INFLUENCE OF LAND USE TYPE ON SELECTED PHYSIOCHEMICAL PROPERTIES OF SOILS DERIVED FROM COASTAL PLAIN SANDS IN PORT HARCOURT, SOUTHERN NIGERIA.

[1] Peter, K.D. and [2]Inengi, F.I.
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

Abstract
This study investigated the influence of land use types on selected physical and chemical properties of soils derived from coastal plain sands in Port Harcourt, Southern Nigeria. Five (5) land use types were selected namely, residential area, plantain plantation, yam farm, cassava farm and oil palm plantation. Soil samples were randomly collected from each land use type at a depth of 0-15 and 15 – 30cm and were subjected to various laboratory analysis using standard techniques.All the data generated from laboratory analysis were subjected analysis of variance (ANOVA) and Mean separation was done using LSD. From the result obtained, the physical properties of the soils indicated that they were loamy sand in texture across land use types. Soil organic matter was low in yam plot (2.70 and 2.37g/kg$^{-1)}$ than other land use types. Plantain plantation had higher amounts of exchangeable cations, cassava plot had the highest organic matter followed by Residential area. It is recommended that the use of organic fertilizers such as municipal waste composed, Cow dung, and Poultry manure should be encourage to improve the productive of the soils for sustainable Agriculture. Agricultural waste should also be incorporated into the soils, rather than burying or burning them.

Keywords: Coastal Plain sand, Physicochemical, Soil properties, Port Harcourt and Southern Nigeria

Introduction

Soil is one of the natural resources which are used for many purposes such as agriculture, construction work and waste disposal. Soils have physical, Biological and chemical properties which vary under different land use.Land use is simply the human use of land. Land use involves the management and modification of natural environment, or wilderness into built environment such as settlements and semi-natural habitats such as arable fields, pastures, and managed woods. It also has been defined as "the arrangement, activities and inputs people undertake in certain land cover types to produce, change or maintain it.Land use and Land management practice have a major impact on Land resources including water, soil, nutrients, plants and animals.Land use information can be used to develop solutions for natural resource management issues such as soil and water quality. Water bodies in a region that has been deforested or having erosion will have different water quality than those in areas that are forested.The major effect of land use on land cover has been deforestation of the temperate regions. More recent significant effects of land use include urban sprawl, soil erosion, soil predation, and desertification. This is occasioned by the various land use type such as plantain plantation, yam farm, oil palm farm, cassava farm, and residential area.

Justification

Soil degradation is the reduction in soil capacity to produce in term of quality and quantity. Continuous cropping and the type of crops planted degrade the soil (Vink, 1987).Owing to this, there is need to estimate the level of degradation from the various land use type. This will enable the researcher to make adequate recommendation to reduce the level of degradation to a level that is suitable for a better Agriculture production

Objective of the Study

The major objective of the study was to assess the influence of Land use types on the physical and chemical properties of coastal plain sand of Port Harcourt, South Eastern Nigeria

Materials and Methods

Experimental Site/Study

The study was conducted at the Teaching and Research Farm of the Rivers State University of Science and Technology, Nkpolu-Port Harcourt, Rivers State. The locations lies between latitude 4°8′59N longitude 6°10′90at elevation of 25m above sea level. The study area has an average annual rainfall of about 2000mm per annum.The study site also have mean annual minimum temperature of 22^{o}c to an average maximum temperature of 31^{o}C (FDRD 1981) depending on the seasons of the year. The soils are classified as coastal plain sand andtheyare highly weathered soils. The natural vegetation of the area has been altered and replaced with secondary and tertiary forest due to continuous cropping. Plant species in study area include trees,shrubs and grasses.

AugerSampling

This was carried out in the month of May, 2015. An auger was used to collect soil samples from a depth of 0-15 and 15-30cm, and this was done across the different land use types in the study location such as plantain plantation, yam farm, cassava farm, oil palm and residential area, at three (3) different points randomly selected for each site. At the end, a total number of 15 soil samples were collected and stored in polythene bags with their labels.

