VARIABILITY OF SELECTED PHYSICO-CHEMICAL PROPERTIES OF SOILS AFFECTED BY DIFFERENT LAND-USE PRACTICES IN OWERRI SOUTHEASTERN NIGERIA.

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Abstract.

We investigated variability of selected physicochemical properties of soils affected by different land use types in Owerri Southeastern Nigeria. Random soil sampling technique was used in collecting 5 soil samples each from dump soil (D1-D5) and arable land (A1-A5)) and at a depth of 0-15, 15-30, 30-45cm respectively. Collected soil samples were subjected to standard routine analyses. Generated soil data were subjected to analysis of variance, coefficient of variation (C.V) and correlation analysis. Generally, there were variations in all selected soils properties, but the degree of the variability differed. Silt indicated highest variations with respect to sampling points (CV=51.1%) and depth of sampling (CV = 68.2%) in the dump soil. Bulk density recorded little variation in both soils at the different sampling points (C.V=12.5and 3.2%) and at the different depths (C.V=6.4 and 3.2%). Soil pH recorded little variations (C.V= 4.1and 5.49%), soil organic matter recorded moderate variation (C.V 49.87 and 25.59%) in both soils respectively. Soil pH, organic matter, effective cation exchange capacity were significantly higher (P<0.01) in dump soil compared to arable land which was significantly higher in soil bulk density. Generally soil variability occurred highest in the dump soil than the arable land. Significant positive correlations (P=0.05) were noted between sand fraction and clay (r^2=0.713), bulk density (r^2=0.5850 and available phosphorus r^2=0.739) respectively. Soil organic matter had significant positive correlation with total nitrogen (r^2=0.601) and while effective cation exchange capacity related significantly (p=0.05) to available phosphorus(r^2=0.494).

Keywords. *Spatial, Variability, physico chemical, Land use, Soil.*

Introduction.

The trend in food crop production is still low especially in developing countries such as Nigeria. Such problems are related to lack of adequate information in soils of an area. One of the most critical natural resource management needs of the 21st century is information about the dynamic nature of soils, or simply, soil changes (Tugel *et al*, 2005).

Soil properties are highly variable, show complex interaction, and are sensitive to human activities and agricultural intervention. Variability in soil indicates heterogeneity in soil resources and affects patterns of soil process rates (Ettema *et al*., 1998), Corstanje *et al*., 2006), resulting to low crop yield and increased cost, (Lal 1987); land devaluation and degradation (Agim *et al*., 2010). Variability in soil is affected comprehensively by topography, land use, erosion (Brady and Weil, 1999), and combine effects of physical, chemical and biological processes that take place in the soil at different intensities (Goovaerts, 1998; Santra *et al*., 2008). Depending on any of the causative factors, soil variability may be classified as little, moderate, and high (Aweto, 1982). The knowledge variability in soil properties, for adequate food production have continued to draw attention in recent times; for instance, Mahinakbarzadeh *et al*.,(1991) investigated variability in soil organic matter along several transects located within a soil map unit, Moulin *et al*., (1994) studied the spatial distribution of soil properties, erosion and crop yield along a cultivated transect and on an adjacent transect in a virgin grass land, Agim *et al* (2010) investigated physico chemical variability and productivity of soils affected by contrasting land use types in Southeastheren Nigeria. Other researchers have studied variability in soil properties, crop yield, and weeds in not only on big fields, McBratney and Pringle, (1997), Corwin *et al*., (2003), Goodwin and Miller (2003), Vrindts *et al*., (2005), but also in small sized fields Mouazen *et al*., (2003) elsewhere and in Nigeria (Law-Ogbomo and Nwachokor, 2010).

The knowledge of soil variability that occurs in basic soil property is important to agricultural development and food security. In addition, the knowledge of soil variability will will help in boosting precision agriculture and land performance.

In the light of the above therefore, the main objective of the study was to determine the variability of soil properties affected by contrasting land use types. Other objectives include:

- To determine the effect of the different land use on soil properties
- To determine some degree of association that exists between soil properties.

Materials and Methods

Site location and description.

