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Elemental and Physico-Chemical Characterization of Farm Lands in Matazu and Musawa, Katsina State, Nigeria

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ABSTRACT

A good understanding of the variation in soil physicochemical properties and elemental composition, particularly in relation to micronutrient status, is essential for proper land evaluation and effective land-use planning. This study was conducted to assess the elemental and physicochemical characteristics of farmlands in Matazu and Musawa Local Government Areas of Katsina State, Nigeria. Field investigations were carried out during the 2020 and 2021 dry seasons using Energy Dispersive X-ray Fluorescence (EDXRF) analysis. A total of 30 composite soil samples were collected from agricultural lands, non-agricultural lands, and erosion-prone areas at a depth of 0–10 cm. The results showed that the soils in the study areas were slightly acidic and contained low to moderate levels of essential macronutrients. Soil physical properties such as moisture content, porosity, particle density, and bulk density were within moderate ranges, indicating favorable conditions for soil aeration, root penetration, and water movement. The soil pH values, together with the concentrations of available nutrients and elements such as nitrogen (N), phosphorus (P), potassium (K), and copper (Cu), suggest that the soils possess moderate acidity, which supports nutrient availability and uptake by plants. However, the concentrations of these essential nutrients were generally low to moderate, indicating that the soils may not adequately sustain optimum crop productivity without nutrient supplementation. Therefore, the application of appropriate fertilizers and soil management practices is recommended to improve soil fertility and enhance plant growth, root and stem development, flowering, fruiting, and seed production. Overall, the study revealed that while the soils possess suitable physical conditions for agriculture, nutrient improvement measures are necessary to achieve sustainable agricultural productivity in the study areas.

Keywords: Physical Properties, Chemical Properties, Elemental Composition, Fertility, Selected Soils

INTRODUCTION

Nigeria's quest to achieve sustainable food security is increasingly threatened by the rapid degradation of agricultural lands. Soil degradation resulting from erosion, nutrient depletion, continuous cultivation, desertification, and poor land management practices has led to a significant decline in soil productivity across many parts of the country (FAO, 2015). In the semi-arid regions of Northern Nigeria, particularly Katsina State, the problem is further aggravated by climatic variability, sparse vegetation cover, wind erosion, and unsustainable farming practices. Since soil is a fundamental natural resource for agricultural production, its sustainable management is essential for maintaining crop productivity and environmental stability.

Agricultural productivity largely depends on the physical, chemical, and biological properties of soils, which influence nutrient availability, water retention, aeration, and root development. Soil physicochemical properties such as pH, moisture content, porosity, bulk density, particle density, and organic matter content are critical indicators of soil fertility and land suitability for agricultural purposes. According to Ayeni and Adeleye (2011), soil fertility is not determined solely by the presence of nutrients, but also by their availability and balance in proportions suitable for optimum plant growth. Favorable soil pH conditions enhance nutrient solubility and uptake, while good physical properties improve root penetration, water movement, and microbial activities necessary for crop development.

Several studies have reported significant spatial variations in soil physicochemical properties and elemental composition across different ecological zones in Nigeria. Umeri (2017) reported soil pH values ranging from strongly acidic to slightly acidic in Delta State, with subsurface soils exhibiting higher acidity levels. Similarly, other researchers have shown that variations in soil elemental composition directly affect soil fertility status, crop performance, and land-use capability. Micronutrients and macronutrients such as nitrogen (N), phosphorus (P), potassium (K), copper (Cu), iron (Fe), zinc (Zn), and manganese (Mn) play vital roles in plant physiological processes, including root development, flowering, seed formation, and photosynthesis. Deficiencies or imbalances in these nutrients may result in poor crop yield and reduced soil productivity.

Recent advances in soil analysis techniques such as Energy Dispersive X-ray Fluorescence (EDXRF) have improved the rapid and accurate determination of soil elemental composition. EDXRF has been widely applied in environmental and agricultural studies because of its non-destructive nature, high precision, and ability to simultaneously determine multiple elements in soil samples.

Despite the importance of soil characterization for sustainable agriculture, there is still limited information on the physicochemical properties and elemental composition of soils in many parts of Katsina State, particularly in Matazu and Musawa Local Government Areas.

