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Effects Of No-Tillage Method On Soil Physico-Chemical Parameters Of Selected Communities In Ikwuano Local Government Area Of Abia State, Nigeria.

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Abstract:
No-till farming offers a way of optimizing productivity and ecosystem services, offering a wide range of economic, environmental and social benefits to the producer and to the society. At the same time, no-till farming is enabling agriculture to respond to some of the global challenges associated with climate change, land and environmental degradation, and increasing cost of food, energy and production inputs. The effects of no-tillage method on soil physico-chemical parameters of selected communities in Ikwuano Local Government Area of Abia State was studied. The study adopted an experimental design which involves laboratory analysis of some selected physico-chemical parameters of selected soil samples in the study area. Four communities viz-a-viz Umudike, Ariam, Umuriaga and Oloko were selected purposively and the soil samples of the studied communities were collected from the agricultural area of No-tillage and tillage and were analyzed for some physico-chemical parameters. The physico-chemical parameters analyzed were: pH, Cation Exchange Capacity (CEC),Soil Organic Matter (SOM), Total Nitrogen (TN), Phosphorus (P),Sulphur (S), Magnesium (Mg), Potassium (K), Copper (Cu), Iron (Fe), Nickel (Ni), Zinc (Zn), Manganese (Mn), Calcium (Ca) and Aluminium (Al). The results state that no-tillage farming practice has more soil physico-chemical parameters and as a result can create higher yield of agricultural produce than Tillage type farming practices.

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I. Introduction:

The issue of feeding a growing population in sub-Saharan Africa is a recurring problem. This is mainly due to widespread land degradation, low soil productivity, limited accessibility, affordability, and a lack of knowledge on managing inputs. These challenges are faced by farmers in their efforts to maintain and improve soil fertility (Vanlauwe et al., 2015). In order to address global food scarcity and alleviate hunger and poverty in sub-Saharan Africa, there is a need for a new approach called sustainable production intensification, as outlined by FAO (2011). This approach emphasizes the importance of productive and profitable agriculture that also conserves and enhances natural resources and the environment. It aims to harness environmental services and promote sustainable crop production intensification. This not only reduces the impact of climate change on crop production but also mitigates the factors that contribute to climate change by reducing labor, saving time, fuel, and machinery costs. This approach is known as Zero Tillage or No-Tillage.

Tillage is an agriculture land preparation through mechanical agitation which includes digging, stirring and overturning (Vishal, 2021). Zero tillage (ZT) is the process where the crop seed will be sown through drillers without prior land preparation and disturbing the soil where previous crop stubbles are present. Vishal, (2021) also state that zero tillage not only reduce the cost of cultivation it also reduces the soil erosion, crop duration and irrigation requirement and weed effect which is better than tillage. Zero Tillage enhances conservation agriculture. Conservation agriculture conserves natural resources, biodiversity and labour. It increases available soil water, reduces heat and drought stress, and builds up soil health in the longer term. Zero Tillage is an agricultural technique for growing crops or pasture without disturbing the soil through tillage. No-till farming decreases the amount of soil erosion tillage causes in certain soils, especially in sandy and dry soils on sloping terrain. Other possible benefits include an increase in the amount of water that infiltrates into the soil, soil retention of organic matter, and nutrient cycling. These methods may increase the amount and variety of life in and on the soil also known as soil biodiversity.

The Food and Agriculture Organization (FAO) of the United Nations has highlighted that soil biodiversity serves as the fundamental component elements for enhancing soil composition, promoting better water penetration, and increasing the soil's ability to retain water (Ingham 2009). Hence the need for Agricultural practices that will address the terrestrial biodiversity loss in the ecosystem and Zero tillage is one of them. Zero or no-till agriculture refers to growing crops with little or no soil disturbance due to tillage. Tillage methods include activities such as shoveling and plowing or using tillers to crush clods and level the soil. No-till farming requires fewer mechanical inputs and associated energy consumption, and typically less labor per unit of production. The goal of zero tillage as sustainable Agricultural practice is to meet society’s food demand without compromising the ability of the future generations to meet their needs (WCED, 1987).To achieve the goals of sustainable Agriculture, the way in which soil tillage takes place is of great importance. This is because the induced physical, chemical, and mechanical changes affect the soil physical, chemical and biological processes. These changes in the soil physical environment brought about by tillage affect the organisms that live within that environment, with different soil organisms responding in different ways. Populations, diversity, and activity are adversely affected by frequent tillage operations (Margulies, 2012),thus directly affecting soil biological properties. Hence, minimum soil disturbance or zero tillage is encouraged in order to preserve the soil’s structure, fauna and soil organisms.

In the study area, very few famers use no-tillage methods, a phenomenon which has been repeatedly described as one of the greatest agricultural revolutions of modern times. This implies that it has not been widely recognized by most farmers in the study area which is in the southeastern Nigeria, an environment widely known to be prone to gully erosion (Ofomata, 1987, Igwe, 2012).

