cmol/kg with CV of 3.2% and 4.16% in the unburnt and burnt soils of 0-15cm depth respectively. It all had means of 0.264cmol/kg and 0.30cmol/kg with CV of 16.89% and 7.49% in unburned and burned rite.Klanna and Raison (2006) in their study stated that Ca^{2+}, K^{+} and Mg^{2+} increased considerately in the soil solution immediately following burning. K^{+} varied from moderate (0.2-0.4cmol/kg) in 15-30cm depth of the burn site though high (>0.4cmol/kg) in the 15-30cm depth of the burn sites to moderate (0.2-0.4cmol/kg) in the unburned site of both depths (Landon, 1991).

Sodium (Na^{+}): Sodium (Na^{+}) had the least concentration in both burnt and unburnt soils amongst the exchangeable bases and had mean values of 0.303cmol/kg and 0.367cmol/kg, 0.195cmol/kg and 0.230cmol/kg with CV of 4.01% and 4.46%, 3.80% and 9.67% in unburnt and burnt site of 0-15cm depth and unburned and burned at 15-30cm depth respectively.
Higher Na^{+} values in burned soils than unburned at both depths, is in line with the work done by Amin (2008) who reported Na^{+} values of 0.97cmol/kg and 1.20cmol/kg for control and burned fields respectively. Na^{+} is moderate (0.3-0.7cmol/kg) in both burnt and unburnt field at 0-15cm depth and low (>0.3cmol/kg in both unburnt and burnt sites of 15-30cm depth (Landon, 1991).

Total Exchangeable Acidity (TEA): TEA was higher in the unburned soils than the burned soils for both 0-15cm and 15-30cm depths. Lower TEA in burned soil may be due to increased availability of basic cations occasioned by bush burning. TEA had 0.54cmol/kg and 0.39cmol/kg, 19.40% and 12.53% as means and CV values for unburned and burned fields at 0-15cm depth and 0.69cmol/kg and 0.53cmol/kg, 23.10% and 16.93% as mean and CV values in unburned and burned sites at 15-30cm depth respectively. Decrease in exchangeable acidity following slash and burn practice have been widely reported. Decrease in TEA as a result of slash and burn depends on the quantity of ash produced and the buffering capacity of the soil (Deronde, 2010).

Effective Cation Exchange Capacity (ECEC)

ECEC ranged from 7.45cmol/kg to 8.044cmol/kg with mean and CV values of 7.76cmol/kg and 2.65% in the unburned and 9.40cmol/kg to 10.29cmol/kg with mean and CV values of 9.79cmol/kg and 5.05% in the burned sites at 0-15cm depth. While at 15-30cm depth, ECEC was higher in the burnt soils than in unburnt soils. This is incontrast to the work of Amin (2008) who reported ECEC of 17.80cmol/kg and 16.95cmol/kg in control and burnt field respectively, but similar to the work of Okonkwo,(2010) who obtained ECEC values of 7.36cmol/kg and 8.62cmol/kg in forest and bush follow ECEC (Landon, 1991).

Base Saturation (BS): In the surface soil, base saturation had mean and CV values of 93.01 and 1.27% in the unburnt field, 96.03 and 0.06% in the burnt field while in the sub-surface (15-30cm) soils, it had mean and CV of 86.67 and 2.88% in the unburned site and 91.14 and 1.70% in the burned field. At both 0-15cm and 15-30cm depths, base saturation was higher in the burnt field than in the unburnt field. Base saturation was high (>60%) in both burnt and unburnt at both surface and sab-surface soils (Landon, 1991).

Table 1: Chemical properties of soil from burnt and unburnt fields at 0-15cm depth.