Most previous studies in Northern Nigeria have focused mainly on general soil fertility assessment, erosion, or agricultural productivity, with little attention given to the integrated evaluation of soil physicochemical properties and elemental composition using advanced analytical techniques such as EDXRF. Furthermore, there is inadequate documented information on the micronutrient status and profile distribution of essential elements in soils within the study areas. This lack of detailed soil information limits effective land evaluation, fertilizer recommendations, and sustainable soil management practices necessary for improving agricultural productivity. Therefore, this study seeks to bridge this knowledge gap by investigating the physicochemical properties and elemental composition of selected soils in Matazu and Musawa Local Government Areas of Katsina State, Nigeria. The findings of the study will provide valuable baseline information for land-use planning, soil fertility management, and sustainable agricultural development in the region. In this regard this paper aimed to determine the physico-chemical properties and elemental composition of some selected soils in Matazu and Musawa Local Government Areas of Katsina State, Nigeria.

MATERIALS AND METHODS

About the Study Areas

Matazu and Musawa are located in the Southern Part of Katsina State (Longitude 7^04^0'E and Latitude 12^014' N and 7^040'11 East of the Greenwich Meridian and latitude 12^07'48) North of the equator respectively.

The rainy season of Matazu and Musawa areas is between the month of May to September and it has its peak in the month of August. The rainfall ranges of 5 – 6months (750mm – 850mm annual), based on average of 10years from 2000 to 2009. It is characterized by conventional rain fall (dry and wet climate) followed by long dry season of 6 – 7 months(Meteorological Unit, 2012).The mean maximum temperature of Musawa area is 39^{o}C in the month of April and May. At the high of rainy season, average maximum temperature is 38^{o}C and in December, average temperature is 20^{o}C (Meteorological Unit, 2012).

Wind is moving air in motion. It results from differences in atmospheric pressure. The wind speed of Musawa is 1.5km/h in the month of July to September and higher as 3.2km/h around December to January. The direction of wind is north-east to south-west and dry in December to January, and it is south-west to north-east direction and wet from April to October. Relative humidity denotes the amount of water vapor in the atmosphere (air) compared to what the air can hold when fully saturated. The minimum relative humidity of Musawa is 18% in December to January and maximum as 95% around July to September, (Meteorological Unit, 2012).

Soils are the mixture of rock particles loosened by weathering, mineral salts and dead vegetation matter. In the southern part of Katsina State, the covering material is largely clayey soil, about five meters in depth, and very fine in texture. The soils of Musawa are light clay in nature, but due to drift deposits resulting into sandy soils (Chude et al., 2012). The land in the study areas is used for cultivation of crops such as guinea corn, maize, millet, sorghum, groundnut, soybean, rice, melon, and other vegetable crops. Trees crops such as mango, cashew and other economic trees are also found in the areas.

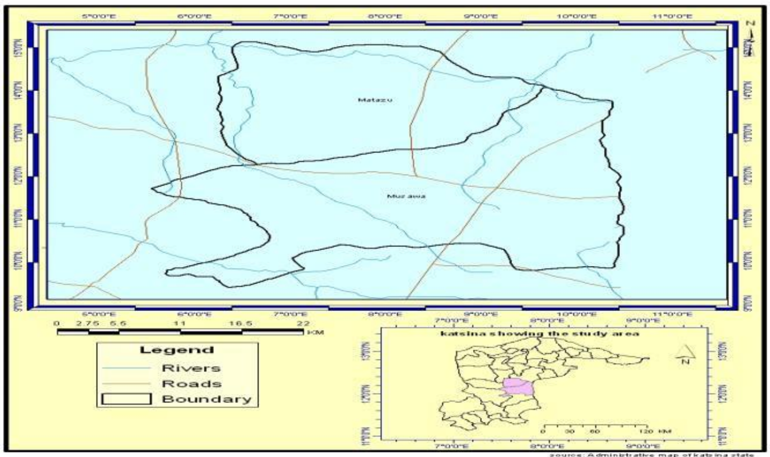

Figure 1: Katsina State Showing Matazu and Musawa (Spherical RS&GIS Ltd, Katsina, 2020)

Sample Collection

A total of thirty (30) soil samples were meticulously collected from the 0-10cm depth using a hand auger. These samples were carefully obtained from three distinct clusters: agricultural farming systems, non-agricultural farming systems, and soil erosion areas. The selection of sample locations took into account the varied soil types and the historical land use and management practices. Within each cluster, ten soil samples were randomly gathered, ensuring a representative and diverse set of samples for analysis. To create composite samples during collection, different sections of neighboring soil were combined and thoroughly mixed. Additionally, precise geographic coordinates were recorded for each sample, facilitating easy traceability and accurate location referencing in subsequent analyses.