This study therefore, becomes imperative in examining the best possible ways on how zero tillage could be practiced in the study area so as to enhance sustainable Agriculture.

Study Area

The study Area is Ikwuano LGA , Abia State South. Ikwuano is one of the local government Areas of Abia state , Nigeria. It is located between latitude $5^{\circ}18'05''$ N and $5^{\circ}30'55''$N of the equator and between longitude $7^{\circ}30'30''$E and $7^{\circ}40'37''$ E of Greenwich meridian.Its headquarters is at Isiala Oboro. It has an area of about281 km^2 and a population of 137,993 at the 2006 census. It has been projected to about 768,500 as at 2022. It is made up of 19 communities and 52 villages, it is bounded by Ini LGA of Akwa Ibiom State by the west and Umuahia North by the north,Obot Akara LGA of Akwa Ibiom by the south and Bende LGA of Abia state by the east as shown on figure 1 below. The climate of Ikwuano is considered to be Af according to koppen-Geiger climate classification. This is a humid tropic, with fairly even temperatures throughout the two seasons (dry and rainy) of the year. The average annual temperature of Ikwuano is $26.4^{o}C$ and about 2333mm of precipitation falls annually. The driest month is January, with 24mm of rain. Most of the precipitation here falls in September, averaging 370mm. The rainy season which usually starts from April/May and ends in October/November is characterized by clouds driven by light winds, relatively constant temperatures, frequent rains and high humidity.The geology of Ikwuano Local Government Area is of asedimentary terrain. Some parts of Ikwuano are alsounderlain by the Benin Formation (Iloeje, 1992). The vegetation of Ikwuano LGA of Abia state is considered tropical rainforest. The vegetation consists of very dense speciesand under growths of creepers. Species found in this vegetation belt are characteristically evergreen;hence, they are exploited for their timber.These include; Oji, *(Chlorapgora excels)*, Ofo, (*Detarium maccrocarpa*), Udara, (*Chrysophylum africanum*), Ukwa, (*Traculia africana*), Abanaya, (*Euphorbia kamerunica*), Inyi, (*Afromonia species*), Aji, (*Anitaris africana*), Apkarata, (*Afzenia africana*) Icheku, (*Diacum Guineensis*), Ose oji, (*Afromonia meleguta*), Ujuru, (*Irvingia gabonesis*),oil palm (*Elaeis guinensis)*among others. Eze (2011) noted that aforementioned trees are heavily embedded in culture and rituals of the Bende people. All these trees have great ethnographic evidence rooted in the people's antiquity.

The economic trees of the rainforest community are extremely numerous in species and varied in sizes, but the appear to be the most important. In recent days most of the forest vegetation of the area has been depleted for Agricultural, Urbanization, Lumbering activities, and fuel purposes. Agriculture is the major occupation of the people of Ikwuano; this is as a result of fertile soil, and abundant rainfall. Subsistence farming is predominant and about 70% of the population is engaged in it. The main crops produced in the study area include (Yam) *Dioscorea species, (*Cassava)*Manihot esculenta*,(Maize) *Zea mays*, (Cocoa) *Theobroma cacao,* (Oil palm) *Elaeis guineensis,* Rice (*Oriza sativa*) and various types of fruits.