This study was carried out in Owerri Imo state Southestern Nigeria located on Latitudes $5^0 25^1$N and Longitudes $7^0 22^1$E. The soils are derived from Coastal plain sand also known as BeniFormation (Ofomata, 1975).The vegetation is secondary forest (Igbozurike 1975).The mean annual rainfall is about 2500 mm (Imo State 1984) with the peaks in the months of July – September. The study area has two seasons (rainy and dry). Rainy season witnesses a dry spell in August otherwise called August-break. The minimum and maximum temperature of the area is between 20-32 °C respectively. Farming is the most economic activities in the area, soil fertility regeneration depends on follows which have decreased in length due to high population pressure (Onweremadu, 1994). The area is made up of many species of plants and arable crops, some of which include oil palm tree (*Elaeis guineensis*), oil bean tree (*Penthclethra macrophylla*), mango (*Magnifera india)*, Avocado (*Persea amexicana*), cashew (*Anacarduim occidentale*), cassava (*Manihot esculenta*), Yam (*Dioscorea spp*), siam weed (*Chromolena odorala*), Bambo (*Phyllostachys aureosulcata*), and guinea grass (*Panicum maximum*).

Field studies: Two adjacent land use types, arable land with (cassava intercropped with maize) for about 5 years and a dumpsite that is up to 15 years were used. The experiment was arranged in randomised complete block design (RCBD), with land use, and depths of sampling as treatments. Random soil sampling technique was used in collecting soil samples from each landuse types in 5 replicates (D1-D5 and A1-A5) at a depth of 0 -15 cm, 15 - 30 cm, 30 - 45cm depths respectively. Soil cores were used to collect undisturbed soils for bulk density determination. All sampled soils, were air dried, allowed to pass 2-mm sieve and labelled for laboratory analysis.

Laboratory analysis: Particle size distribution (PSD) was determined by hydrometer method (Gee and Or, 2002) using sodium hexa meta phosphate (calgon) as dispersant.

Bulkdensity was determined using core samplers as Grossman and Reinsch, (2002) recommended. Moisture content (V.M.C) was determined gravimetrically by oven drying the sample in moisture can at 100^0C (Baver et al., 1972).

Porosity (F) was determined by calculation from bulk density (Vomocil, 1965 and landon ,1991). Soil pH was determined in deionised water using the pH meter in soil /liquid suspension of 1:2.5(Hendershot *et al*., 1993). Organic carbon was determined by the Walkly and Black dichromic wet oxidation method (Nelson and Somers 1982).Total nitrogen was determined by the procedure of Bremner, (1996). Available phosphorus was extracted with Bray 2 solution determined by the molybdenum blue method (Olsen and Sommers, 1982). Exchangeable acidity was measured titrimetically (Mclean,1982). Effective cation exchange capacity(E.C.E.C) was calculated from the summation of all exchangeable bases and exchangeable acidity.Exchange sodium percentage

$$ESP\ (\%) = \frac{\text{Exchangeable } Na^+ \text{ (Cmol/kg)}}{\text{C.E.C (Cmol/kg)}} \times 100$$

Data analysis: Data were subjected to Analysis of variance ANOVA and significant means were separated using LSD (P<0.05), coefficient of variation (C.V) was also used according to the procedure of Aweto, (1982), correlation was used.

Result and discussion:

Table 1.0 shows the physical properties of studied soil.

Table 1.0 : Physical properties of studied soil.

Dumpsoil sampling points	Sand g/kg	Silt g/kg	Clay g/kg	SCR	TC	VMC g/kg	ℓb. g/cm^3	Porosity %
DI	806.26	19.57	174.09	0.13	SL	131.7	1.65	37.81
D2	874.8	24.33	118.47	0.21	SL	94.5	1.47	44.08
D3	838.1	40.94	120.87	0.36	SL	102.23	1.57	40.81
D4	843.87	22.20	120.59	0.20	SL	100.2	1.47	44.37
D5	872.9	19.7	108.27	0.18	SL	99.8	1.57	40.95
Mean	*847.19*	*25.87*	*128.45*	*0.22*		*105.68*	*1.55*	*41.59*
∂	34.16	8.01	28.47	0.10		16.19	0.19	7.29
%CV	4.03	51.1	22.16	11.34		15.32	12.25	17.5
Rank	LV	HV	MV	MV		MV	LV	MV
Arable land								
A1	843.73	26.69	129.58	0.21	SL	80.60	1.59	39.44
A2	835.6	24.38	140.06	0.17	SL	78.60	1.53	41.07
A3	850.3	27.17	122.53	0.22	SL	78.37	1.57	39.81
A4	860.20	26.92	112.88	0.24	SL	82.60	1.58	40.58
A5	806.30	24.30	169.10	0.23	SL	85.17	1.66	37.30
Mean	*850.35*	*27.53*	*123.76*	*0.24*		*81.07*	*1.59*	*39.74*
∂	15.42	1.45	14.60	0.14		3.27	0.05	5.48
%CV	1.8	5.30	11.79.	9.33		4.05	3.20	11.20
Rank	LV	LV	MV	LV		LV	LV	MV
LSD$^{0.05}$	**24.96****	**2.47****	**16.15****	**0.04***		**5.77****	**0.08****	**0.60****