Sample Preparation

Sample preparation is recognized as the major source of errors and if not done properly, may affect the final results. Therefore, close attention was paid to every sample to avoid cross contamination of the soil samples amongst other precautions.

Laboratory Analyses

X-ray Fluorescence Spectrometry (XRF) was used to determine the major elemental composition of 30 soil samples from the Agricultural farmlands, Non-Agricultural farmlands and Soil Erosion Areas. The major elements in their oxidized state were determined as a percentage of composition.

The samples used in the XRF analyses were obtained from 0 to 10 cm soil depth randomly collected from the Agricultural farmlands, Non-Agricultural farmlands and Soil Erosion Areas.

Samples were prepared at the Central Laboratory of the Faculty of Natural and Applied Sciences, Umaru Musa Yar'adua University Katsina. The soil samples were freeze-dried at ~60 °C in a Modulo 4 k Freeze Drier for 5 days. The dried samples were pulverized into a fine powder with an agate mortar and pestle. To avoid contamination and the mixture of samples during preparation, both faces of the compression die for each of the samples were well covered. Each pulverized ground sample (powder pellet) was then weighed prior to analysis; weights of samples ranged from 1 to 2 grams. These samples were analyzed with ARL QUANT'X EDXRF Analyzer 9952120 which produces high X-ray intensity and permits quantitative analysis of elements in the ng range.

The moisture content and porosity of the soil were determined by hydrometer gravimetric method of Blake and Hartge (1986) and cylindrical core method of (Udo *et al*., 2009) respectively. Bulk density (BD) and Particle Density (PD) were also obtained by cylindrical core method (Obi, 2000). The glass electrode method was used to determine the soil pH (Udo *et al*., 2009). Electrical conductivities (EC) of the soil samples were measured with electric conductivity meter in a paste of 1:5 soil/water (Udo *et al*., 2009). The particle size distribution of the soils was determined by hydrometer method and are classified using soil textural classification and discussed under fertility related variables.

Statistical Analysis

The data obtained from the physicochemical and elemental analyses of the soil samples were subjected to statistical analysis using IBM SPSS Statistics, Minitab, and Microsoft Excel. Descriptive statistics, including mean, standard deviation, minimum, maximum, and coefficient of variation, were used to summarize the measured soil parameters and elemental concentrations from the different sampling locations.

The data were first checked for completeness, consistency, and normality before further analysis. Mean values and standard deviations were calculated for all measured physicochemical properties and elemental concentrations to determine the variability of soil characteristics within and between the study areas. Results were presented as mean ± standard deviation.

Inferential statistical analyses were performed to evaluate the significance of differences among the sampled locations and land-use types. Analysis of Variance (ANOVA) was employed to determine whether significant differences existed in the physicochemical properties and elemental concentrations among agricultural lands, non-agricultural lands, and erosion-prone areas. Where significant differences were observed, post hoc multiple comparison tests were conducted to identify the specific groups responsible for the observed variations.

In addition, graphical and tabular presentations including charts and summary tables were generated using Microsoft Excel to facilitate interpretation and comparison of results across the study locations. All statistical tests were conducted at a 95% confidence level, and differences were considered statistically significant at $p < 0.05$.

RESULTS AND DISCUSSION

Soil Physico-chemical Properties of the Study Sites

Soil pH

The results of the soil pH of the study sites as obtained using pH meter were also analyzed using SPSS version 23 and the descriptive statistics of the results were presented in Table 1. The results obtained for soil pH indicated that the value decreases with increase in depth. They vary from slightly acidic to moderately acidic, with mean values of (6.65 – 6.91). This indicates that there is no statistical difference in pH content between Musawa and Matazu soils as the hypothesis of no difference was retained. The acidic nature of the soils may be attributed to the acidic igneous and metamorphic rocks parent material, their well – drained condition due to high sand fractions and high rainfall which could leach out basic cations for the soil solum. This result collaborated with the findings of (Akpan *et al.,* 2012). In addition low pH observed is likely to cause acid potent cations in the long run due to the high rainfall prevailing in the study area and this may encourage leaching of the base forming cations from the surface and their accumulations in lower layers. Therefore, the moderate acidity implied that nutrients are likely to be available for crop uptake. According to Odunze *et al.* (2006), pH range of 5.5 – 6.5 is optimum for the release of plant nutrients. The results also indicated that there is statistically insignificant level of difference ($P > 0.05$) between the soil pH content of the two local governments for the Non-Farming System and Soil Erosion sites while there is statistically significant level of difference ($P < 0.05$) between the soil pH content of the two local governments for the Farming System site (the p – values were above 0.05 in MTZ and MSW Non Farming System and Soil Erosion Areas while the p – values were below 0.05 in Matazu and Musawa Farming System Area and all sites). Also the t – cal values are greater than t – critical in Matazu and Musawa NFSA and SEA whereas t – cal is less than the t – critical in Matazu and Musawa FSA and All sites. For soil pH, we also retained the hypothesis of no difference ($P > 0.05$) across all the three (3) soil types in Matazu, Musawa and General or Combined.