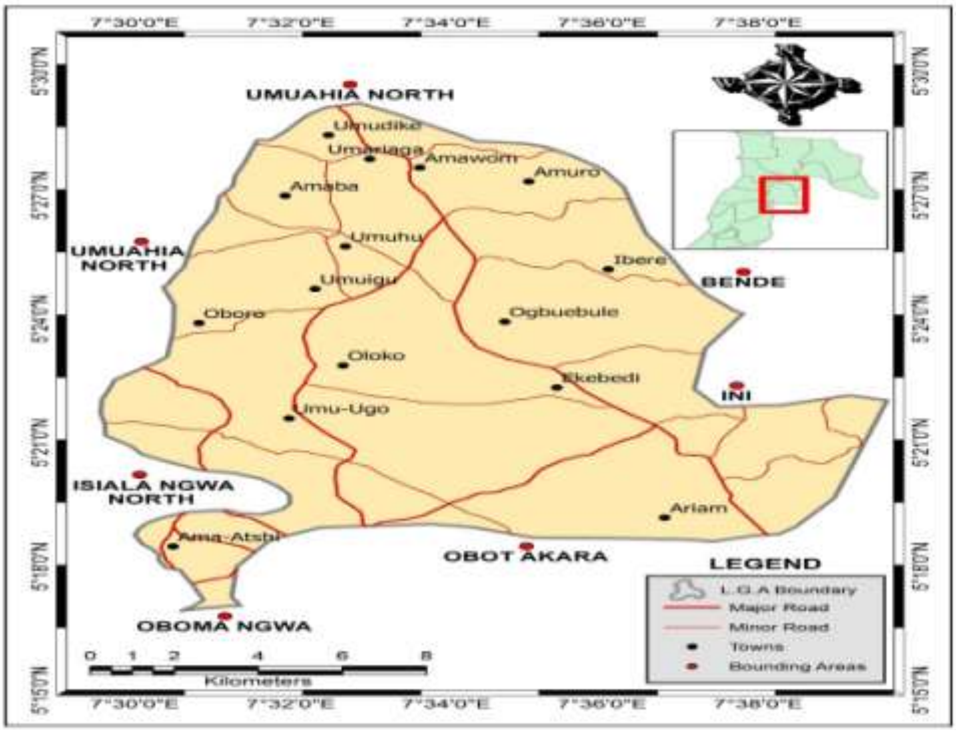

Figure. 1 : Ikwuano L.G.A Showing the study area
Source: GIS unit, Department of Geography and Environmental Sustainability, UNN

Theoretical Framework
Soil Quality Theory

The soil quality theory was propounded in 2003 by Dr. Daniel L. Karlen, Dr. Charles A. Ditzler, and Dr. Stuart S. Andrews in their paper titled "Soil Quality: Why and How?" Soil Quality Theory focuses on the overall health and functionality of soil, taking into account its physical, chemical, and biological properties. It recognizes that soil is a vital natural resource that supports plant growth, sustains ecosystems, and provides essential services to humans. The concept of Soil Quality Theory has emerged through the collective contributions of numerous scientists and researchers in the field of soil science and agronomy.

II. Materials And Methods

Soil samples were collected from four different communities in the study area. Four soil samples were collected and analyzed for the physicochemical parameters of the soil. Two communities (Umudike and Umuriaga) were designated for no-tillage method while the other 2 communities (Ariam and Oloko) were designated for tillage method. Soil samples were collected from the farm lands of each communities designated as no-tillage and tillage farmlands. Collection of soil samples was done using soil augur. All the soil samples were collected into polyethene bags. The polythene bags were labeled before sampling and gloves were used in handling the bags. The soil samples were collected and were handled carefully to avoid foreign materials that may affect the reading of laboratory analysis. Also, the samples were preserved in a sack bag and sent immediately to the laboratory within 24 hours for analysis.

The soil physicochemical parameters used in this study are shown in the table below. The parameters were selected based on their relevance to soil health and easy interpretation and relation to agricultural use. The list includes: Cation Exchange capacity (CEC), Soil PH, Soil organic matter, Total Nitrogen, Phosphorus, Calcium, Potassium, Magnesium, Iron, Copper, Zinc, Aluminum, Sulphur, Nickel, Manganese. These parameters were chosen purposefully for each of the group. the reason for selection because they are parameters needed for growth and proliferation of agricultural produces. The selected parameters are shown in the table below.

Table: 1 Land use types and the level of their physicochemical parameters. Source: Field work, 2023.

	Umudike (No-tillage)	Ariam (Tillage)	Umuariaga (No-Tillage)	Oloko (Tillage)	standard limit
PH	7.5	7.60	7.8	7.7	5.6
CEC (meq/100g)	6.8	6.8	4.4	5.6	12.8
SOM (%)	7.97	7.79	6.76	6.96	3.00
TN (%)	0.48	0.46	0.44	0.42	0.124
P (mg/kg)	620.4	596.2	570.6	558	26.88
S (mg/kg)	86.2	82.8	76.0	70.4	5.20
K (ppm)	6.27	4.72	3.56	5.65	0.13
Cu (ppm)	0.03	0.00	0.03	0 .00	4.28
Mg (ppm)	4.37	2.138	2.35	5.40	1.40
Fe (ppm)	185.84	132.49	125.57	131.56	5.60
Ni (ppm)	0.61	0.61	0.00	0.10	2.84
Zn (ppm)	0.19	0.15	0.09	0.22	7.40
Mn (ppm)	0.64	0.16	0.36	0.52	7.48
Ca (ppm)	8.0	0.66	0.67	9.33	2.60
Al (ppm)	8.0	4.0	0	2.0	6.80

From the above it shows the quantity of each parameter (in parts per million) found in various sampled communities of the study area.

The study of soil parameters is crucial for understanding soil quality and fertility. This comprehensive analysis aims to investigate a wide range of soil parameters, including Cation Exchange Capacity (CEC), Soil hydrogen ion concentration (pH), Soil Organic Matter, Total Nitrogen (TN), Calcium (Ca), Potassium (K), Magnesium (Mg), Iron(Fe), Copper(Cu), Zinc(Zn), Aluminum (Al), Sulphur(s), Nickel(N), and Manganese (Mn). These parameters showed the effect of zero-tillage on agriculture in the study area.

