INFLUENCE OF LAND USE ON PHYSICOCHEMICAL PROPERTIES OF SOILS IN KHANA, RIVERS STATE, NIGERIA.

[1] Peter, K.D. and [2] Anthony, J.U.
Department of Crop/Soil Science, Faculty of Agriculture, Rivers State University of Science and Technology, P.M.B. 5080, Port Harcourt, Nigeria
Email: dumkapbase@yahoo.com and reign_well25@yahoo.com

Abstract
Influence of land use on soil physicochemical properties of Swart Farm in Khana, Rivers State, Nigeria was investigated in this study. The land use types were Fallow land (FL), Plantain plantation (PP), Oil palm plantation (OP), Fish pond effluent discharge land (FPDEL), Snail farm (SF) and Yam/Cassava Farm (YCF). Soil samples were collected from two depths of 0-15cm and 15-30cm across the land use types using soil auger. Some soil physicochemical properties were studied in the field and laboratory using routine analytical tools. Soil samples collected were air-dried, grinded and sieved with 2mm sieve and analysed in the laboratory. The highest value of sand was recorded in Oil palm plantation (813gkg^{-1}), while the lowest was found in Fish pond effluent discharge land (752gkg^{-1}). Soil texture in the study site was predominantly sandy loam. The soil was slightly acidic ranging from 5.50 to 6.20 IN WATER OR SALT SOLUTION. Organic carbon content of soils in the study area across land use types were generally low when compare to available standard. It ranges between 0.14 to 1.2 gkg^{-1}. Total N was also low and increased from 0.04% to 0.07% at both depths across land use types. Available phosphorus was higher in Snail farm at 0-15cm depth (108.77mgkg^{-1}) compared to 5.562Mgkg^{-1}recorded in Oil palm plantation. Calcium-magnesium ratios were higher in Fish pond effluent discharge land (4.20 and 4.80 cmolk^{-1}g), Snail farm (4.00 and 5.00 cmolkg^{-1}) when compared to Plantain plantation and yam/cassava farm.GIVE VALUES However, magnesium was higher (5.40cmol/kg^{-1} and 5.20cmol/kg) in Fallow land and plantain plantation at 15-30cm depth respectively.
Keywords: Edaphic, Swart, effluent, land use

Introduction

In an ecosystem, soil functions are greatly influence by its Physico-chemical properties. It also determined how best such soils can be effectively manage to boost agricultural productivity and sustainability. The Physico-chemical properties of soils also influenced the nutrient status and its ability to effectively support plant growth and their development. Humid tropical soils are highly susceptible to degradation especially under continuous cultivation without any conservative measures put in place (Ovie et al 2013).

Excessive cultivation also results in low yield, nutrient depletion and degradation, as such, sustainable soil management practices is highly needed in the Humid Tropical region to improve the productive capacity of the soil (Peter and Onweremadu, 2016).

Humid tropical rainforest is characterized by high rainfall which causes run-off, leaching of nutrient elements and soil erosion (Onweremadu and Peter 2016). Soil in the region has been subjected to anthropogenic activities, thereby resulting to changes in its properties.

Different Land use systems has adverse effects on the soils on which they are practiced. Therefore, land use which is the application of human control in a systemic manner to land in order to boost its productive capacity, greatly influenced the Physico-chemical properties of soil. The traditional agriculture widely practiced in the Humid Tropical region is changing due to rapid increase in population and high rate of urbanization.

These changes have results in decrease fallow period that is essential to remedy and sustained soil productivity to enhance better crop yield. No form of Land use, has more influence on soil Physico-chemical properties than Agriculture (Isirimah 2002). Land use change the productive capacity of soils as a result of the intensification of agricultural activities leading to poor soil quality and changes in its physical, chemical and biological properties. (Adaikwu and Ali 2013).

Land use change also influenced natural resources and ecological processes such as surface runoff, erosion and changes to resilience. The intensity of Land use may cause erosion and soil compaction through changes in soil Physical and Chemical Properties (Qygard and Jaune 1993). Some Land use and cropping systems such as cultivation, deforestation and over grazing have been reported to cause significant variation in soil properties and reduction of output.

Land use types and cropping systems play important role in agriculture and environmental management especially with regards to soil properties in term of fertility and soil quality. As such, information on changes or variation among soil properties as influenced by land use types is imperative for sustainable agricultural production.