Table 1: Soil Physico-chemical Properties of the Study Sites

Parameter	Sample Area	No. of samples	Mean	St. Deviation
OC (g/kg)	MTZ	15	0.36	0.11
	MSW	15	0.34	0.22
pH	MTZ	15	6.65	0.14
	MSW	15	6.82	0.06
EC (dS/m)	MTZ	15	0.97	0.09
	MSW	15	0.75	0.10
PR (%)	MTZ	15	33.34	7.30
	MSW	15	34.66	2.46
MC (%)	MTZ	15	0.08	0.02
	MSW	15	0.24	0.06
PD (g/cm^3)	MTZ	15	2.23	0.07
	MSW	15	2.39	0.01
BD (g/cm^3)	MTZ	15	1.48	0.14
	MSW	15	1.65	0.02

Soil Electrical Conductivity

The results for the soil Electrical Conductivity of the study sites was obtained using Conductivity Meter Bridge were analyzed using SPSS version 23 and the descriptive statistics of the results were presented in Table 1. The results obtained for soil Electrical Conductivity revealed that it is dominant in Matazu FSA as compared with Musawa sites which is lower and Matazu other sites. The Electrical Conductivity (EC) value ranged from (0.75-0.97) dS/m, the high concentration of EC in Matazu soils indicates that salt content is high. This result agrees with the findings of (Onojuke *et al.*, 2012) who found high values of EC for about a range of (1.29 – 3.07) dS/m in soils of Ndoni Local Government Area in Rivers State. Their results also revealed that the subsurface layer of the soil has high concentration of EC compared with surface layer of the soils. Inspecting the p –values, it was found to be greater 0.05 in all sites and Soil Erosion Areas while it was less than 0.05 in Matazu and Musawa Farming System and Non-Farming System Areas. Also the t – cal values are greater than t – critical in Matazu and Musawa SEA and all sites whereas t – cal is less than the t – critical in Matazu and Musawa FSA and NFSA. For Electrical Conductivity (EC), the null hypotheses are rejected ($P < 0.05$) for Matazu and Musawa.

Soil Porosity

The results for the soil porosity of the study sites was obtained using cylindrical core method were analyzed using SPSS version 23 and the descriptive statistics of the results were presented in Table 1. The results obtained highlighted that the total porosity ranged from 32.16% – 35.88%. The porosity of soils in Matazu sites is higher than the porosity of soils in Musawa sites, this shows that soil erosion areas in Matazu has the highest percentage of total porosity compared with other sites in Matazu and Musawa. The porosity of the soils is 33% higher at a top layer depth of the soil (0 – 15 cm) but porosity of the soil increases with increase in depth of the soil. This is in agreement with the finding of (Oyetola *et., al.* 2021) - the total porosity of soils increased with increase in depths (30.5% - 45.0%) which is due to the high silt and clay contents in the subsurface horizon. The p – value was greater than 0.05 and also the t – cal values are greater than t – critical in all the sites (Matazu and Musawa). For soil porosity (PR), we also retain the hypothesis of no difference ($P > 0.05$) across all the three (3) soil types in Matazu, Musawa and General or Combined.