In order to conduct this study, a comprehensive array of specialized instruments and equipment were used. These tools enable accurate measurement and evaluation of various critical soil properties. Soil sampling tool like the soil auger was used for the collection of representative samples at different points. Clean polythene bags were used for contamination-free storage of soil samples. pH meters equipped with suitable electrodes were employed for pH measurement, while moisture meters were used to assess soil moisture content. Instruments for determining Cation Exchange Capacity (CEC), analyzing organic matter content (SOM), and assessing nutrient levels such as Total Nitrogen (TN), Phosphorus(P), Calcium (ca), Potassium (K), and Magnesium (Mg) were used to determine the presence of soil physico-chemical parameters in the soil of the study area especially area that practices zero tillage. Similarly, atomic absorption spectrometers and specialized reagent kits are used to analyze micronutrients like Iron (Fe), Copper (Cu), Zinc (Zn), Aluminum (Al), Sulphur(S), Nickel (N), and Manganese (Mn). The preparation of samples involved drying, grinding, and sieving.

III. Interpretation Of Results

Soil pH:

Soil pH is a measure of the acidity or alkalinity of a soil. It is a scale from 0 to 14, with 7 being neutral. A pH below 7 is acidic, and a pH above 7 is alkaline. The standard limit of pH for soil is 5.6. The ideal pH for most plants is between 6 and 7.5. However, some plants prefer more acidic or alkaline soils. Soil pH affects the availability of nutrients to plants. Acids dissolve minerals in the soil, making them more available to plants. Bases bind to minerals, making them less available. Therefore, plants growing in acidic soils may need to be fertilized with lime to increase the pH. Plants growing in alkaline soils may need to be fertilized with sulfur to decrease the pH.

Cation exchange capacity (CEC): CEC refers to the ability of negatively charged soil particles like clay and organic matter to attract and exchange positively charged ions (cations) (Sonon, 2014). The cations are held on the surface of the particles by electrostatic forces but can be replaced by other cations in the soil solution. This exchange of cations allows the cations to remain in the soil and be available for plant uptake (Sumner 2018).Deforestation and cultivation especially tillage-based cultivation can significantly deplete CEC by reducing soil organic matter and weathering clay minerals (Saikh, 2004). Soil organic matter, pH, ionic strength, silt, and clay all contribute to the CEC of tropical soils in varying degrees based on soil type, climate, and land use. The CEC of the soil in the study area ranged from 6.8 to 9.97 meq/100g, which is considered to be high. the standard limit for cation exchange capacity is 12.8 meq/100g, so the soils in the study area are above the limit. a high CEC indicates that the soil has a good ability to hold nutrients.

Soil organic matter (SOM): Soil organic matter plays a crucial role in maintaining soil fertility and crop productivity in tropical soils (Ross,*etal*., 1993). It provides nutrients for plants and microorganisms, improves soil structure, and regulates the soil's ability to retain and supply water and nutrients (Schnitzer, 2013; Blume, 2016). Tropical soils are often poor in nutrients, so organic matter provides essential nutrients through decomposition and mineralization (Tiessen, 1994; Woomer, 1994). Organic matter also improves soil structure, moisture retention, and buffering capacity in tropical soils (Ross,*et al.*1993). According to the Food and Agriculture Organization, the standard limit for soil organic matter in tropical soils is 3% or higher (FAO, 2001). In the study area analysis found that in agricultural areas with no tillage have about 7.97%, while agricultural area with tillage 7.79%,this means that the no-tillage environment (Umudike and Umuriaga) arebetter suitable for agriculture, as crops will can thrive successfully in that environment. No-tillage, residue retention, and organic inputs can help increase and maintain soil organic matter in tropical soils (Ross,*etal.*,1993). Specifically, Kushwaha (2001) found that reduced or no-tillage and residue retention increased soil organic matter, aggregation, and microbial biomass in tropical soils. Ramos (2018) also found that no-till farming for 10 years doubled the cation exchange capacity of a tropical soil in Brazil by increasing soil organic matter.

In summary, soil organic matter is crucial for soil health and crop production in tropical soils but is often depleted under cultivation. No-tillage, residue retention, and organic inputs can help build up and maintain soil organic matter in tropical soils according to the standard limit recommended by the FAO.

Total Nitrogen (TN): From the table 4 above, the total nitrogen content for the soil tested for No-tillage 0.48 (Umudike and Umuriaga), Tillage agriculture 0.46 (Ariam and Oloko). The standard for total nitrogen in soil according to soil chemical analysis and interpretation is 0.124. However, several studies suggest minimum thresholds for maintaining soil quality and crop production. Nandasena (2000) found that most tropical soils have low total nitrogen, around 0.2-0.5%, though some paddy soils can reach up to 2%. Veldkamp (2012) also indicates that many tropical forest soils are nitrogen-limited, with total nitrogen below 0.5%. Patrick (2013) suggests that while there may be minimum thresholds around 0.5-2% for a given soil, maximum thresholds are difficult to establish and depend on crop needs and nitrogen use efficiency. Some studies have found that tropical soils with very low total nitrogen, around 0.2-0.5%, can still produce large amounts of mineral nitrogen and support plant growth. Cunningham (1962) found that undisturbed tropical forest soils produced high amounts of mineral nitrogen, especially in surface layers, allowing for plant growth even with little total nitrogen. However, cultivation of these soils requires maintaining organic matter to preserve this mineralization capacity.

