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Full Length Research Article

ASSESSMENT OF THE IMPACT OF BUSH BURNING ON SOIL IN KAJURA LOCAL GOVERNMENT AREA, KADUNA STATE NIGERIA

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ABSTRACT
Bush burning is a common practice in both the savannah and forest zones of Nigeria and has greatly altered the soil status, especially in Kajuru LGA. The study was conducted to identify the causes of bush burning on soil around Kasuwa Magani, Kajuru LGA Kaduna, Nigeria, investigate the consequences of bush burning on soil nutrients and soil physicochemical properties and microbial biomass activity. Laboratory soil analysis was conducted on burnt land and unburnt land and Kjeldahl method was employed for nitrogen assessment., the Bray II method for phosphorus, and the flame photometer method for potassium. CEC was determined by the ammonium acetate method, while soil microbial activity was assessed by the substrate-induced respiration (SIR) method. Three soil samples were collected from burnt and unburnt soil, each of which makes a total of six samples and the distance from each sample is 5 m, soil samples were collected using a soil auger at a depth of 0-15 cm. Independent t-test was employed and also observational technique was used to assess the main causes of bush burning on soil. The results showed that there is no significant difference in soil nutrients, soil physio-chemical properties and microbial biomass activity between burnt soil and unburnt soil due to low fire intensity in the study area. It also shows that the main causes of bush burning in the study area were farm clearing, hunting and sometimes arson. It is important to create public awareness campaign on the need to preserve the soil ecosystem by avoiding the dangers of bush burning on land.

Keywords: Burning; Microbial, Nutrient, Soil texture, Total Organic Carbon, Total Organic Matter

INTRODUCTION

The quest for survival of humanity, improvement of quality of life and well-being has made modern man the culprit of the degradation of the Earth. This is due to the uncontrolled pattern of consumption of natural resources, especially energy, and many adverse ecological behaviors.

Bush burning, or fire, is a chemical reaction between oxygen and fuel, which is raised to an ignition temperature by heat and the reaction is self-sustaining unless it goes out or the fuel concentration drops below a minimum level. Most often, bush burning is the result of a rapid exothermic reaction in combination with oxygen and one combustible material, which Abui et al (2019) found that bush burning is part of the way of life in some countries.

Culturally, bush burning is a practice in most developing countries including Nigeria at the beginning of the planting season until the middle of the dry season. As more land is cleared and prepared for cultivation every year, bush burning has become the easiest and most convenient method that is quite often used in agricultural practices as well as in environmental management. In many areas, the attitude has changed to total burning (wildfire), which is becoming the main cause of nutrient depletion. This calls for studies of this kind to determine the effect of such localized burns and fires on the soil and their subsequent effect on crop production. The vast majority of areas burned and cleared each year for the purpose of growing crops, driving out game for hunters, improving livestock grazing conditions, and land migration and settlement lie in the savanna ecological zone (Isah and Adegeye, 2002). This practice always leads to heating and drying of the soil.

Bush burning is one of the ways in which man has significantly changed the natural environment. For the farmer, it is the cheapest way to clean the agricultural land. It is the easiest way for the nomad to clear the garbage to allow for the early germination of fodder for the animals, hunters say it is a game hunting technique (Agbeshie *et. al.,* 2020).

Bush burning has been practiced since time immemorial and has been accepted as an integral part of the traditional agricultural system in many societies. However, changing lifestyle patterns, population growth, urbanization and agricultural systems that put pressure on the natural environment indicate that the traditional bush burning system can no longer be sustained, but has been difficult to reduce or eliminate completely (Agbeshie et al, 2020). According to Satendra and Kaushik (2014), it is interesting to know that the first experience of fire experienced by ancient human beings was forest/wild fire. Forest fires have thus become an integral part of human civilization.