Site	Depth	pH (KCl)	Av.P (mg/kg)	TN (%)	OC (%)	OM (%)	Ca^{2+} ←	Mg^{2+}	K^+ Cmol	Na^+ Kg	TEA ←	ECEC	BS (%)
Unburn 1	0-15	5.8	20.0	0.221	2.40	4.13	4.6	2.0	0.416	0.305	0.72	8.04	91.04
Unburn 2	0-15	5.9	19.8	0.188	1.87	3.22	4.8	1.8	0.398	0.308	0.62	7.92	92.17
Unburn 3	0-15	5.7	20.4	0.196	2.12	3.65	4.6	2.0	0.386	0.312	0.46	7.75	94.06
Unburn 4	0-15	5.7	21.9	0.201	2.28	3.90	4.4	2.1	0.402	0.280	0.52	7.70	93.24
Unburn 5	0-15	5.8	20.4	0.190	2.33	4.02	4.6	1.9	0.390	0.302	0.48	7.67	93.74
Unburn 6	0-15	5.79	20.0	0.218	2.44	4.21	4.5	1.8	0.379	0.313	0.46	7.45	93.82
Mean(x)		5.78	20.42	0.201	2.24	3.86	4.58	1.93	0.395	0.303	0.54	7.76	93.01
STD		0.07	0.77	0.01	0.21	0.37	0.13	0.12	0.01	0.01	0.11	0.21	1.18
% CV		1.30	3.75	6.50	9.90	9.54	2.9	6.26	3.32	4.01	19.40	2.65	1.27
Unburn 1	0-15	6.25	21.0	0.084	1.65	2.85	5.8	3.0	0.480	0.365	0.46	10.11	95.45
Unburn 2	0-15	6.10	20.9	0.088	1.23	2.12	4.9	2.8	0.490	0.380	0.42	8.99	95.32
Unburn 3	0-15	6.22	22.5	0.079	1.59	2.74	5.4	2.8	0.442	0.375	0.38	9.40	95.95
Unburn 4	0-15	5.99	21.8	0.089	1.72	2.96	5.6	3.1	0.477	0.359	0.36	9.89	96.35
Unburn 5	0-15	6.37	22.0	0.072	1.32	2.33	5.7	3.2	0.493	0.381	0.32	10.09	96.82
Unburn 6	0-15	6.50	21.6	0.077	1.48	2.55	5.5	3.6	0.458	0.339	0.38	10.27	96.29
Mean(x)		6.23	21.63	0.082	1.50	2.59	5.48	3.08	0.473	0.367	0.39	9.79	96.03
STD		0.18	0.61	0.01	0.19	0.32	0.32	0.30	0.02	0.02	0.05	0.49	0.57
% CV		2.93	2.81	8.17	12.44	12.41	5.81	9.71	4.16	4.46	12.53	5.05	0.60

Note: Av.P = Available phosphorus, TN = Total Nitrogen, OC = organic carbon, OM = Orgnic matter, Ca^{2+} =Calcium, Mg^{2+} = Magnessium, K^+ = Potassium, Na^+ = Sodium, TEA = Total exchangeable acidity ECEC = Effective cation exchange capacity, BS-Base saturation std= standard deviation, CV = coefficientof variation.

Table 2: Chemical properties of soil from burnt and unburnt fields at 15-30cm depth.

Site	Depth	pH (KCl)	Av.P (mg/kg)	TN (%)	OC (%)	OM (%)	Ca^{2+} ←	Mg^{2+}	K^+ Cmol	Na^+ kg	TEA ←	EC EC	BS (%)
Unburn 1	15-30cm	3.6	17.5	0.118	1.22	2.10	3.0	1.6	0.203	0.190	0.92	5.91	84.43
Unburn 2	15-30cm	5.3	17.9	0.104	1.17	2.01	3.1	1.4	0.281	0.201	0.78	5.76	86.45
Unburn 3	15-30cm	5.5	16.9	0.114	1.24	2.14	2.8	1.4	0.211	0.188	0.78	5.57	85.47
Unburn 4	15-30cm	5.5	18.1	0.128	1.40	2.41	3.0	1.6	0.298	0.188	0.58	5.66	89.75
Unburn 5	15-30cm	5.6	19.0	0.103	1.50	2.58	3.1	1.3	0.280	0.204	0.56	5.45	89.72
Unburn 6	15-30cm	5.3	18.0	0.131	1.53	2.63	3.3	1.0	0.301	0.201	0.52	5.32	90.22
Mean(x)		5.47	17.9	0.116	2.31	2.31	3.05	1.38	0.264	0.195	0.69	5.58	87.67
STD		0.14	0.70	0.01	0.26	0.26	0.16	0.22	0.04	0.01	0.16	0.24	2.52
% CV		2.50	3.89	10.09	11.42	11.42	5.39	16.11	16.89	3.80	23.10	4.21	2.88
Unburn 1	15-30cm	5.4	17.6	0.045	1.09	1.8	3.4	11.8	0.264	0.208	0.58	6.45	91.00
Unburn 2	15-	5.6	17.1	0.039	0.78	1.34	3.2	1.4	0.301	0.240	0.62	6.16	89.93