Phosphorus (P): From the table above, we have 620.0 Mg/kg, 596.2 Mg/kg, 570.6 Mg/kg, and 558 Mg/kg for Umudike, Ariam, Umuariagu and Oloko The standard limit for this parameter according to soil chemical analysis and interpretation is 26.88 Mg/kg. the phophorus content of the soil in the study area range from 6.27 to 5.65 mg/kg, which is considered too low. The standard limit for P is 0.13 mg/kg, so the soils in the study area are below the standard limit. A low P content indicates that the soil is not very fertile. Phosphorus availability is commonly assumed to limit plant growth in tropical soils (Dalling 2016). The amount of phosphorus adsorbed by tropical soils is highly correlated with soil properties like exchangeable aluminum, total iron, organic matter, and low pH (Dabin, 1980).

In summary, while phosphorus limits plant growth in nearly half of all terrestrial ecosystems, it is especially limiting in tropical soils. The amount and forms of phosphorus in tropical soils depend on factors like parent material, weathering, and agricultural practice. Phosphorus fertilization and organic phosphorus solubilization can significantly improve plant growth, but phosphorus management must aim for sustainability.

Sulfur (S): From the table above, sulfur content of the soil tested for Umudike is 86.2mg/kg, Ariam is 82.8 mg/kg, Umuriaga has 76.0 mg/kg, while Oloko has 70.4 mg/kg and the standard limit is 5.20. According to Yesmin (2021), the critical limit of sulphur for mustard and wheat in Bangladeshi soils is 11-14 mg/kg. Similarly, Kumar (2019) found the critical limit of sulphur for groundnut in alluvial Indian soils to be 18.6-19.58 mg/kg. However, other studies found lower critical limits. Patra (2012) determined that most surface and subsurface soils in West Bengal, India were deficient in sulphur below 8.5 mg/kg. Isitekhale (2013) also found that soils in central Nigeria were deficient in inorganic sulphur below 8.5 mg/kg. While the critical limit varies in different tropical regions and for different crops, most of the research points to a critical limit of sulphur between 8.5 to 19.58 mg/kg for tropical soils according to the FAO. The variability depends on factors like soil properties, crop requirements, and agro-ecological conditions. For example, Ogeh (2012) found a wide range of sulphur in soils from different parent materials in southern Nigeria, from 0.47 to 12.36 mg/kg.

Potassium (K): From the table 4 above, Umudike, Ariam, Umuriaga and Oloko, have 6.27, 4.72, 3.56, and 5.65 respectively, with standard limit of 0.13. Studies found that many tropical soils are deficient in potassium, with 75-90% of soils in some areas having available K below 0.2 cmol/kg, which can limit plant growth (Rosolem 2017). However, potassium levels vary based on factors like soil type, land use, and fertilization. Clay soils and those receiving long-term potassium fertilization tend to have higher K levels (Rosolem, 2017; Firmano, 2020).

Copper (Cu): From the table above, it appears that soil tested are below the standard limit of 4.28, this will imply that it is within the healthy range. Copper is an essential micronutrient for plants and animals, but in excess it can be toxic. Copper in soil comes from both natural and anthropogenic sources. Naturally, copper enters soil through the weathering of copper-bearing rocks and minerals (Zhen, 2002). Anthropogenically, copper pollution comes from industrial activities like mining, smelting, and agriculture (Ladonin, 1996). Once in the soil, copper binds strongly to organic matter and accumulates in upper soil layers (Sharma, 2009). The amount of organic matter and soil particle size are the main factors controlling how much copper is retained in soil. Copper also binds to clay minerals and iron and manganese oxides, though to a lesser extent (Sharma, 2009).

While copper levels decreased over time, they remained elevated compared to control plots, showing copper can persist in soils for decades. Lime and compost addition decreased copper levels, especially when combined with the waste treatment, indicating these amendments may help remediate copper-contaminated soils. (Salam, 2021). Engelhardt (2020) found that while some species like maize and dry beans were relatively tolerant of high copper levels, other species like rice and radishes showed significant negative impacts on growth, indicating copper phytotoxicity.

Magnesium (Mg): Mg levels in tropical soils are highly dependent on soil properties and management practices. According to Hailes (1997), exchangeable Mg levels are typically low in highly weathered, acidic tropical soils, with the median level being 0.37 cmol/kg. However, Mg levels can vary greatly based on factors like soil pH, clay content, and organic matter. While tropical soils may contain adequate total Mg, much of this Mg is locked within soil minerals and unavailable for plant uptake (Senbayram, 2015). The small amount of Mg released from weathering is often insufficient for high crop yields and quality (Senbayram, 2015).