Bush burning is a notorious driver of deforestation and environmental degradation in Nigeria. Wendi as cited in Ubuoh, Ejekwolu & Onuigbo (2017) observed that when land is burnt, its nutrients are destroyed and the soil is depleted. And when grass is burned, it releases carbon dioxide into the atmosphere, which contributes to ozone depletion and climate change. Bush burning is bad for both agriculture and the environment as it affects the soil through drying, erosion and degradation and the environment through pollution.

Nigerians are facing a serious global environmental problem and there is widespread concern that the ozone layer, which is causing severe deterioration, is contributing to climate change and global warming (Isah & Adegeye., 2002)). Blaming fingers are pointed at bush burning to reduce crop yields, alien/alien species invasion, soil compartmentalization. A number of research studies and

many articles have been published on the issue of bush burning and its accompanying effect on grasslands. Many have contributed positive suggestions to reduce bush burning (Gbaa, & Iorpe, 2015), although this suggestion has not been followed (Ambe, Eja & Agbor 2015).
Bush burning, whether as a result of a forest fire or controlled burning, affects not only the appearance of the landscape, but also the quality of the soil. A landscape can recover quickly after a fire, with fresh new growth and emerging seedlings. However, bush burning has a negative effect on soil conditions and soil recovery can take much longer. Man has proven to be a very important geomorphic agent and is able to change the environment much faster than many natural processes. The impact of fire on site productivity is also related to intensity. While high intensity fires tend to reduce site productivity, low intensity fires can increase site productivity (Carter and Foster 2003).

STUDY AREA

The study was conducted in Kajuru Local Government located in Kaduna State, Nigeria. The area is known for its significant agricultural activity and is prone to frequent bush burning. The selection of this area was based on its susceptibility to bush burning and its potential impact on soil properties (Fig. 1)

LOCATION OF THE STUDY AREA

Kajuru local government area is located between longitudes 9° 59'N to 10° 55'N and 7° 34'E to 8° 13'E, with an area of 2,229 km^2 (Fig. 1). Nigerian National Population Commission and National Bureau of Statistics (NPC & NBS, 2023).

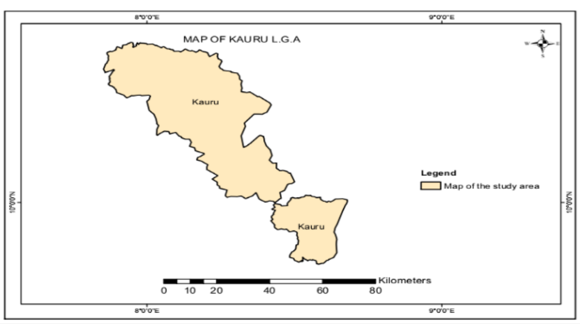

Figure 1. Location of Kajuru Local government Kaduna

RESEARCH DESIGN

The research adopted a cross-sectional research design that involved data collection at a specific point in time. This design is suitable for investigating the effect of bush burning on soil properties in the study area. Various soil properties were measured and compared between burnt and unburnt areas to assess the effect of bush burning on the soil.

Location Selection

A purposive sampling technique was used to select the study sites. Six plots, each 100 x 50 m in size was selected: burnt areas that have recently experienced bush burning and unburnt areas that served as control sites. Burnt and unburnt areas was selected to ensure a representative sample capturing the variability of soil properties.

The distance between plots was 30 m to ensure that each plot is independent of the others, reducing the chance of any plot influencing the results of the others as the plot areas are homogenous.
A total of 6 sampling points was randomly selected for soil sampling, consisting of 3 from burned areas and 3 from unburned areas on the plots, the distance from point A, point B and point C was 5 m respectively, i.e. limit the mutual influence of any point because the area are for each homogeneous and give the research the right result.
Samples were taken at a depth of 0-15 cm, which is often referred to in soil science as the "root zone" or "topsoil". This depth was chosen because it is where most of the biological activity and nutrient cycling in the soil occurs.