Therefore, the main objective of this research was to find out the effect of Land use on Physico-chemical properties of soils in Khana, Rivers State, Nigeria.

Materials and Methods

Brief Description of the Study Site

The study was conducted at Swart Farm in Nonwa-Sogho, Nyokhana District of Khana Local Government Area of Rivers State, Nigeria. It is located between latitude 4·799335N, 7.40054E. The area has in average annual rainfall between 2000mm – 2500mm. The rainfall distribution is bimodal with a peaks in July – September and a period of low precipitation in August normally called August break (Peter and Ayolagha 2012). The monthly temperature ranges from 27 – 35^{o}C with relatively humidity of 83%. Soils in the study area are well drained and derived from coastal plain sand of Marine deltaic deposits commonly called Ogoni sands (Peter and Oweremadu, 2015). The attitude is about 20 meters above the sea level. The geological material from which soils of the study areas were developed include Coastal Plain Sands (Bernin Formation) of the Oligocene Mioceneera (Orajaka, 1975), while the vegetation of the study area is the multistoried high tropical rainforest. Characterized by a multiplicity of tree species. Generally, the climax of the vegetation has been tremendously altered by the impact of Land degradation, uncontrolled forest exploitation and continuous land Cultivation. Some Tropical tree species that are predominant in the study area are *Delinoxregia*, *Mahogany*, *Iroko*, *Crotariaexelsa* etc. Some lands in the study area are grown with secondary vegetation and fallow with grasses such as *Panicum maximum*, *Penesetumpurpureum* etc.

The vegetation of the study area has been seriously affected due to anthropogenic activities especially continuous cropping and deforestation, resulting to depleted vegetation due to population and urbanisation pressure.