Iron (Fe): from the table above we have 135.84, 132.49,125.57, 131.56, for Umudike, Ariam, Umuriaga and Oloko for agricultural soils, with the standard limit of 5.60. Iron content in tropical soils varies but it is generally within the standard range for world soils. Nandra (2004) found 2-8% free iron oxide in Tanzanian red soils, within the standard range. Winbourne (2017) showed iron controls nitrogen fixation in Belizean limestone forests, with more fixation in wet seasons. In summary, while total iron levels in tropical soils are typically in the standard range, the specific chemical forms and distributions of iron can vary substantially based on factors like soil type, geology, vegetation, and climate.

Nickel (Ni): From the table above we have, 0.62, 0.62, 0.0000, 0.10, for Umudike, Ariam, Umuriaga and Oloko respectively with the standard limit of 2.84. Nickel concentrations in tropical soils and plants vary widely depending on location and soil characteristics. Multiple studies found high total nickel concentrations in tropical soils, often exceeding recommended limits for agricultural use (Rawat, 2020; Nkrumah, 2019). However, available nickel, which is more relevant for plant uptake and toxicity, was often low due to nickel binding strongly to soil particles (Susaya, 2010). Soil pH and organic matter content were found to significantly impact nickel availability and accumulation. Lower soil pH and higher organic matter were associated with higher available nickel (Rawat, 2020; Nkrumah, 2019). The specific mineralogy and nickel-bearing phases in the soil also played a major role in controlling nickel availability, sometimes more so than pH alone (Nkrumah, 2019). The effects of nickel contamination and high concentrations were found to vary in different tropical ecosystems.

Zinc (Zn): From the above table, Umudike has 0.19mg/kg, Ariam has 0.15 mg/kg, Umuriaga has 0.09 mg/kg and Oloko has 0.22 mg/kgwith standard limit of 7.40 mg/kg. Zinc availability and mobility in tropical soils is complex and depends on many factors. Multiple studies have found that zinc concentrations in tropical soils can vary greatly depending on soil properties and conditions. For example, Liang (2022) notes that zinc isotopic signatures can differ based on soil constituents, weathering, and leaching, complicating our understanding of zinc availability. While zinc deficiency appears to be an issue in some tropical soils, others contain high levels of zinc pollution from human activities like mining or sewage disposal. For instance, Salam (2021) found that zinc concentrations remained 17-53% of initial levels up to 21 years after industrial waste amendment, though lime and compost additions helped decrease zinc over time. Similarly, Gomes (2022) observed that phosphate amendment of mining-polluted soil altered zinc speciation and increased its mobility, posing risks of groundwater contamination.

Manganese (Mn): From the table above, we have 0.64 mg/kg, 0.16 mg/kg, 0.36 mg/kg, 0.52 mg/kg, for Umudike, Ariam, Umuriaga and Oloko respectively with a standard limit of 7.48 mg/kg. Manganese concentrations in tropical soils can vary widely but often exceed recommended limits, according to several studies. Zaman (2020) found that a green extraction method could determine "trace" amounts of manganese in tropical soils, suggesting manganese may accumulate in these soils. Rhodes (2005) directly measured manganese solubility in Sierra Leonean soils and found it was too high to persist in an exchangeable form, implying total manganese was very high. Manganese toxicity is a risk in tropical soils, especially at low pH. In summary, manganese is abundant yet variable in tropical soils and sediments, where it commonly exceeds recommended limits and presents a risk of toxicity, especially where pH is low. The distribution and chemistry of manganese in these environments depends on a variety of soil properties and environmental factors. Legumes and other plants show varied sensitivity to excess manganese, depending in part on their ability to sequester it in roots.

Calcium (Ca): from the table above we have, 8.00 mg/kg, 0.66 mg/kg, 0.67 mg/kg, 9.33 mg/kg for Umudike, Ariam, Umuriaga and Oloko respectively, with a standard limit of 2.60 mg/kg. However, other research indicates higher optimal levels of exchangeable calcium for maximum plant productivity and health, around of 1200 to 1400 mg/kg (Messmer 2014). While plants can survive at lower calcium levels, deficiency problems may still arise (Wallace, 1975). For example, Hartz (2012) found that calcium-related disorders were common in vegetable crops at levels considered adequate by standard soil tests. Adding calcium amendments improved plant health and yield. Similarly, Ritchey (1982) found that adding calcium salts to clayey subsoils with very low exchangeable calcium (0.2 meq/100 g or less) effectively normalized seedling root growth, which was otherwise stunted. In summary, while plants can survive at a range of calcium levels, most research indicates that exchangeable calcium concentrations of 1200 mg/kg or higher are ideal for maximizing plant health, growth, and yield in tropical soils and especially in no-till soils.

Aluminum: from the table we have,8.00 mg/kg, 4.00 mg/kg, 0.00 mg/kg, 2.00 mg/kgfor Umudike, Ariam, Umuriaga and Oloko respectively with a standard of 6.80 mg/kg. Powell (1997) found that aluminum concentrations in soil solution were highest in acidic soils (pH 4.33-5.76) that received little to no phosphate or sulfur fertilizer. The amount of aluminum decreased as soil pH increased, indicating that aluminum solubility depends strongly on soil acidity. Vogt (2001) also found that aluminium concentrations were highest in acidic forest soils, with median pH of 4.4 and aluminium concentration of 3.4mg/L. The amount of aluminium in soil solution decreased as sulfate concentrations decreased due to reduced atmospheric sulfur deposition, suggesting that sulfate may influence aluminium mobility.