Analysis of Soil Samples for the Impact of Bush Burning on Soil Properties

i. Physical properties such as soil texture, bulk density, and porosity were determined using standard laboratory techniques, including sieving, sedimentation, and determination of soil moisture content.
ii. Chemical properties: Analyze soil samples for chemical properties such as pH, organic matter content, nutrient levels such as nitrogen, phosphorus, and potassium and heavy metal concentrations. These analyzes can be performed using a variety of laboratory methods, including pH meters, spectrophotometry, and atomic absorption spectroscopy.
iii. Biological properties: Assess soil biological properties such as microbial activity and diversity. This was achieved using techniques such as microbial biomass determination, enzyme activity assays and DNA sequencing.

Laboratory Analysis.

Soil samples collected from the field were taken to the laboratory for further analysis. Laboratory analysis included determination of nutrient content (nitrogen, phosphorus and potassium), cation exchange capacity (CEC) and soil microbial activity. Nutrient content was analyzed using standard procedures, the Kjeldahl method for nitrogen, the Bray II method for phosphorus, and the flame photometer method for potassium. CEC was determined by the ammonium acetate method, while soil microbial activity was assessed by the substrate-induced respiration (SIR) method.
Soil pH, organic matter content, soil moisture, soil texture and bulk density were measured using the following method;
A. Soil pH: The soil is potentionmentrically measured in the supernatant suspension of a 1:2:5 soil: liquid mixture. The liquid is either water (pH (H2O)) or a 1 M KCl soil solution (pH (KCl)).
B. Soil organic Matter: loss on ignition (LOI) or dry combustion (Dumas) methods which was used in measuring the loss of weight as the soil sample was heated in an oven over 400°c, effectively burning off the organic matter and measuring the weight lost given the amount of soil organic matter.
C. Soil moisture content, often expressed as a percentage of dry weight, was determined by weighing the wet soil sample, drying in an oven, and then weighing the dry soil. The moisture content was then calculated by dividing the difference between the wet and dry weights by the dry weight, then multiplying by 100
D. Soil texture: Jar Sedimentation Method was used as a jar was filled with soil and water to measure the settling time of different particle sizes, allowing for the estimation of sand, silt, and clay percentages
E. Bulk Density: The core method was used to determine the bulk

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density by involves extracting a cylindrical soil sample using a coring device, measuring its dimensions and weight, and calculating bulk density by dividing the dry weight of the sample by its volume.

RESULTS AND DISCUSSION

The pH scale ranges from 0 to 14, with values below 7 indicating acidity, values above 7 indicating alkalinity, and a pH of 7 considered neutral.

In this case, the unburnt soil pH values range from 4.91 to 5.00, which suggests a slightly acidic to neutral pH. On the other hand, the burnt soil pH values range from 4.95 to 5.29, indicating a slightly acidic to slightly alkaline pH. Burn-related increases in soil pH are due to the acid neutralizing capacity of ash (Khanna et al., 1994) and to consumption of hydrogen ions during the of organic acids in soil and the forest floor.

It is important to note that soil pH can affect various aspects of soil health, nutrient availability, and plant growth. Different plants have different pH requirements, and soil pH can influence the availability of essential nutrients for plants. Generally, most plants prefer a slightly acidic to neutral pH range for optimal growth.

Based on the provided data, the study shows that the burnt soil has slightly higher pH values compared to the unburnt soil.

The Total Organic carbon (TOC) value for unburnt soil at point A is 3.29, and the same value is observed for burnt soil at point A. This indicates that the TOC content remained unchanged after burning.

The TOC value for unburnt soil at point B is 3.39, while for burnt soil at point B, it is 2.39. This suggests a decrease in the TOC content after burning at point B (Table 1).

The TOC value for unburnt soil at point C is 6.02, whereas for burnt soil at point C, it is 3.39. This indicates a significant decrease in the TOC content after burning at point C (Table 1). Total Organic Carbon (TOC) is a measure of the carbon content in organic matter present in the soil. It is an important parameter for assessing soil fertility, nutrient availability, and overall soil health. Higher TOC values generally indicate a higher organic matter content, which can contribute to better soil structure, water-holding capacity, and nutrient retention.