*D1-5=Points of sampling in dumpsite soil while A1-5= Points of sampling in Arable land, S.C.R = silt clay ratio, T.C= Textural class, VMC=Volumetric moisture content, ℓb= bulk density, LSD=Least significant different, ∂= Standard Deviation, CV=Coefficient of variability, LV=Little variation, MV=Moderate variation,, HV=High variation,**= Highly significant,* significant*

Results showed that the texture of the studied soils ranges from sandy loam – loamy sand (Table 1.0). This is in line with Onweremadu *et al*., (2008) on soils of the same area and that of Bonsu and Lal , (1983) on soils of Western Nigeria. Sandiness of these soils is due to a combination of sandy parent material (Coastal Plain Sands), tropical climate and land use Onweremadu *et al.*, (2007) which influence pedogenesis and properties of soils (Akamigbo, 1999; Wang et al., 2001). While the values of sand fraction range from 838.1 - 874.8 k/kg and 806.3 - 860.2 g/kg, silt ranges from 19.7-40.94 and 24.3-27.17g/kg and clay ranges from 108.27-174.07 g/kg and 112.88-169.1 g/kg respectively on the different studied soils. With respect to the points of sampling, little variations in particle size was found at both soils as follows ; (sand fraction, C.V = 4.03 and 1.8%, Silt and clay fractions at the arable land only (C.V= 5.3 and 11.79%) while minimum variation occurred in silt and clay at the dump soil (CV =31.23 and 22.16%) respectively (Table 1.0). Babalola, (1978) reported minimum variation in soils of the western Nigeria. Here, results showed that dumpsite soil introduced many variables to the soil properties than the arable land. This could be attributed to different materials deposited on the soil. Variability in mechanical properties of soil in West Africa is partly caused by variables concentrations of gravel and skeletal material (Lal, 1987).

Results of variability with respect to depth of sampling noted little variation which occurred in all except in silt fraction where high variation occurred in the dump soil (C.V =68.22%) (Table 3.0). However, sand fraction decreased with depth. This is in line to the work of Lal, (1987) and is attributed to horizon differentiation. There was no particular trend on silt with regards to the depth of sampling. This is contrary to the work of Santra *et al*., (2008) who found higher values of silt in the upper horizon. This change could be attributed to littological discontinuities that brought about the soil formation.

In comparing the effects of the studied soils to selected properties, dump soil reduced the sand fraction by up to 0.36 % that is 847.19 against 850.35g/kg in the arable soil (Table 1.0). Land use and depth of sampling significantly affected sand , silt and clay respectively at (P<0.01) (Table 1.0). Sand and silt were significantly higher in the dumpsite soil compared to the arable land that is significantly higher in clay fraction only (Table 1.0).

The result of the silt clay ratio was in the range of 0.1-0.62 (Table 1.0). This result is very low indicating high weatherebility and age of soil. (Wanbeke 1978, Unamba-Opara and Enwezo, 1978). Similarly, Igwe *et al*.(1995) documented that the higher the silt clay ratio the younger the soils and that higher SCR are associated with landscape devastated by erosion. It follows that arable land with higher silt clay ratio is younger than the dumpsite soil. However, the soils are highly weathered and are old. Variability in silt clay ratio was moderate at dump soil (C.V= 11.34%) and little at the arable land (C.V = 9.33%) (Table 1.0).