Soil Moisture Content

The results for the soil Moisture Contents of the study sites was obtained using Gravimetric Hydrometer were analyzed using SPSS version 23 and the descriptive statistics of the results were presented in Table 1. The results obtained shows that the moisture content ranges from (0.08% – 0.47%), the moisture content of Musawa soils is greater in Soil Erosion Areas (SEA) compared with Matazu soils. The result of the high moisture may lead to the problem of viability and soil aeration, which may affect the nutrient status of the soils (Ekweozor, 1998). Consumption and CO_2 production in normal agricultural soils depend on soil moisture content and temperature (Gill *et al.*, 2003). When the soil is saturated and the pore spaces are filled with water, there is no gaseous concentration gradient in the soil. Therefore, oxygen would not be able to diffuse to the plants roots from the atmosphere, some of the plants roots become depleted of oxygen and this leads to changes in redox potential of the root zone (Ozumba, 1999). Inspecting the p – values, it was observed that the value is greater than 0.05 in Matazu and Musawa Non Farming System and Soil Erosion Areas, while it is less than 0.05 in Matazu and Musawa Farming System Areas and all sites. Also the t – cal values are greater than t – critical in Matazu and Musawa NFSA and SEA whereas t – cal is less than the t – critical in Matazu and Musawa Farming System Areas and all sites. For soil moisture content (MC) hypothesis of no difference was retained for Matazu and Combined results but it was rejected ($P<0.05$) in the case of Musawa.

Soil Particle Density

The results for the soil Particle Density of the study sites was obtained using Pycnometer were analyzed using SPSS version 23 and the descriptive statistics of the results were presented in Table 1. The results obtained from the studied sites indicated that the Particle Density of the soils derived from erosion area in Matazu site is higher than the values from other sites and Musawa all sites. The value ranged from (2.23 – 2.50g/cm^3). The particle density of the soils in Matazu and Musawa LGAs fall between (2.23 – 2.50g/cm^3) which indicates that organic matter weighs much more than an equal volume of mineral solids and often has bulk density of (1.47 – 1.65) Mg/cm^3. This result is in good agreement with that of Brady (1974), who asserts that loose and porous materials have lower bulk densities than more compact materials. Therefore, the particle density of the soil affects fuel handling and storage as well as transportation. It also has important implications in the mixing secretion behavior of the fuel in the fluidized bed. The p – values were all greater than 0.05 in most of the sites except in Matazu and Musawa Farming System Areas where the p – value is less than 0.05 and also t - cal is greater than t – critical whereas t – cal is less than t - critical in Matazu and Musawa Farming System Areas. For Soil Particle Density (PD), there exists a significant difference between Matazu and Musawa soil types whereas there is no significant difference in the combined results.

Soil Bulk Density

The results for the soil Bulk Density of the study sites was obtained using cylindrical core method were analyzed using SPSS version 23 and the descriptive statistics of the results were presented in Table 1. The results obtained for Bulk density highlighted that the values ranged from (1.47 – 1.65) g/cm^3 of the soil were rated as moderate and were considered to favor good aeration, root penetration and free water movement in the soil. This result is in good agreement with those of Donahue *et al. (*1990); Landon, (1991): Maniyunda and Malgwi, 2011 who suggested that plants perform best in bulk densities within 1.40 g/cm^3 and 1.60 g/cm^3 for clay and sandy soils respectively and higher bulk density above 1.60 g/cm^3 tends to inhibit root growth. This is due to soil's resistance to root penetration, poor aeration, slow movement of nutrients and water and build up toxic gases and root exudates as explained by (obi, 2000) and (Agber *et al.*, 2017). However, with continuous cultivation without proper management practices, the agricultural land use may exert some influence on bulk density of the soils. Looking at p – values were all below 0.05 in most of the sites except in Matazu and Musawa all sites where the p – value is above 0.05 and also the t – cal values are greater than t - critical values in most of the sites whereas t – cal is less than t – critical in Matazu and Musawa all sites.

For each of the property, Figures obtained from the three different sites of each of the LGAs were compared. Thus, the needs for use of ANOVA since the number of samples exceeded two or were more than two. For Soil Bulk Density (BD), there exist a significant difference between Musawa soil types and Matazu and the Combined while there exist no significant difference between Matazu soil types and the general or combined.

Soil Particle Size Distribution

The results for the soil particle size distribution of the study sites were obtained using Hydrometer Method were analyzed using SPSS version 23 and the descriptive statistics of the results for the studied sites (Matazu and Musawa) were presented in Figure 1 and 2 respectively. The particle size distribution of the soil indicates Sandy Loam (SL) texture at 0.15 cm depth at its locations. Sand is the dominant fine earth fraction in Matazu Farming System Area with the mean value of ± 73.60, followed by silt which is also dominant in the Matazu Soil Erosion Areas with a mean value of ± 20.40 and clay which is highest or dominant in Matazu soil erosion areas with a mean value of 12.00. The clay is highest or dominant in Musawa Farming System Area with a mean value of 13.60 and the silt is also dominant in Musawa SEA. Lastly, sand is almost the same in all sites of the Musawa LGA, with the same mean value of 70.80.