The decrease in TOC values observed after burning the soil at points B and C suggests that the burning process may have resulted in the loss of organic matter. This loss of organic matter can have implications for soil fertility and nutrient cycling. This result negates the finding of Edem et.al (20015) who observed increased in soil SOC in the soil surface after burning but supported the finding of Mamman and Flolorunsho (2015) who reported the loss of organic carbon in soil occurs as a result of fire depleting the litter on the surface.

The Total Organic Matter (TOM) value for unburnt soil at point A is 5.68, and the same value is observed for burnt soil at point A (Table 1). This indicates that the TOM content remained unchanged after burning.

The TOM value for unburnt soil at point B is 5.84, while for burnt soil at point B, it is 4.13. This suggests a decrease in the TOM content after burning at point B (Table 1).

The TOM value for unburnt soil at point C is 6.02, whereas for burnt soil at point C, it is 5.84 (Table 1). This indicates a slight decrease in the TOM content after burning at point C.

Total Organic Matter (TOM) is a measure of the organic material present in the soil, including plant and animal residues in various stages of decomposition. TOM is an important component of soil fertility and plays a crucial role in nutrient cycling, moisture retention, and soil structure.

The decrease in TOM values observed after burning the soil at points B and C suggests that the burning process may have resulted in the loss of organic matter. This loss of organic matter can have implications for soil fertility, nutrient availability, and overall soil health. The soil organic matter increases structure stability, resistance to rainfall impact rate of infiltration and faunal activities (Ubuoh et al, 2017).

Total Nitrogen (TN):

The Total Nitrogen (TN) values for burnt soil at points A, B, and C are slightly lower compared to the corresponding unburnt soil TN values. This suggests a slight decrease in TN content after burning.

The decrease in TN may indicate the loss of nitrogen compounds during the burning process, which can affect nutrient availability and soil fertility. The result disagrees to the finding of Edem and Alphonsus (2016) who observed increased in total nitrogen in burnt soil in continuous cropped arable experimental plots

Available Phosphorus (P):

The available P values for burnt soil at points A, B, and C are generally similar to or slightly lower compared to the corresponding unburnt soil P values. This indicates that the burning process may have had little effect on the available phosphorus content. The result is consistent with the finding of Jamala et al (2017) who observed increase in available P was higher immediately after burning than after one year of cropping relative to the unburned forest vegetation

However, it is important to note that the available P values can be influenced by various factors, including soil pH, organic matter content, and specific soil properties.

Table 1: Showing result gotten from the lab indicating the various data of the soil physiochemical properties among burnt and unburnt soil

Lab Number	Soil sample I.D number	Soil pH 1:2:5 (SW)	T.O.C	T.OM	TN	Avail P(BRDY1)
						(Mg.kg^1)
1	UNB(A)	5	3.29	5.68	0.47	10.98
2	UND(B)	4.93	3.39	5.84	0.49	6
3	UNB(C)	4.91	3.49	6.02	0.5	7.36
4	BND(A)	5.29	3.29	5.68	0.45	8.48
5	BND(B)	5.11	2.39	4.13	0.34	7.93
6	BND(C)	4.95	3.39	5.84	0.43	9.09

Soil Macro Nutrient among Burnt and Unburnt Soil
Potassium (K)
The K values for burnt soil 0.64,0.61,0.26 at points A, B, and C respectively are generally higher compared to the corresponding unburnt soil K values 0.29,0.12,0.16 (Table 2). This suggests an increase in K content after burning.
The burning process may have released or concentrated potassium compounds in the soil.

Sodium (Na):
The Na values for burnt soil at points A and B, 0.74 and 0.72 respectively are higher compared to the corresponding unburnt soil Na values 0.27, 0.16 and 0.10. At point C, the Na value 0.25 for burnt soil is slightly lower (Table 2).
The burning process may have resulted in the release or redistribution of sodium compounds in the soil.