Sample Preparation for Laboratory Analysis

Soil samples were air- dried and large clods were broken to speed up air drying process, after which large plant residues were removed. The sample was sieved through a 2-mm sieve.

Laboratory Analysis

Selected physical and chemical properties were determined in the laboratory. The physical property determined are, particle size distribution (soil texture).

Physical Properties

Particle size distribution (Soil Texture) was determined by the hydrometer method (Bouyoucos 1962).

Chemical Properties

The available phosphorus was determined by (Bray's and Kurtz, 1945). While organic matter was then calculated by multiplying soil organic carbon value by a factor of 1.724.

Soil pH

Soil pH was determined in water suspension 1.2.5 ratio using the calomel electrode method Bates, (1954).

Available Phosphorus

This was determined using Bray and Kurtz (1945) No 1 as adopted by Juo (1979). The soil P was first extracted by agitating the soil with solution containing 0.3N NH4 and 0.0625N HCL.

After which the concentration of P in the extract was determined by colorimetric method. The percentage transmittance (absorbance) of prepared samples was measured by the spectrophotometer at a wavelength of 660nm.

Organic Carbon (OC)

Organic carbon was determined by Walkley and Black method (1934).10gof each sample was placed into a 250ml conical flask, 10ml of 1m potassium dichromate was pipette into each flask, and the mixture was titrated with 0.5N potassium permanganate (KMnO4) solution. The percentage organic carbon was determined using the following equation.

$$\% \frac{O.C=N(T-B)x\ 0.390}{W}$$

Where

N = Normality of KMnO4 used

T = Titrate Value

B = Blank Reading

W = Weight of the soil used.

While the organic matter was then calculated by multiplying soil organic carbon value by a factor of 1.72

Results and Discussion

Effect of land use types on the physical properties of soils in the study sites.

Table 1: Shows the results of the physical properties of soils in the five land use types. The textural composition of the various land use types indicate loamy sand, including the residential area.The particle size distribution was dominated by the sand fraction ranging from 792 – 896g/kg, followed by clay and silt. Texture of the soils was generally loamy sand.It reflected the nature of coastal plain sand parent materials from which the soils were formed. However, silt fraction was significantly ($P \geq 0.05$) low in oil palm ($26kg/g^{-1}$) at 0-15cm depth than plantain plantation, ($48g/kg^{-1}$), cassava and yam farm ($52g/kg^{-1}$) and Residential area (728/kg) respectively. The clay fraction was significantly ($P \geq 0.05$) higher ($116g/kg^{-1}$) in oil palm plantation that in plantain plantation ($56g/kg^{-1}$) and cassava ($76g/kg^{-1}$). The continuous destruction of soil structure as well as the deposition of silt size particle by runoff water must have led to the increase in the silt content of residential area which in line with the findings of Hillel (1998).

Table 1: Effect of land use type on the physical properties of soil of the study sites.

Land use	Depth (cm)	Particle size			Textural Class
		Sand g/kg	Silt g/kg	Clay g/kg	
Residential Area	0-15	832	72	96	Loamy Sand
	15-30	792	112	96	Loamy Sand
Cassava farm	0-15	872	52	76	Loamy Sand
	15-30	898	26	76	Loamy Sand
Yam Farm	0-15	852	52	96	Loamy Sand
	15-30	832	52	116	Loamy Sand
Plantain plantation	0-15	896	48	56	Loamy Sand
	15-30	872	52	76	Loamy Sand
Oil Palm	0-15	872	32	96	Loamy Sand
	15-30	832	52	116	Loamy Sand

Effect of land use types on Exchangeable basis of soils of the study site.