From the study, it was observed that No-till farming practices result in increased soil organic matter content, soil moisture content, and soil biodiversity and increase soil physic-chemical parameters as compared to conventional plow-tillage systems. Bulk soil density is often higher under no-tillage systems, but there is also greater macrospore structure under no-till farming because of the preservation of earthworm burrows compared to conventional tillage systems.Generally, tillage has negative impact on soil micro and organisms. Therefore, to achieve the goal of preserving the soil organisms and increase its biodiversity, new tillage method such as no-tillage or reduced tillage should be encouraged among farmers.

Based on the results of the study, it can be concluded that the soils in the study area are slightly alkaline, have a high CEC, but low SOM, TN, and P contents. These results suggest that the soils in the study area are not very fertile even with no-tillage agricultural practices, but they have the potential to be improved by increasing the SOM and TN contents even with no-tillage agricultural practices.

IV. Conclusion

Soil tillage methods have complex effects on physical, chemical and biological properties of soil. Because of the changing physical and chemical properties of soil, by soil tillage methods, the biological properties of soil may also change. Actually, these changes are indirect results of tillage. Changed physical and chemical soil properties by soil tillage methods affect the parameter directly related to soil physicochemical parameters such as organic matter, soil humidity, temperature and ventilation as well as the degrees of interaction between soil mineral and organic matter.

No-till agricultural practice is beneficial for its ability to reduce soil erosion, sequester soil carbon, reduce agricultural runoff, and improve farmland wildlife habitat, while maintaining or even improving crop yields. The findings of this study can be used to inform land use planning and management decisions in order to protect and restore soil quality. For example, agricultural planners can designate areas for conservation and restoration, and farmers can adopt practices that improve soil quality, such as crop rotation, cover cropping, and reduced/no- tillage.

References

[1] Blume, H., Brümmer, G.W., Fleige, H., Horn, R., Kandeler, E., Kögel‐ Knabner, I., Kretzschmar, R., Stahr, K., & Wilke, B.-. (2016). Soil Organic Matter.

[2] Cardoso, I.M., Janssen, B.H., Oenema, O., & Kuyper, T.W. (2003). Phosphorus Pools In Oxisols Under Shaded And Unshaded Coffee Systems On Farmers' Fields In Brazil. Agroforestry Systems, 58, 55-64.

[3] Cunningham, R.K. (1962). Mineral Nitrogen In Tropical Forest Soils. The Journal Of Agricultural Science, 59, 257 - 262.

[4] Dabin, B. (1980). Phosphorus Deficiency In Tropical Soils As A Constraint O Agricultural Output.

[5] Dalling, J.W., Heineman, K.D., Lopez, O.R., Wright, S.J., & Turner, B.L. (2016). Nutrient Availability In Tropical Rain Forests: The Paradigm Of Phosphorus Limitation.

[6] Igwe, C. (2012) Gully Erosion In Southeastern Nigeria: Role Of Soil Properties And Environmental Factors. Nsukka, Enugu State, Nigeria. Licensee Intech. Doi:Http://Dx.Doi.Org/10.5772/51020

[7] Isitekhale, Aboh, & Oseghale (2013). Sulphur Status Of Some Soils In Edo State, Nigeria. International Journal Of Scientific & Technology Research, 2, 91-95.

[8] Keller, M., Kaplan, W.A., & Wofsy, S.C. (1986). Emissions Of N2o, Ch4 And Co2 From Tropical Forest Soils. Journal Of Geophysical Research, 91, 11791-11802.

[9] Kushwaha, C.P., Tripathi, S.K., & Singh, K.P. (2001). Soil Organic Matter And Water-Stable Aggregates Under Different Tillage And Residue Conditions In A Tropical Dryland Agroecosystem. Applied Soil Ecology, 16, 229-241.

[10] Ladonin, D.V. (1996). The Influence Of Industrial Pollution On The Distribution Of Copper And Zinc In The Soil. Eurasian Soil Science, 28, 93-103.

[11] Lambin, E. F., & Meyfroidt, P. (2011). Global Land Use Change, Economic Globalization, And The Looming Land Scarcity. Proceedings Of The National Academy Of Sciences, 108(9), 3465-3472.

[12] Lombin, G., & Fayemi, A.A. (1976). Magnesium Status And Availability In Soils Of Western Nigeria. Soil Science, 122, 91–99.

[13] Margulies, J. (2012). No Till Agriculture In The Usa. School Of Geography And The Environment, University Of Oxford.