Calcium (Ca):
The Ca values for burnt soil 6.00 and 6.00 at points A and B respectively are similar to the corresponding unburnt soil Ca values 6.80 and 4.80 while at point C, 7.20 is slightly higher (Table 2). At point C, the Ca value 4.80 for burnt soil is slightly lower. The burning process may have had little effect on the calcium content in the soil.

Magnesium (Mg):
The Mg values for burnt soil 1.80, 1.78, 1.45 at points A, B, and C respectively are generally similar to or slightly lower compared to the corresponding unburnt soil Mg values 1.98, 1.44.2.16 (Table 2).
The burning process may have had little effect on the magnesium content in the soil.
The amounts of organic carbon, total nitrogen, available phosphorus, calcium and magnesium contents of the soil were seen to decrease as a result of burning. (Pantami, et. al., 2010).

Table 2: Soil Macro Nutrient among Burnt and Unburnt Soil.

Exchangeable Macro nutrient (mol.kg^1)

Soil sample I.D number	K	Na	Ca	Mg
UNB(A)	0.29	0.27	6.60	1.98
UND(B)	0.12	0.16	4.80	1.44
UNB(C)	0.16	0.10	7.20	2.16
BND(A)	0.64	0.74	6.00	1.80
BND(B)	0.61	0.72	6.00	1.78
BND(C)	0.26	0.25	4.80	1.43

Particle Size Distribution among Burnt And Unburnt Soil
Particle Size Distribution
Clay Content:
The clay content in the burnt soil 9,8,8 is slightly higher or remained the same compared to the unburnt soil 8,7,10 at all three points (Table 3).
The burning process may have had minimal impact on the clay content in the soil.
Silt Content:
The silt content in the burnt soil 32, 37, 33 and unburnt soil 38, 38, 37 varies across the different points (Table 3). For the burnt soil point, A, the silt content decreased, while at point B, it remained the same, and at point C, it decreased. While for unburnt soil at point A, the silt content increased and point B, it remains the same with point A while at point C it decreases.
The burning process may have resulted in the redistribution or loss of silt particles in the soil.
Sand Content:
The sand content in the burnt soil 59,55 and 59 across all sample point are generally similar to or slightly higher compared to the unburnt soil 57,55,53 at all three points (Table 3).
The burning process may have resulted in the redistribution or concentration of sand particles in the soil.

Soil Texture:
The soil texture remained the same (Sandy Loam) for both unburnt and burnt soil at all three points. The burning process may not have significantly altered the overall soil texture.

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Exchange Acidity:
The exchange acidity values for burnt soil at points A and C 0.02 and 0.80 respectively are different compared to the corresponding unburnt soil values 0.40 and 0.60 respectively (Table 3). At point A, 0.02 the exchange acidity decreased, while at point C, 0.80 it increased. At point B, 0.40 the exchange acidity remained the same in both burnt and unburnt soil (Table 3).
The burning process may have resulted in changes in the exchange acidity, which can affect soil pH and nutrient availability.

Gravimetric moisture content (%)
The given values represent measurements of the gravimetric moisture content (%) of unburnt soil and burnt soil. Gravimetric moisture content is a measure of the amount of water present in a substance relative to its dry weight.
The finding indicate that 7.95% value indicates a gravimetric moisture content of 7.95% for unburnt soil. It means that, for a given weight of soil, 7.95% of that weight is composed of water, 10.92% measurement represents a gravimetric moisture content of 10.92%. It suggests that unburnt soil contains a higher amount of water compared to the previous measurement and 9.89% this value indicates a gravimetric moisture content of 9.89%, which is slightly lower than the previous measurement. It suggests that the soil being measured contains a slightly lower amount of water.
For burnt soil 4.76% measurement represents a gravimetric moisture content of soil sample A, it suggests that burnt soil contains a lower amount of water compared to the previous measurements, 6.17% this value indicates a gravimetric moisture content of sample B soil, it suggests that the soil being measured contains a moderate amount of water relative to its dry weight. And 3.76% this measurement represents a gravimetric moisture content of soil sample C. which is the lowest value among the given results. It indicates that burnt soil contains the least amount of water.