In general, the texture of the soils showed an irregular decreasing trend with sandy loam greater than sandy, silt loam greater than sandy clay. The soils of the study sites exhibited an irregular trend in particle size distribution with high proportion of sand in Matazu FSA. There exists a high proportion of clay in Musawa FSA, which shows that the Agricultural farm land of Musawa had the highest percentage of clay content in the soil compared with Matazu which has the lowest. It also indicates that Musawa Agricultural farm land has more soil nutrients, soil fertility which may translate to the production of higher agricultural products, since the land is favorable for farming system. This agrees with reports by Dasog and Pabel, (2011) and Amara and Momoh, (2014).

For Matazu, the percentage contents are displayed in Figure 1. Clay is the same for all sites in Matazu Farming System Area (MTZFSA), as for silt the contents ranges from 15.20% to 20.40%.While for sand the percentage (%) of sand ranges from 68.40% to 73.60% with FSA having the highest and SEA having the least percentage. All these are presented in Figure 1.

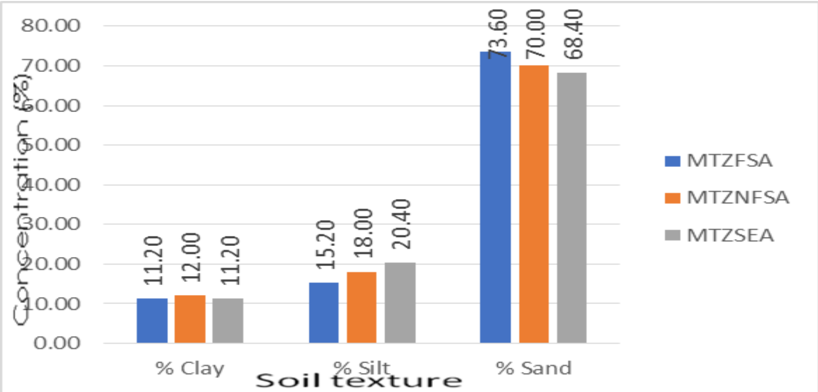

Figure 1: Bar Chart Showing the Textural Class for All the Sites in Matazu Local Govt Area

For Musawa, the percentage contents are displayed in Figure 2. Looking at the Figure, the clay content ranges from 8.80% to 13.60%, as for silt the percentage ranges from 15.60% to 20.00%, the Figures for sand showed a maximum concentration of 71.20 in Soil Erosion Area (SEA) and a minimum concentration of 70.80% for both Farming System Area (FSA) and Non-Farming System Area (NFSA).

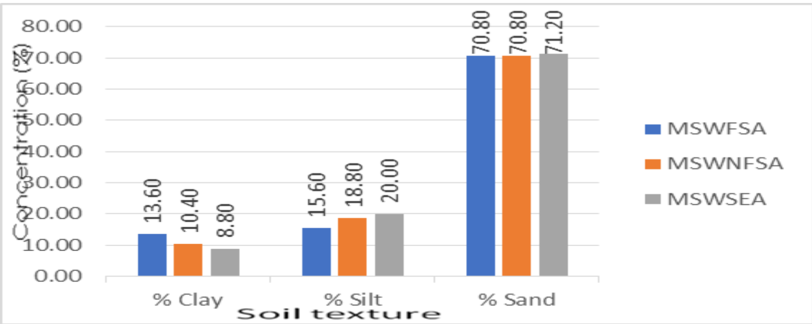

Figure 2: Bar Chart Showing the Textural Class for All the Sites in Musawa Local Govt Area

Elemental Composition of the Soil Samples

From Figure 3, the percentages of each type of soil were studied based on Local Government Areas. Looking at the data for Fe, for all soil types, Musawa has the highest than Matazu. All these are presented in Figure 3. Fe (Iron) is essential for the formation of chlorophyll and is involved in various enzymatic processes in plants (FAO, 2015).