Soil moisture content has its minimum and maximum values as 99.8 and 131.7 g/kg respectively with a mean of 105.68 in the arable land and 112.88 and 169.1 g/kg with a mean of 123.76 in the dump soil (Table 1.0). The highest mean value occurred at points D1 and D5 in the dumpsite while they occurred at points A4 & A2 in the arable land. Moderate variation was found in the dump soil (CV=15.32%). While little variation occurred in the arable land (C.V=2.86%) (Table 1.0). Similar results were found in Ibadan Nigeria by Babalola, (1978). On the other hand, little and moderate variations occurred in the dump soil with respect to the depth of sampling while little variation occurred in both surface and sub surface sampling in the arable land. (CV =2.53 and 5.3%) respectively (Table 3.0). Variability in soil moisture content is attributed to variations in vegetation, water uptake and root system distribution (Lal, 1987). In some cases, soil moisture variability is attributed to the method of its determination and by the degree of soil wetness (Babalola, 1978). In comparison, dumpsite soil increased the soil moisture retaining capacity by 30.36%. (105.68 against 81.07 in arable land) (Table 1.0). The effect of land use, and depth significantly affected the soil moisture content (P<0.01) (Table 1.0).

The soil bulk density ranged from 1.47-1.65 g/cm^3 in the dump soil and 1.53-1.66 g/cm^3 in arable land (Table 1.0), and is within the range of soils that are not compacted as was documented by (Landon 1991). Result varied lightly in both studied soils, with respect to the points sampled (C.V=12.25 and 3.20 %) Table 1.0 and with respect to the different depths (C.V=6.4 and 3.2%) (Table 3.0) respectively. Lal, (1978), attributed variation in bulk density to variation in particle size and method adopted in sampling. Bulk density decreased with depth in the studied land uses (Table 3.0). This is in conformation with the work of Santra *et al.*, (2008) and Mbagwu (1983) and was significantly (P=0.05) lower in dump soil than in the arable land (Table 1.0). Increase of bulk density down the layers could be attributed to overburden effect on deeper layers as well as declining organic matter content with depth. In their work, DeGeus, (1973) and Koorevaar *et al.*, (1983), reported that at high bulk density, there will be reduced pore space, increase compaction, reduced infiltration, restricted root growth and seed emergence and high run off as a result of surface seal. This implies that the arable land will be more prone to erosion. Total porosity ranges from 44.81 and 37.81% and varied moderately in both soils. There exists good and significant (P=0.05) relationship with bulk density, porosity and available phosphorus (r^2= 0.999, and 0.492) (Table 4.0).This signifies that about 99 % and 49 % of the values of porosity in the soil was contributed by the degree of compactness the soil were.

Table 2.0 Selected chemical properties of studied soils.

points of Sampling	pH(water)	SOM g/kg	TN %	AP Mg/kg	TEB Cmol/kg	EA Cmol/kg	ECEC Cmol/kg	SAR	ESP %
Dumpsoil									
D1	6.20	1.39	6.03	39.66	2.94	2.49	5.46	0.43	7.48
D2	6.07	1.68	10.33	30.80	3.64	0.61	4.25	0.39	8.81
D3	6.47	1.62	7.60	39.80	3.11	1.78	4.89	0.40	7.19
D4	6.40	0.83	6.80	39.20	3.61	2.24	6.52	0.45	7.04
D5	6.30	2.61	7.67	37.03	3.26	2.33	5.93	0.58	5.72
Mean	*6.29*	*1.61*	*7.68*	*17.33*	*3.31*	*1.81*	*5.41*	*0.45*	*7.40*
∂	0.26	0.80	2.82	32.04	3.33	0.87	0.81	0.27	2.50
Cv	4.1	49.87	36.71	11.38	23.32	46.50	14.90	57.00	34.47
Rank	MV	MV	MV	35.04	MV	MV	LV	HV	MV
Arable land									
A1	5.37	1.27	7.89	32.46	2.73	1.76	4.49	0.21	5.44
A2	5.44	0.90	7.17	27.36	2.78	1.37	4.15	0.31	3.70
A3	5.59	1.13	7.66	22.73	2.91	2.60	5.51	0.32	3.86
A4	5.60	0.90	7.00	25.93	2.41	2.34	4.75	0.33	3.63
A5	5.31	0.69	8.40	27.90	1.96	1.17	3.13	0.33	3.71
Mean	*5.46*	*0.98*	*7.62*	*27.28*	*2.56*	*1.85*	*4.41*	*0.30*	*4.07*
∂	0.14	0.29	0.74	4.21	0.35	0.21	0.99	2.5	1.26
Cv	5.49	29.59	9.6	15.43	14.00	11.29	22.34	8.0	30.95
Rank	LV	MV	LV	MV	MV	MV	MV	LV	MV
LSD 0.05	*0.09***	*0.08***	*4.32**	*5.23**	*0.05***	*0.02***	*0.06***	*0.03***	*0.67**