Bulk Density
The given values represent measurements of bulk density (B.D) in grams per cubic centimeter (g/cm^3) for three different soil samples (A, B, C) from both unburnt soil and burnt soil.

Unburnt soil:
Based on the laboratory analysis 1.27 g/cm^3 value indicates the bulk density of unburnt soil sample A. It means that for every cubic centimeter of volume, sample A has a mass of 1.27 grams, 1.30 g/cm^3 this value represents the bulk density of unburnt soil sample B. It suggests that sample B has a slightly higher density compared to sample A, and 1.27 g/cm^3 this value indicates the bulk density of unburnt soil sample C. It is the same as the bulk density of unburnt soil sample A, suggesting similar density between the two samples.

Burnt soil:
For burnt soil 1.50 g/cm^3 value represents the bulk density of burnt soil sample A. It indicates that the burnt soil has a higher density compared to unburnt soil samples A and C, 1.73 g/cm^3 value indicates the bulk density of burnt soil sample B. It suggests that burnt soil sample B has the highest density among all the samples, and 1.43 g/cm^3 represents the bulk density of burnt soil sample C. It suggests that burnt soil sample C has a slightly lower density compared to burnt soil sample B.
Bulk density can provide insights into soil compaction, porosity, and water-holding capacity, among other soil properties.

Table 3 Particle Size Distribution Among Burnt And Unburnt Soil Particle Size Distribution

Soil sample I.D number	Clay (%)	Silt (%)	Sand (%)	Soil textural Class (U.S.D.A)	EXCH Acidity (H+ +H3+) (mol.mg.kg-1)	GM.C (%)	B.D (g.cm-3)
UNB(A)	8	38	57	S. L	0.40	7.95	1.27
UND(B)	7	38	55	S. L	0.40	10.92	1.30
UNB(C)	10	37	53	S. L	0.60	9.89	1.27
BND(A)	9	32	59	S. L	0.20	4.76	1.50
BND(B)	8	37	55	S. L	0.40	6.17	1.73
BND(C)	8	33	59	S. L	0.80	3.76	1.43

Microbial Biomass
The microbial biomass values for burnt soil at all three points are similar to the corresponding unburnt soil values. The burning process may not have significantly affected the microbial biomass in the soil. It is important to note that exchange acidity and microbial biomass are important indicators of soil health and nutrient cycling. Exchange acidity can affect nutrient availability and soil pH, while microbial biomass plays a crucial role in organic matter decomposition and nutrient transformation.

Clay Content:
The clay content in the burnt soil 9,8,8 is slightly higher or remained the same compared to the unburnt soil 8,7,10 at all three points (Table 3).
The burning process may have had minimal impact on the clay content in the soil.

Silt Content:
The silt content in the burnt soil 32, 37, 33 and unburnt soil 38, 38, 37 varies across the different points (Table 3). For the burnt soil point, A, the silt content decreased, while at point B, it remained the same, and at point C, it decreased. While for unburnt soil at point A, the silt content increased and point

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B, it remains the same with point A while at point C it decreases.
The burning process may have resulted in the redistribution or loss of silt particles in the soil.

Sand Content:
The sand content in the burnt soil 59,55 and 59 across all sample point are generally similar to or slightly higher compared to the unburnt soil 57,55,53 at all three points (Table 3).
The burning process may have resulted in the redistribution or concentration of sand particles in the soil.

Soil Texture:
The soil texture remained the same (Sandy Loam) for both unburnt and burnt soil at all three points. The burning process may not have significantly altered the overall soil texture.

Exchange Acidity:
The exchange acidity values for burnt soil at points A and C 0.02 and 0.80 respectively are different compared to the corresponding unburnt soil values 0.40 and 0.60 respectively (Table 3). At point A, 0.02 the exchange acidity decreased, while at point C, 0.80 it increased. At point B, 0.40 the exchange acidity remained the same in both burnt and unburnt soil (Table 3).
The burning process may have resulted in changes in the exchange acidity, which can affect soil pH and nutrient availability.