[14] Nandasena, K.A. (2000). Nitrogen Status And Its Supplying Capacity Of Tropical Soils

[15] Nigerian Meteorological Agency. (N.D.). Climate Of Nigeria. Retrieved From Https://Nimet.Gov.Ng/Climate-Of-Nigeria.

[16] Nkrumah, P.N., Echevarria, G., Erskine, P.D., Chaney, R.L., Sumail, S., & Van Der Ent, A. (2019). Effect Of Nickel Concentration And Soil Ph On Metal Accumulation And Growth In Tropical Agromining 'Metal Crops. Plant And Soil, 443, 27 - 39.

[17] Nnaji, G. U., & Onyekwelu, J. C. (2019). Soil Survey Of Nsukka Local Government Area, Enugu State, Nigeria. Journal Of Agricultural Extension And Rural Development, 11(4), 70-79. Doi: 10.5897/Jaerd2018.1026

[18] Ogbuene, E., & Okonkwo, C. I. (2017). Geomorphological Mapping Of Nsukka Area, Enugu State, Nigeria. Ethiopian Journal Of Environmental Studies & Management, 10(2), 165-174. Doi: 10.4314/Ejesm. V10i2.1

[19] Ogeh, J., Uzu, F.O., & Obi-Ijeh, O. (2012). Distribution Of Sulphur In Soils Formed From Different Parent Materials In Southern Nigeria. Nigerian Journal Of Basic And Applied Sciences, 20, 73-77.

[20] Ofomata, G.E.K. (1982). Soil Erosion In Nigeria, The Views Of A Geomorphologist. Nsukka. University Of Nigeria.

[21] Patrick, M., Tenywa, J.S., Ebanyat, P., Tenywa, M.M., Mubiru, D.N., Basamba, T.A., & Leip, A. (2013). Soil Organic Carbon Thresholds And Nitrogen Management In Tropical Agroecosystems: Concepts And Prospects. Journal Of Sustainable Development, 6, 31.

[22] Products, E.P. (2012). Scientific Opinion On The Tolerable Upper Intake Level Of Calcium. Efsa Journal, 10.

[23] Ramos, F.T., Dores, E.F., Weber, O.L., Beber, D.C., Campelo, J.H., & Maia, J.C. (2018). Soil Organic Matter Doubles The Cation Exchange Capacity Of Tropical Soil Under No-Till Farming In Brazil. Journal Of The Science Of Food And Agriculture, 98 9, 3595-3602.

[24] Ross, S. (1993). Organic Matter In Tropical Soils: Current Conditions, Concerns And Prospects For Conservation. Progress In Physical Geography, 17, 265 - 305.

[25] Sahoo, S. (2019). Impact Of Land Use Change On Soil Physicochemical Parameters. International Journal Of Agriculture, Environment And Biotechnology, 12(3), 325-332.

[26] Saikh, H., Varadachari, C., & Ghosh, K. (1998). Effects Of Deforestation And Cultivation On Soil Cec And Contents Of Exchangeable Bases: A Case Study In Simlipal National Park, India. Plant And Soil, 204, 175-181.

[27] Schnitzer, M.I., & Khan, S.U. (2013). Soil Organic Matter.

[28] Senbayram, M., Gransee, A., Wahle, V., & Thiel, H. (2015). Role Of Magnesium Fertilisers In Agriculture: Plant–Soil Continuum. Crop And Pasture Science, 66, 1219 - 1229.

[29] Sonon, L.S., Kissel, D.E., & Saha, U.K. (2014). Cation Exchange Capacity And Base Saturation.

[30] Sumner, M.E., & Miller, W.P. (2018). Cation Exchange Capacity And Exchange Coefficients. Sssa Book Series.

[31] Veldkamp, E., Koehler, B., & Corre, M.D. (2012). Indications Of Nitrogen-Limited Methane Uptake In Tropical Forest Soils. Biogeosciences, 10, 5367-5379.

[32] Wced 1987. Report Of The World Commission On Environment And Development: Our Common Future [Online]. Brundtland. World Commission On Environment And Development Pp. 91. [Access 5.03.2020].

[33] Zaman, B.T., Turan, N.B., Bakırdere, E.G., Topal, S., Sağsöz, O., & Bakırdere, S. (2020). Determination Of Trace Manganese In Soil Samples By Using Eco-Friendly Switchable Solvent Based Liquid Phase Microextraction-3 Holes Cut Slotted Quartz Tube-Flame Atomic Absorption Spectrometry. Microchemical Journal, 157, 104981.

[34] Zhang, R., Zhao, X., Zhang, C., & Li, J. (2020). Impact Of Rapid And Intensive Land Use/Land Cover Change On Soil Properties In Arid Regions: A Case Study Of Lanzhou New Area, China, 12(21), 9226; Https://Doi.Org/10.3390/Su12219226

[35] Zhen, M. (2002). Environmental Geochemistry Of Copper In Soils In The Regions Rich In Copperdeposits, Southeast Hubei Province, Along The Middle Reaches Of The Yangtze River.