LSD=Least significant difference, TEB=Total exchangeable bases, EA= Exchangeable acidity, SOM=Soil organic matter, ECEC=Effective cation exchange capacity, SAR= Sodium adsorption ratio, TN= Total Nitrogen, AP= Available phosphorus, ,ESP=Exchangeable sodium percentage, ∂= Standard Deviation, CV=Coefficient of variability, LV=Little variation, MV=Moderate variation,, HV=High variation,**= Highly significant

Soil pH in water ranged from 6.07-6.40 in the dump soil and 5.31-5.6 in the arable soil, was significantly higher in dump soil compared to arable land (Table 2.0) and decreased with depth (Table 3.0). The values found in dump soil are moderately acidic while that of the arable land is strongly acidic although both are typical of humid tropical soils as was opined by Singer and Munns, (1999). While the variability could be attributed to climate and parent materials from which the soils are formed and leaching as a result of high rainfall, the decreased with depth is attributable to lower organic matter below the soil layers and is indication of illuviation of basic cations translocated after intensive leaching from the surface horizons (Onweremadu *et al*., 2007). Soil pH recorded little variations in both soils with respect to points of sampling (C.V=4.1 and 5.49%) (Table 1.0) and depth of sampling and (C.V=4.2 and 3.0%) (Table 3.0) respectively. Soil pH had significant relationship (p=0.05) with available phosphorus (r^2 = 0.520) implying that about 52 % of the result of phosphorus was caused by soil pH.

Soil organic matter ranges from 0.69 g/kg in arable land to 2.61 g/kg in the dumpsite soil. The values are low, Landon, (1991) thus showing low fertility of soils of the area. Soil organic matter varied moderately with respect to the points of sampling (C.V=49.87 and 29.59 %) (Table 2.0) and the depth of sampling (C.V=46.44 and 13.55 %), (Table 3.0) in both soils respectively. On the other hand SOM decreased with depth in all the studied soils (Table 3.0) and is significantly higher (P<0.05) in the dump soil than the arable land (Table 2.0). This is in line with Mbagwu (1983) and Santra *et al.*, (2008). Organic matter and nitrogen availability in the soil is a function of their relationships to Soil pH, C:N ratio, bulk density among other things (Bot and Benites, 2005). Soil had significant relationship (P=0.05) with total nitrogen and available phosphorus (r^2 = 0.61 and 0.432). Agim *et al*, 2012, Yao, (2010) and Unamba-Oparah, (1982) found significant positive correlation between SOM and total nitrogen and available phosphorus. Increase in organic matter content of the soil increases total nitrogen and available phosphorus.

Total nitrogen in the study ranged from 3.5-13% in dump soil and 6.5-9 % in the arable land (Table 2.0). The values of total nitrogen significantly differed with land use, and depths of sampling (P<0.05). The highest and lowest values of 10.33 % and 6.03% occurred at points D2 and D1 in dump and at points A5 (8.40 %) and A4 (7.00 %) in arable land (Table 2.0). Total nitrogen moderately varied (C.V=36.71%) in the dump soil and little variation (C.V= 9.6%) in the arable land. Like organic matter, total nitrogen also decreased with depth which is in line with the documentations of Mbagwu (1983) and Santra *et al.*, (2008) (Table 3.0). However, total nitrogen related significantly to soil organic matter(r=0.601 P<0.05) (Table 4.0). The positive correlation coefficient implied that increase in soil organic matter increases soil total nitrogen. This also means that about 60% of the variation caused in total nitrogen is caused by SOM.

This ranged from 11.20 - 44.8 mg/kg in the dump soil and 20.2 - 35.8 mg/kg in arable land. However, mean values of Table 2.0 shows that available phosphorus had its highest value of 39.66 mg/kg at the D1 meter interval and its value of 17.33 mg/kg at the D5 point in the dump soil while the values of 32.46 and 22.73 mg/kg occurred at the A1 and A3 points. Available P also decreased with depth in all the studied soils.