Table 3. Soil Microbial Biomass Among Burnt and Unburnt Soil Microbial Biomass (%)

Sample I. D	T.C	T. N	T. P
UND (Un-Burnt Soil)	0.035	0.023	0.26
BND (Burnt Soil)	0.015	0.016	0.18

T-test of soil physical properties from the two-independent farm
For each variable (Soil pH, Total organic carbon, Total organic matter, Total nitrogen, and Available Phosphorus), there are two sets of results: one assuming equal variances and the other assuming unequal variances.

1. **Equal variances assumed:**
i. t: This is the t-value, which measures the difference between the two group means relative to the variability within the groups.
ii. df: This is the degrees of freedom, which determines the critical value for the t-distribution.
iii. Sig. (2-tailed): This is the p-value associated with the t-test. It indicates the probability of obtaining the observed difference in means by chance alone, assuming the null hypothesis is true.
iv. Mean Difference: This is the difference in means between the two groups.
v. Std. Error Difference: This is the standard error of the difference in means.
vi. 95% Confidence Interval of the Difference: This provides an interval estimate for the true difference in means. The lower and upper values represent the lower and upper bounds of the confidence interval, respectively.

Potassium:
Assuming equal variances, the t-value is -2.368 with 4 degrees of freedom, resulting in a p-value of 0.077.
This suggests that there may be a significant difference in mean Potassium levels between the "Unburnt soil" and "Burnt soil" groups at a significance level of 0.05.

Nitrogen:
Assuming equal variances, the t-value is -2.346 with 4 degrees of freedom, resulting in a p-value of 0.079.
This indicates that there may be a significant difference in mean Nitrogen levels between the "Unburnt soil" and "Burnt soil" groups at a significance level of 0.05.

Calcium:
Assuming equal variances, the t-value is 0.728 with 4 degrees of freedom, resulting in a p-value of 0.507.
This suggests that there is no significant difference in mean Calcium levels between the "Unburnt soil" and "Burnt soil" groups at the conventional significance level of 0.05.

Magnesium:
Assuming equal variances, the t-value is 0.768 with 4 degrees of freedom, resulting in a p-value of 0.485.
This suggests that there is no significant difference in mean Magnesium levels between the "Unburnt soil" and "Burnt soil" groups at the conventional significance level of 0.05
The impact of fire on site productivity is also related to intensity. While high intensity fires tend to decrease site productivity, low intensity fires can increase site productivity (Carter and Foster 2003). In one study of low intensity prescribed fire, nearly all the fire effects were limited to the forest floor and that the effects were weak. When compared to an unburned stand, nutrient pools in frequently burned stands were unaffected (P, Mg, K, S), increased slightly (Ca), or decreased (N, S).
Fire intensity will most likely determine post-fire soil nutrient dynamics. High intensity fires usually decrease nutrient pools more than low intensity fires and can have many other post-fire impacts that lower site productivity. Nutrient pools in the organic soil horizons are more likely to be impacted by fires than those in the mineral horizons
In summary, based on the provided information, so therefore the null hypothesis will be accepted for all the tests conducted.
The impact of fire on soil microbes this dependent to a large extent on the fire intensity. The responses of soil microbes to fires range from no detectable effect in low intensity fires to total sterilization of the surface layers of soil in very hot wildfires (Dhakal, S. and Sedhain, G.K.2016). This early work focused primarily on the abundance of microorganisms and not their activity levels. This is interesting because workers have observed that although there is a decrease in abundance of microbes following fire, the remaining microbes can have levels of activity that are greater than that of the microbial community prior to the fire (Auclerc et al. 2019). These authors found that the increased rates of microbial processes, such as denitrification and production of methane and carbon dioxide, persisted for one year

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following fire.