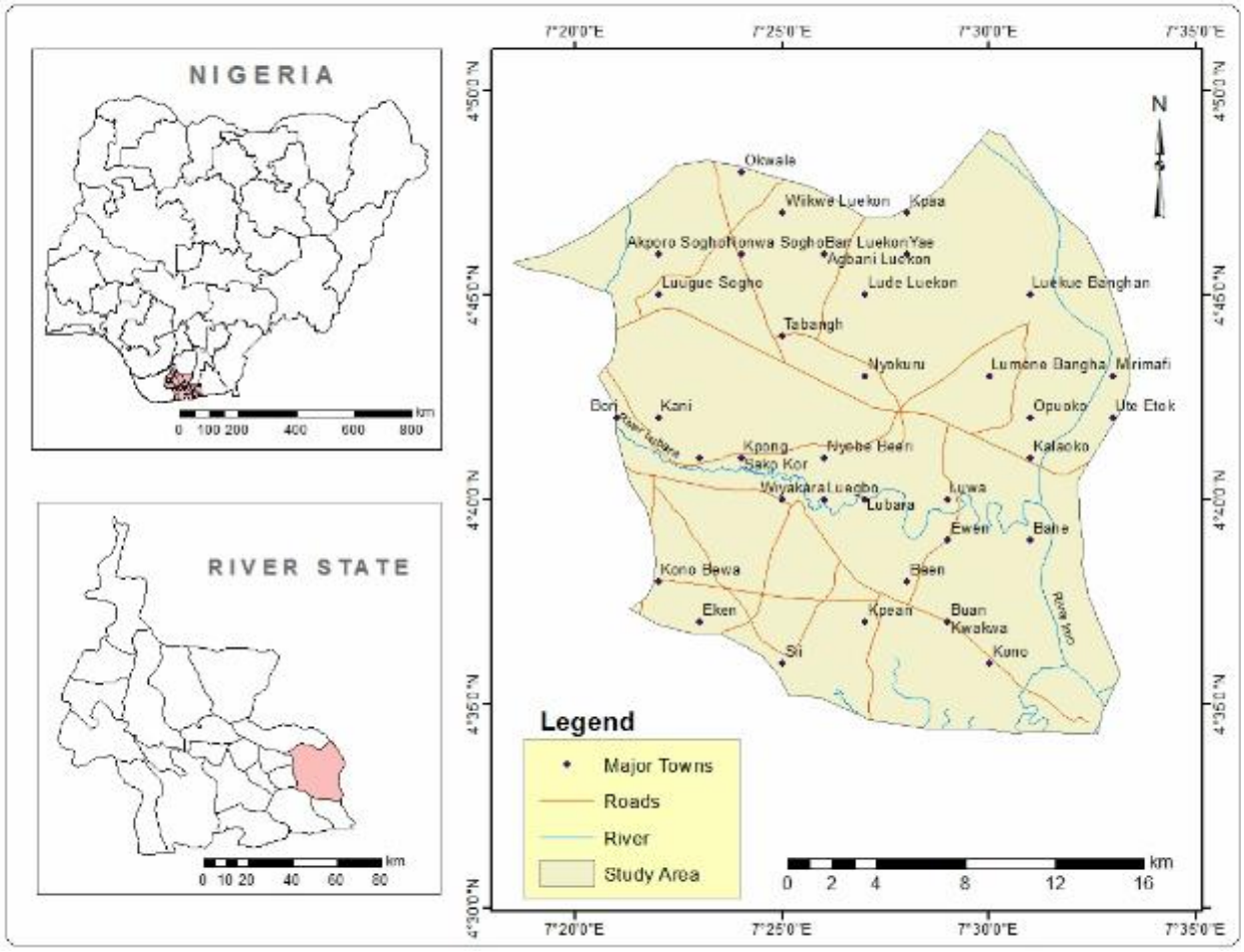

Fig. Map of Khana Local Government Area

Field Studies

A reconnaissance visit was made to the study location to identify the different Land use types and sampling points and to obtain relevant information about the study site. Fallow Land (FL), Oil palm plantation (OPP) Plantain Plantation (PP), Fish Pond Effluent discharge Land (FPEDL), Snail Farm (SF) and Yam/Cassava Farm (YCF) was identified. Soil samples was collected from four sampling points from each of the land use types at a depth of 0-15cm and 15-30cm using soil auger. Geographical coordinates of the Soil Sampling points were taken using Handheld Global positioning system (GPS) receiver (Garmin Ltd). Soil colour was determined using Munsell Soil colour charts (Munsell colours Co. 1992). Composite soil samples was make from the four samples collected from each land use type for the determination of soil physical and chemical properties. The soil was air-dried, grind and sieved with 2mm sieve.

Laboratory Analysis

Samples was analysed for selected physical and chemical properties. Particle size was determined using the bouyoucos hydrometer method (Gee and Or, 2002). Soil pH was determined using water at 1:25 and glass electrode and determined by pH meter.10g of the soil samples was weighed into a pH cup 25ml of distilled water was added and allowed to stand for 30 minutes with occasional stirring with a glass rod.

The pH meter was calibrated using a buffer solution of pH 7.0 and 4.0 before taking the reading. The electrode was inserted into the partly settled suspension and the reading were taken. Total nitrogen was determined by the micro kjedahl digestion distillation method (Bremner 1996).

10g of soil was disintegrated with concentrated H_2S0_4. The digest was then distilled with acid. Organic carbon was determined using the wet oxidation method of Nelson and Sommers (1982). Available P was determined by Bray 1 method (Olsen and Sommers, 1982).

Exchangeable bases (Ca, Mg, Na and K) were determined using Ethylene diamine tetra acetic acid (EDTA) titration method, while concentration of Na and K were measured with the flame photometer method.

Data Analysis

All data of on physical and chemical characteristics of soils were subjected to analysis of variance (ANOVA) using the Genstat Discovery 14th Edition Software.

Results and Discussion

Effect of Land use on some physical properties of the Soils in the Study Area

Table 1 revealed the effect of Land use type on some physical properties of soils in the study area. The sand content ranged from 772 – 812g/kg[1] The highest value of sand was recorded in Oil palm plantation (812g/kg[1]), while the least was recorded in the Fish pond effluent discharge land (772g/kg^{-1}). The silt content also increase from 34g/Kg^{-1} in Fallow land to 94g/kg in Fish pond effluent discharge land. The value of silt was low compared to those of sand and clay fractions. The clay content of soil in the study area across land use type ranged from 134_g/kg^{-1} in oil palm plantation and plantain plantation to 174_g/kg^{-1} in Fallow land. However, clay value was highest at the surface soil (0-15cm) depth in snail farm. This increase in clay content may be as a result of illuviation process. This is in line with the report of Singh (1999) and Adamu (2013). The soil textural class from Table 1 revealed that it was predominantly sandy loam; while the general characteristics of the soils were high sand, followed by clay and low silt content.