	30cm												
Unburn 3	15-30cm	5.3	17.3	0.047	1.06	1.82	3.0	1.3	0.280	0.240	0.62	5.50	88.72
Unburn 4	15-30cm	5.4	16.9	0.041	1.12	1.93	3.2	1.4	0.303	0.240	0.46	5.56	92.44
Unburn 5	15-30cm	5.3	19.8	0.047	1.09	1.88	3.1	1.5	0.318	0.260	0.44	6.09	92.44
Unburn 6	15-30cm	5.57	19.7	0.062	0.89	1.53	3.3	1.7	0.322	0.230	0.53	5.91	91.14
Mean(x)		5.43	18.07	0.047	1.01	1.72	3.24	1. 51	0.300	0.230	0.53	5.91	91.14
STD		0.13	1.32	0.01	0.14	0.24	0.22	0.18	0.02	0.02	0.09	0.38	1.55
% CV		2.41	7.33	17.22	13.68	13.64	8.61	11.18	7.49	9.67	16.93	6.39	1.70

Note: Av.P = Available phosphorus, TN = Total Nitrogen, OC = organic carbon, OM = Orgnic matter, Ca^{2+} =Calcium, Mg^{2+} = Magnessium, K^{+} = Potassium, Na^{+} = Sodium, TEA = Total exchangeable acidity ECEC = Effective cation exchange capacity, BS-Base saturation std= standard deviation, CV = coefficientof variation.

Table 3: Mean (X) chemical properties of soil from burnt and unburnt field at 0-15 and 15-30cm depths.

Treatment	Depth (cm)	pH (KCl)	Av.P (mg/kg)	TN (%)	OC (%)	OM (%)	Ca^{2+} ←	Mg^{2+}	K^{+} Cmol	Na^{+} Kg	TEA ←	ECEC	BS (%)
Unburn	0-15	5.78	20.42	0.201	2.24	3.86	4.86	1.93	0.395	0.303	0.54	7.76	93.01
Burn	0-15	6.23	21.63	0.084	1.65	2.85	5.80	3.00	0.480	0.365	0.46	10.11	95.45
T-test (0.05)		0.34	Ns	0.017	0.30	0.50	0.46	0.44	0.022	0.024	0.12	0.88	1.73
Unburn	15-30	5.47	17.90	0.116	1.34	2.31	3.05	1.38	0.264	0.195	0.69	5.58	87.67
Burn	15-30	5.43	10.07	0.047	1.01	1.73	3.27	1.63	0.300	0.230	0.53	5.91	91.14
T-test (0.05)	NS	NS	0.021	NS	NS	NS	NS	NS	NS	NS	NS	NS	3.45

Note that NS = not significant.

Table 3: T-test of the mean chemical properties of soil from burnt and unburnt field at 0-15 and 15-30cm depths.

The result of T-test conducted to determine the effect of slash and burn practice on soil chemical propertion in Uratta in Owerri North Local Government area of Imo State as presented in Table 4:3. The results show that there was no significant (P> 0.05) difference in chemical properties at the depth of 15.30cm in both burnt and unburnt field except base saturation (BS) that was significantly (P < 0.05) higher in burnt field than in the unburut field and total nitrogen was significantly (P < 0.05) higher in burnt field than burnt field. The findings for the subsurface soils are in line with Amin (2008) who reported no significant difference (P > 0.05) in soil chemical properties when the effect of fires on soil chemical properties was assessed.

Unlike in the subsurface soils, the surface (0-15cm) of the burnt and unburnt fields were significant (P > 0.05) in virtually all the properties except total exchangeable base (TEA), available P, Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}, ECEC and K^{+}base saturation were significantly (P > 0.05) higher in the burnt field surface soils than in the unburnt field while total Nitrogen and organic carbon were significantly (P > 0.05) higher in the unburn surface soils than the burnt field surface soils. (Table 3).

Conclusion

The study concludes that slash-and-burn practice substantially alters the chemical properties of soil, particularly within the surface layer (0–15 cm), where burnt soils generally recorded higher pH, available phosphorus, exchangeable bases, ECEC and base saturation than unburnt soils. However, burning reduced total nitrogen and organic carbon contents, indicating possible depletion of important soil organic matter and nutrients despite the short-term increase in some chemical properties.

Overall, the effects of burning were more pronounced in the surface soil than in the subsurface layer (15–30 cm), suggesting that repeated burning may have important implications for long-term soil fertility and sustainable agricultural production.

Recommendations

In view of the importance of soil for food production and conservation of ecosystem, the following recommendations were made:

1. Government should create conservation awareness through the help of the soil scientists in Nigeria on how best to conserve the soil other than bush burning.
2. Efforts should be made toward enlightening the public/farmers on the long-term negative impact of burning on soil properties and structure of the vegetation by extension agent.

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