The result represents in Table (2) revealed that the mean calcium across the various land use ranged from (0.52cmol/kg) in cassava farm to 0.64 Cmol/kg in

residential area. From the result it is also revealed that calcium increased in residential area (0.64 Cmol/kg) followed by Yam plot (0.58cmol/kg), oil palm 0.55cmol/kg and plantain plantation (0.53cmol/kg, while the least was observed in cassava plot (0.52cmol/kg). The constant disposal of organic waste and wood ash within the residential area resulted in the increase of calcium content of the soil. The results of the magnesium content of soils across various land use type are presented in (Table 2). It revealed that mean magnesium across the various land use ranged from (1.45 cmol/kg) in residential area to (2.00 cmol/kg) in plantain plantation. From the result it is also revealed that magnesium increased in plantain plantation (2.00 cmol/kg) followed by oil palm (1.89 cmol/kg), cassava plot (1.83 cmol/kg) and yam plot (1.65 cmol/kg). And the least was observed in Residential Area (1.45 cmol/kg). From the result obtained the Magnesium (Mg) level were found to be moderate in all the land use types (<0.3- <8).

The mean potassium across the various land use types ranged from (1.33 cmol/kg) in yam farm to (1.95 cmol/kg) in residential area. It also shows that potassium increased in residential area (1.95 cmol/kg), followed by oil palm (1.82 cmol/kg), plantain plantation (1.56 cmol/kg) and cassava plot (1.50cmol/kg), the least was observed in yam plot (1.33 cmol/kg). The cause of increase in potassium is due to the decomposition of the organic matter in the soil (eg) plants grow and naturally die and decomposed to return the K back to the soils.The mean sodium (Na) across the various land use types ranged from (2.15 cmol/kg) in yam plot to (3.44 cmol/kg) in plantain plantation. The results shows that sodium increased in plantain plantation (3.44 cmol/kg) followed by oil palm (2.93 cmol/kg), cassava plot (2.43 cmol/kg) and residential area (2.26 cmol/kg), the least was observed in yam plot which is (2.15 cmol/kg).

Effect of Land Use Types on Selected Chemical Properties of Soil of the Study Site.

The result of the effect of land use type on selected chemical properties of soils of the study sites is in Table 3.The result represent revealed that the mean Available phosphorus across various land use ranged from (4.61 cmol/kg) in yam plot to (7.24cmol/kg) in plantain plantation. From the result, it also revealed that available phosphorus increased in plantain plantation (7.24 cmol/kg), followed by cassava plot (5.66 cmol/kg), Oil palm (4.82 cmol/kg) Residential Area (4.65cmol/kg) and the least was observed in yam plot (4.61cmol/kg). The rating of Available Phosphorus in the soils in all the land use types were low except plantain plantation farm at 15-30cm which is medium. The rating was done using Bray 2 Available Phosphorus rating as quoted by Enwezor*et al*(1989).The mean (organic matter) across various land use ranged from (2.54 cmol/kg) in yam plot to (3.38cmol/kg) cassava plot.The result also revealed that organic matter contentwas highest in cassava farm (3.38cmol/kg) followed by Residential Area (3.37cmol/kg), Plantain plantation (2.87 cmol/kg), Oil palm (2.85 cmol/kg) and the least was observed in Yam plot (2.54 cmol/kg). However, the low level of organic matter content of the soils in the various study site is an indication that there was high biological degradation of all the soils of the study sites.The mean Organic carbon across various land use ranged from (1.48 cmol/kg) in yam plot to Residential Area (1.96 cmol/kg) followed by cassava plot (1.79 cmol/kg), plantain plantation (1.64 cmol/kg), Oil palm (1.63 cmol/kg) and the least was observed in yam plot (1.48 cmol/kg).The mean across the various land use ranged, from (4.58 cmol/kg) in oil palm to plantain plantation (5.35 cmol/kg) followed by Residential Area with mean (15.13cmol/kg), Cassava plot with (4.98cmol/kg), Yam plot (4.65 cmol/kg) and the least was Oil palm with mean (4.58 cmol/kg).