The sandy nature of soils across the various Land use types may be as a result of the parent material, the Coastal plain sand. This is similar to the finding of Peter and Onweremadu (2015), who reported that Ogoni sands are well drained and derived from the Coastal plain sand of marine deltaic deposits. The colour of the soils ranged from very Dark brown 10 YR 3/3 moist in Oil Palm Plantation to Dark brown 10 YR 3/3, moist Fallow land, Fish Pond effluent discharged, Yellow brown 10 YR ¾ moist and Dark greyesh brown 10 YR 3/2 moist in Snail farm land.

Table 1: Effect of Land use on some Soil Physical Properties

Land use types	Coordinates	Depth Cm	Sand	Silt	Clay	Textural class	Colour notation class
			→ g/kg ←				
FL1	04.75933^{N}	0-15	792	34	174	Sandy Loam	Dark brown10YR $^{3}/_{3}$
FL 2	007.40054^{E}	15-30	792	54	154	SL	Yellow brown10YR $^{5}/_{4}$
OP 1	0.475876^{N}	0-15	812	54	134	SL	Very dark brown10YR $^{3}/_{3}$
OP 2	007.39974^{E}	15-30	810	14	154	SL	Dark brown10YR $^{3}/_{3}$
PP 1	0.476640^{N}	0-15	792	74	134	SL	Dark brown10YR $^{3}/_{3}$
PP 2	007.40112^{E}	15-30	792	94	134	SL	Yellow brown10YR $^{5}/_{6}$
FPDL 1	0.475976^{N}	0-15	772	94	154	SL	Dark brown 10YR $^{3}/_{3}$
FPDL 2	007.40019^{E}	15-30	752	94	154	SL	Yellow brown10YR $^{5}/_{4}$
SF 1	04.76034^{N}	0-15	792	54	154	SL	Dark greyish brown10YR $^{3}/_{2}$
SF 2	007.39989^{E}	15-30	720	34	174	SL	Brown10YR $^{5}/_{3}$
YCF 1	04.75944^{N}	0-15	792	54	154	SL	Dark brown10YR $^{3}/_{3}$
YCF2	007.40058^{E}	15-30	812	34	154	SL	Yellow brown10YR $^{5}/_{4}$

FL = Fallow Land, OP = Oil Palm Plantation, PP = Plantain Plantation FPDL = Fish pond effluent discharge land, SF = Snail farm and YCF = Yam/Cassava Farm

Effect of Land use on some Chemical Properties of Soils in the Study Area

Some soil chemical properties as affected by Land use are shown in Table 2. There was great variation in the various soil chemical properties across the Land use types. The result revealed that the soil was slightly acid. The soil pH ranged from 5.6 to 6.20 at a depth of 0-15cm across Land use types and 5.5 to 6.1 at depth of 15-30cm across the different land use types, respectively. The slightly acidic nature of soil in Plantain Plantation and Fish pond effluent discharge land (6.2 and 6.1) at a depth of 0-15cm and Snail farm (6.1) at a depth of 15-30cm may be attributed to wood ash applied to the soil in the plantain plantation, the calcium content of feed fed to the fishes and mineralization of their hatched egg and broken shell of dead snail. The increase in pH in the study site at both depths may be as a result of the lime and calcium content of the snail broken egg shell and broken shell cover of dead snail.

Organic carbon level increase from 0.55g/kg^{-1} in Fish pond effluent discharge land to 1.2g/kg^{-1} in Plantain plantation at a depth of 0-15cm, while there was an increase from 0.14g/kg^{-1} in Fish pond effluent discharge land to 0.82g/kg^{-1} in Oil palm plantation at a depth of 15-30cm.

The organic carbon content of soils in the study area across Land use types were generally low when compared to available standard (organic matter rating and interpretation guide) as reported by Isirimah 2006, Ayolagha et al 2006, Peter and Ayolagha 2012 and Douglass and Peter 2016. Total N increase from 0.04g/kg^{-1} to 0.07g/kg^{-1} at both depth across Land use types respectively. The result revealed that, there was very low N in the soil across Land use. Total N is directly related to organic carbon content of the soil that was also very low.

Available P increased sharply to 108.77g/kg^{-1} in Snail farm and 75.44g/kg^{-1} in Fish pond effluent discharge land at a depth of 0-15cm and 85.96mg/kg^{-1} in Snail farm and 54.39mg/kg^{-1} in Fish pond effluent discharge land at a depth of 15-30cm.