Table 3.0 showing depth function of the selected physico chemical properties of studied soils .

Table 3.0 Depth function of the selected physico chemical properties of studied soils.

	Depth (cm)	Sand	Silt g/kg	clay	TC	VMC	ℓb g/cm^3	pH (water)	SOM g/kg	ECEC Cmol/kg	TEB	EA
						Dump soil						
D1	10-15	809.62	25.60	164.80	SL	138.0	1.55	6.4	1.55	4.92	3.09	1.83
	15-30	789.80	12.80	197.40	SL	143.0	1.80	6.2	1.41	6.52	3.45	3.07
	30-45	816.61	20.30	160.09	SL	114.0	1.60	6.0	1.22	4.94	2.39	2.55
D2	0-15	859.59	12.81	127.60	LS	100.6	1.16	6.3	2.34	4.32	3.89	0.43
	15-30	869.70	30.00	100.30	SL	93.0	1.67	5.7	1.41	4.85	4.15	0.70
	30-45	842.40	30.22	127.40	SL	89.9	1.58	6.7	1.31	3.59	2.89	0.70
D3	0-15	849.60	22.80	127.61	LS	99.1	1.30	6.5	2.86	5.14	4.44	0.70
	15-30	822.40	40.20	137.60	LS	96.5	1.71	6.2	1.10	4.98	2.70	2.28
	30-45	842.50	60.21	97.30	LS	111.1	1.70	6.7	0.89	4.57	2.19	2.38
D4	0-15	872.30	30.31	93.40	LS	95.0	1.25	6.6	1.07	5.55	3.60	1.95
	15-30	809.60	22.80	127.60	SL	100.2	1.50	6.2	0.97	6.88	4.38	2.50
	30-45	849.60	13.80	136.40	SL	105.3	1.68	6.4	0.45	5.14	2.86	2.28
D5	0-15	869.70	12.80	117.50	SL	85.1	1.47	6.0	3.10	5.53	4.05	1.48
	15-30	859.60	32.90	107.70	SL	108.3	1.71	6.4	2.83	5.72	2.87	2.85
	30-45	889.50	13.40	99.60	LS	106.0	1.44	6.5	1.90	5.50	2.85	2.65
CV		**28.8**	**68.22**	**0.09**		**8.84**	**6.40**	**4.20**	**46.44**	**15.34**	**12.29**	**38.02**
Rank		MV	HV	LV		LV	LV	LV	MV	MV	LV	MV
						Arable land						
A1	0-15	849.60	25.61	124.79	SL	76.40	1.55	5.50	1.39	5.64	3.14	1.50
	15-30	859.30	26.21	114.49	SL	82.30	1.62	5.40	1.21	4.62	3.30	1.32
	30-45	822.30	28.21	149.49	SL	83.10	1.61	5.21	1.20	3.21	1.76	1.45
A2	0-15	853.60	24.60	121.80	LS	78.10	1.55	5.40	1.00	4.33	2.83	1.50
	15-30	832.10	23.21	144.69	SL	78.80	1.56	5.61	0.86	4.11	2.91	1.20
	30-45	821.11	25.21	153.68	SL	78.90	1.58	5.30	0.85	4.00	2.59	1.41
A3	0-15	854.40	26.20	119.40	SL	77.71	1.56	5.60	1.29	5.64	3.04	2.60
	15-30	844.20	27.11	128.69	SL	80.10	1.61	5.61	1.10	5.67	3.17	2.50
	30-45	852.31	28.21	119.48	SL	77.30	1.62	5.55	1.08	5.21	2.51	2.70
A4	0-15	862.30	26.00	111.70	SL	81.20	1.50	5.60	0.97	3.83	2.13	1.70
	15-30	852.11	26.55	121.34	SL	82.30	1.61	5.61	0.81	5.33	2.52	2.81
	30-45	866.21	28.21	105.58	SL	84.31	1.62	5.60	0.92	5.10	2.59	2.51
A5	0-15	828.11	23.11	148.78	LS	83.10	1.61	5.30	0.99	3.30	2.01	1.21
	15-30	802.13	24.10	173.77	SL	84.11	1.68	5.31	0.10	3.10	2.00	1.10
	30-45	789.11	25.30	185.59	SL	88.32	1.70	5.33	0.99	3.00	1.80	1.20
CV		2.4		5.8	0.04	5.30	3.20	3.00	13.55	25.12	19.13	37.48
Rank		LV		LV	LV	LV	LV	LV	LV	LV	LV	LV
LSD$^{(0.05)}$	**7.89****		**0.78****	**5.11****	**1.82***	**0.06****	**0.10***	**0.09****	**0.07****	**0.08****	**0.14****	