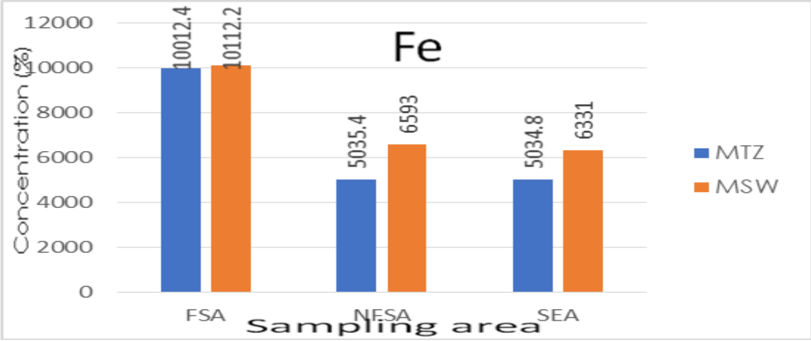

Figure 3: Bar Chart Showing the Composition of Fe in the Study Sites

In Figure 4, by looking at the data for Ca, for all soil types, Musawa has the highest than Matazu. All these are presented in Figure 4. Ca (Calcium) is important for root development, cell wall structure, and nutrient uptake in plants. It also helps prevent disorders like blossom end root in certain crops (FAO, 2012).

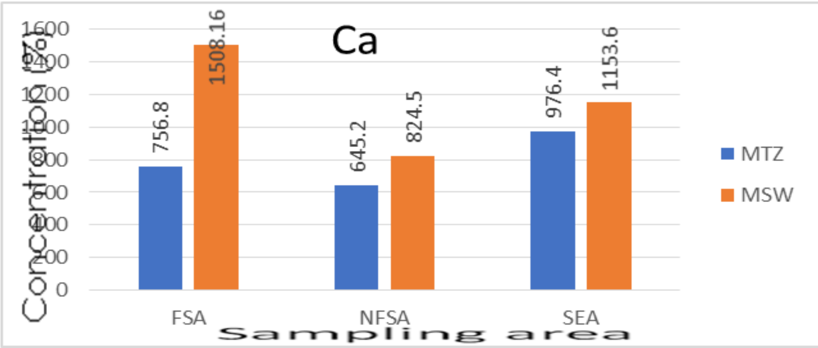

Figure 4: Bar Chart Showing the Composition of Ca in the Study Sites

From Figure 5 by Inspecting at the data for P, for all soil types, Matazu has a higher concentration of P in FSA and NFSA compared to Musawa. Meanwhile, the concentration of P in SEA is much higher in Musawa than Matazu. Phosphorous is crucial for energy transfer and storage in plants. It plays a vital role in root development, flowering, and fruiting. It is commonly supplied to plants through phosphate fertilizers (FAO, 2010).

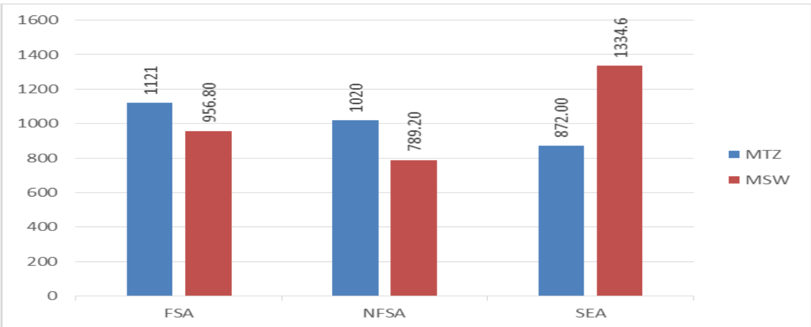

Figure 5: Bar Chart Showing the Composition of P in the Study Sites

In Figure 6, by taking a look at the data for Zn, for all soil types, Musawa has a higher concentration of Zn in FSA and NFSA compared with Matazu. Meanwhile, the concentration of Zn is least in SEA in Matazu. Zinc is a micronutrient required for enzyme activity and plays a crucial role in various metabolic processes, including growth regulation and hormone synthesis (FAO, 2015).