Table 2: Effect of Land use on some soil Chemical Properties

Land use Types	Depth (cm)	pH H_20	OC g/kg	N	Av.P Mg/Kg
FL 1	0-15	5.60	0.76	0.04	82.46
FL 2	15-30	5.60	0.15	0.07	82.46
OP 1	0-15	5.90	1.03	0.06	5.62
OP 2	15-30	5.80	0.82	0.07	7.02
PP 1	0-15	6.20	1.2	0.06	87.72
PP 2	15-30	5.50	0.70	0.06	61.40
FPDL 1	0-15	6.10	0.55	0.07	75.44
FPDL 2	15-30	6.00	0.14	0.07	54.39
SF 1	0-15	5.90	0.93	0.04	108.77
SF 2	15-30	6.60	0.64	0.07	85.96
YCF 1	0-15	5.70	0.97	0.07	77.19
YCF 2	15-30	5.60	0.84	0.10	63.16

FL = Fallow Land, OP = Oil Palm Plantation, PP = Plantain Plantation FPDL = Fish pond effluent discharge land, SF = Snail farm and YCF = Yam/Cassava Farm

Effect of Land use on Exchangeable Bases (Ca,Mg,K and Na)

Result of the effect of Land use on exchangeable bases are presented in Table 3. Ca sharply increased from 1.60 Cmol/kg in Fallow land to 4.20 Cmol/kg in Fish pond effluent discharge land. Calcium was high (4.20 Cmol/kg) at both depth in FPEDL followed by Snail farm (4.00 and 3.50 Cmol/kg), Plantain plantation (3.00 and 2.40 Cmol/kg), Oil palm plantation (2.80 and 2.10 Cmol/kg) and Yam cultivated farm (2.50 Cmol/kg) at a depth of 0-15cm. The least was observed in Fallow land at both depth (1.60 and 2.00 Cmol/Kg) and Yam cultivated farm (1.80 Cmol/Kg) at a depth of 15-30cm.

Table 3: Effect of Land use on soil Exchange Bases

Land use types	Depth (cm)	Ca	Mg CMol/Kg	K	Na
FL1	0-15	1.60	4.40	0.14	0.27
FL2	15-30	2.00	5.40	0.09	0.25
OP1	0-15	2.80	4.40	0.14	0.25
OP2	15-30	2.10	4.60	0.13	0.25
PP1	0-15	3.00	5.20	0.19	0.24
PP2	15-30	2.40	4.80	0.16	0.22
FPDL1	0-15	4.20	5.00	0.25	0.28
FPDL2	15-30	4.20	4.80	0.27	0.27
SF1	0-15	4.00	5.00	0.39	0.23
SSF2	15-30	3.50	4.60	0.34	0.19
YCF1	0-15	2.50	4.40	0.13	0.24
YCF2	15-30	1.80	5.00	0.14	0.20

FL = Fallow Land, OP = Oil Palm Plantation, PP = Plantain Plantation FPDL = Fish pond effluent discharge land, SF = Snail farm and YCF = Yam/Cassava Farm.

The sharp increase in exchangeable calcium in Fish pond effluent discharge land may be as a result of calcium component of the feed fed to the fish and broke shell of dead snail and even the broken shell of their hatched egg; while the increase in calcium in plantain may be as a result of the wood ash applied. Exchangeable magnesium of soil in the study area was high across the Land use types. Magnesium level ranged from 4.40 $Cmol/kg^{-1}$ at 0.15cm depth in Fallow land, Yam cultivated land, Oil palm plantation to 5.00 $Cmol/kg^{-1}$ in Snail farm, and Fish pond effluent discharge land and 5.20 $Cmol/kg^{-1}$ in Plantain plantation and 5.40 $Cmol/kg^{-1}$ in Fallow land at depth of 15-30cm respectively.

K content of the soil ranged from very low in Fallow land (0.14 and 0.09 $Cmol/kg^{-1}$) and Yam cultivated farm (0.13 and 0.14 $Cmol/kg^{-1}$) to low in Plantain plantation (0.19 and 0.16 $Cmol/kg^{-1}$); while exchangeable Na increased from 0.24 and 0.20 $Cmol/kg^{-1}$ in Yam cultivated farm to 0.2 and 0.27 $Cmol/kg^{-1}$ at a depth of 0-15 and 15-30cm respectively

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