LSD=Least significant difference, TC=Textural class, TEB=Total exchangeable bases, E.A= Exchangeable acidity, ℓb= bulk density, VMC=Volumetric moisture content, SOM=Soil organic matter, ECEC=Effective cation exchange capacity, CV=Coefficient of variability, LV=Little variation, MV=Moderate variation,, HV=High variation,**= Highly significant, ∂= Standard deviation

Effective cation exchange capacity ranged from 3.59- 6.88 cmol/kg and 3- 5.67 cmol/kg in both soils respectively. The values where low in the soil using ranking of Landon (1991) thus indicating that the soils will have resistant to the release of nutrients to planted crops. Low ECEC indicates low clay and organic matter content, low water holding capacity, requires more frequent lime and fertilizer additions, and is subject to leaching of NO_3, B, NH_4, K and perhaps Mg (Brady and Weil, 1999). While there is little variation in ECEC in dump soil (CV= 14.9%), moderate variation (C.V= 22.34%) was found in arable land. Moderate variations were found in both the surface and subsurface samples in the arable land (CV=20.49 and 25.12 %) respectively Table (Table 3.0). Effective cation exchange capacity significantly varied with land use, and depth of sampling (P<0.05) (Table 2.0).

Conclusion: This study reviled that, there were variations in all selected soils properties, but the degree of the variability differed. Silt indicated highest variations with respect to sampling points (CV=51.1%) and depth of sampling (CV = 68.2%) in the dump soil. Bulk density recorded little variation in both soils at the different sampling points (C.V=12.5and 3.2%) and at the different depths (C.V=6.4 and 3.2%).While soil pH recorded little variations (C.V= 4.1and 5.49%), soil organic matter recorded moderate variation (C.V 49.87 and 25.59%) in both soils respectively. Soil pH, organic matter, effective cation exchange capacity were significantly higher (P<0.01) in dump soil compared to arable land which was significantly higher in soil bulk density. Generally soil variability occurred highest in the dump soil than the arable land. Significant positive correlations (P=0.05) were noted between sand fraction and clay (r^2=0.713), bulk density (r^2=0.5850 and available phosphorus r^2=0.739) respectively. Similarly, soil organic matter had significant positive correlation with total nitrogen (r^2=0.601) and while effective cation exchange capacity related significantly(P=0.05) to available phosphorus(r^2=0.494). Farmers are recommended to sort out material in refuse dumps before their application to the soil.

Table 4.0 showing correlation matrix of selected soil properties.

Table 4.0 .Correlation matrix of selected studied soil properties.

	ECEC	AP	TN	SOM	pH	TP	ℓb	VMC	Clay	sand
ECEC	1.00**									
AP	0.494*	1.00**								
TN	0.490^{ns}	0.498*	1.00**							
SOM	0.322^{ns}	0.432^{ns}	0.601**	1.00**						
PH	0.242^{ns}	0.520*	0.095^{ns}	0.063^{ns}	1.00**					
TP	0.228^{ns}	0.492*	0.234^{ns}	0.318^{ns}	0.245^{ns}	1.00**				
ℓb	0.239^{ns}	0.498*	0.342^{ns}	0.322^{ns}	0.238^{ns}	0.999**	1.00**			
VMC	0.264^{ns}	0.385^{ns}	0.340^{ns}	0.540*	0.200^{ns}	0.378^{ns}	0.372^{ns}	1.00**		
Clay	0.256^{ns}	0.488*	0.112^{ns}	0.153^{ns}	0.217^{ns}	0.297^{ns}	0.289^{ns}	0.718*	1.00**	
Sand	0.202^{ns}	0.739*	0.100^{ns}	0.420*	0.420*	0.572*	0.585*	0.589*	0.713*	1.00**

ℓb= bulk density, VMC=Volumetric moisture content, SOM=Soil organic matter, AP=Available phosphorus, T.N= Total nitrogen. ECEC=Effective cation exchange capacity, **= Highly significant, NS=Not significant.

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