Conclusion

The impact of wildfires on soil properties largely depends on fire severity, which consists of fire intensity and duration. In some regions, controlled fires are used as a management tool to prevent large-scale wildfires by removing dry leaves, grass, and branches that could fuel a potential fire. However, if these controlled fires are not managed properly, they can also lead to uncontrolled spread. The causes of forest fires are multifaceted and include a combination of natural factors, human activities and changing environmental conditions.

Recommendation

Since the method of bush burning for land preparation and hunting has been around since time immemorial, it will be very difficult to stop until local farmers in the area are sanitized of the impact of bush burning on the soil ecosystem and the environment as a whole. It therefore proposes an effective expansion of environment awareness. Land restoration is suggested in area fire has affected the soil as that will increase soil nutrients.

REFERENCE

Agbeshie AA, Logah V, Opoku A, Tufour HO, Abubakari A, Quansah C (2020) Mineral nitrogen dynamics in compacted soil under organic amendment. Sci Afr 9:e00488
Auclerc A, Le Moine JM, Hatton PJ, Bird JA, Nadelhofer KJ (2019) Decadal post-fre succession of soil invertebrate communities is dependent on the soil surface properties in a northern temperate forest. Sci Total Environ 647:1058–1068

Abui, Y. M., Siaka, S., Yusuf, N. B., Saidu, S., & Bulus, M. (2019). Analysis of bush burning in the northern Guinea savannah of Kaduna State: Implication for agriculture and the environment. *Journal of Environmental Science, Toxicology and Food Technology, 13(1), 1-8. https://doi.org/10.9790/2402-1301010108*

Carter, J. O., & Foster, G. R. (2003). Fire effects on soil aggregation: *A review. Journal of Range Management, 56(6), 595-602. https://doi.org/10.2307/4003895*

Edem, I. D., Udoinyang, U. C., & Edem, S. O. (2015). Variability of soil physical conditions along a slope as influenced by bush burning in acid sands. Journal of Environmental Science, Toxicology and Food Technology, 9(3), 1-7. https://doi.org/10.9790/2402-09310107

Fisher, R. F., & Binkley*, D. (2000). Ecology and management of forest soils. John Wiley & Sons.*

Gbaa, S., & Iorpe, P. S. (2015). Peoples perception on the effects of bush burning in Gwer-East local government area, Benue State, Nigeria. *Journal of Environmental Science, Toxicology and Food Technology, 9(3), 1-7. https://doi.org/10.9790/2402-09310107*

Isah, A. D., & Adegeye, A. O. (2002). Effects of grassland fire on selected properties of soil in the savannah region of Nigeria. *Journal of Arid Environments, 52(3), 345-358. https://doi.org/10.1006/jare.2002.1013*

Jamala, G. Y., Boni, P. G., Abraham, P., & Teru, C. P. (2017). Evaluation of environmentaland vulnerability impact of bush burning in southern Guinea savanna of Adamawa State, Nigeria. *Journal of Environmental Science, Toxicology and Food Technology, 11(4), 1-9. https://doi.org/10.9790/2402-1104010109*

Mamman, M., & Folorunsho, J. O. (2015). Assessment of open burning of agricultural waste in Biu local government area of Borno State, Nigeria. *Journal of Environmental Science, Toxicology and Food Technology, 9(3), 1-7. https://doi.org/10.9790/2402-09310107*

Satendra, K., & Kaushik, R. (2014). Household bush burning practice and related respiratory symptoms in Grenada, the Caribbean. *Journal of Environmental and Public Health, 2014, 1-7. https://doi.org/10.1155/2014/60596*8

Ubuoh, E. A., Ejekwolu, E. O., & Onuigbo, I. N. (2017).

Wan, S., Hui, D., Luo, Y., & Wallace, L. (2001). Fire effects on nitrogen pools and dynamics in terrestrial ecosystems: *A meta-analysis. Ecological Applications, 11(5), 1349-1365. https://doi.org/10.1890/1051-0761(2001)011 [1349: FEONPA]2.0.CO;2*