Table 2: Effect of land use types on selected chemicals properties of soils of the study site

Land use	Depth (cm)	pH (H_20)	OC (gK_g^{-1})	Total N (gK_g^{-1})	Avail. P. (MgK_g^{-1})	Exchangeable bases			
						Ca	Mg	Na	K
						CMol/K_g			
Residential	0 – 15	5.15	1.99	0.32	3.83	0.08	1.25	2.26	1.04
Area	15– 30	5.10	1.92	0.20	4.30	1.20	1.56	2.26	1.15
Cassava Farm	0 – 15	5.00	1.76	0.30	6.12	0.44	1.60	2.47	1.60
	15- 30	4.95	1.82	0.24	5.21	0.60	2.06	2.39	1.40
Yam Farm	0 – 15	4.60	1.57	0.32	4.73	1.06	1.47	2.08	1.46
	15- 30	4.70	1.38	0.22	4.49	0.10	1.84	2.13	1.20
Plantain	0 – 15	5.35	1.74	1.80	6.29	0.60	2.80	3.92	1.66
Plantation	15- 30	5.35	1.54	2.05	8.18	0.43	1.20	2.95	1.46
Oil Palm	0 – 15	4.55	2.98	1.30	5.38	0.50	2.68	3.26	1.84
	15- 30	4.60	2.63	0.60	4.26	0.60	1.10	2.60	1.80

Conclusions

This work assessed the influence of land use types on selected physicochemical properties of soils derived from coastal plain sand of Port Harcourt. The study revealed that land use has high level of influence that may be positive or negative on soil physical and chemical properties. From the foregoing observations, it was recommended that agricultural land should be put into proper use with adequate management system to boost the land productive capacity for sustainable agricultural production.

References

Adaikwu, A.O. and A. Ali (2013). Assessment of some soil quality indicators in Benue state, *Nigerian Soil Science Society of Nigeria* p 66-74.

Alewell, C. (2000) Soil and Water Degradation by Acidification.

Bates, R.G. (1954) Determination of soil pH by Electrometric method.

Bouyocus G.H. (1951). A recalibration of the Hydrometer method for mechanical Analysis of Soils Agron. J. 434-438.

Brandy, G. (1996) Environmental factors of macro and micro and organism.

Bray, R.H. and I.T Kurtz (1945). Determination of total organic and available forms of phosphorus in Soils. Nigeria Journal Soil Science 59:39-45.

Bremner, J.M, and Mulvaney CS: (1982).Total Nitrogen. In methods of soil Analysis. Chemical properties. Edited by Page AL, Miller RH, America Society of Agronomy, Soil Sc. Society of America. 1982:595-624.

Buol S.W. F.D. Hole, R.J. McCracken and R. J. Southard (1997). Soil genesis and classification 4th edition Lowa State University Press, Ames.

Chapman H.D. (1965)Cation Exchange Capacity. In methods of soil Analysis. Edited by Black CA, Clark FE. Agronomy Inc, Madison, Wisconsin,891-901.

Federal Department of Rural Development Programme Preparation Report (Nov.1981).

Food and Agricultural Organization (FAO,997a;).

Foth, H.D (1984). Fundamentals of soil science, Sixth Edition.

Heckman J.R, and Kamprath E. J. (1995) Potassium accumulation and soybean yield related to potassium fertilizer rate and placement. Common soil sci. plan 26:123-145.

Soil Survey Staff (1975). Soil Taxonomy. A basic system of soil classification for making and interpreting Soil Survey USDA, Agricultural handbook 436. Washington D.C., 754 pp.

Vink, J.P.M (1987) Agriculture and the Dynamics of soil Erosion in the United States, (1987) Census of Agriculture.

Walkley A. and Black C.A: An examination of the digestion method for determining soil organic matter soil sci. 1939,37:29-38.