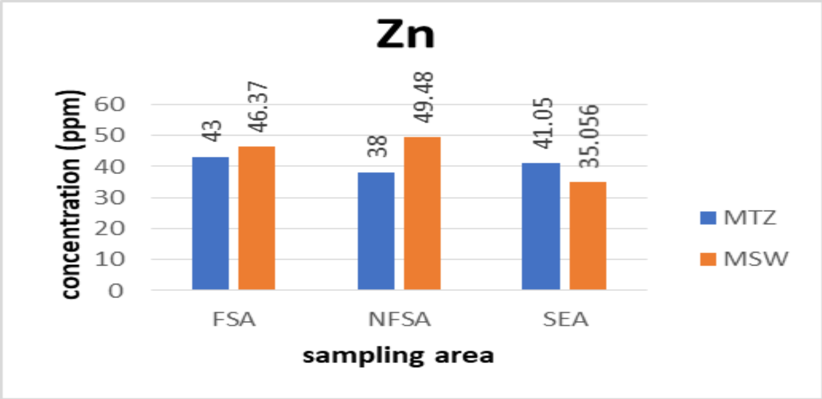

Figure 6: Bar Chart Showing the Composition of Zn in the Study Sites

From Figure 7, by looking at the data for Cu, for all soil types, Matazu has a higher concentration of Cu in FSA and NFSA than Musawa, whereas the concentration of Cu in Musawa and Matazu is nearly the same in SEA. Copper is an essential element for several enzymatic reactions in plants, including photosynthesis and respiration. It also contributes to lignin formation and disease resistance (FAO, 2015).

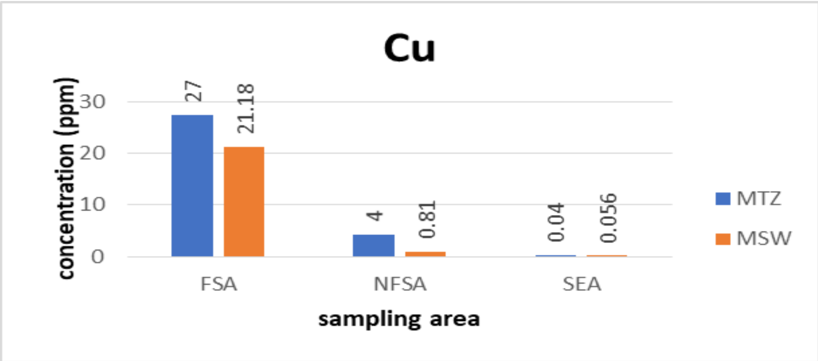

Figure 7: Bar Chart Showing the Composition of Cu in the Study Sites

Figure 8 displayed the data for K, for all soil types i.e. Farming System Area (FSA), Non-Farming System Area (NFSA) and Soil Erosion Area (SEA), Matazu has the highest than Musawa. The detailed report is further provided in the appendix. Therefore, the type of fertilizer to be applied for better plant growth is NPK where K responsible for seeds and fruits (reproduction) which is for vegetative crops example groundnut, cowpea, soybean etc., P is responsible for plant growth of root and stem, N is responsible for leaves and flowers (FAO, 2015).

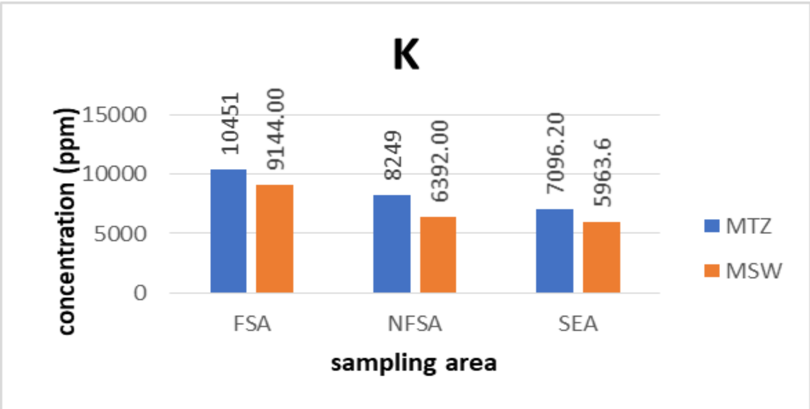

Figure 8: Bar Chart Showing the Composition of K in the Study Sites

CONCLUSION

The main objective of this study was to evaluate the elemental composition and physicochemical characteristics of agricultural soils in Matazu and Musawa Local Government Areas of Katsina State, Nigeria, in order to determine their fertility status and suitability for agricultural production. Soil analyses were therefore conducted to assess the levels of essential plant nutrients and important soil physical properties. In conclusion, the study revealed that the agricultural soils of Matazu and Musawa Local Government Areas are predominantly Sandy Loam with generally favorable physicochemical characteristics that support agricultural production. The soils possessed suitable pH, good aeration, moderate moisture retention, and adequate levels of essential micronutrients and some macronutrients necessary for plant growth. However, deficiencies in available phosphorus and exchangeable potassium were identified, indicating the need for appropriate nutrient supplementation to sustain optimum crop productivity. Overall, the findings provide important baseline information for soil fertility assessment, fertilizer recommendation, and sustainable land management practices aimed at improving agricultural productivity and food security in the study areas.

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