ERODIBILITY INDICES AND MINERALOGICAL PROPERTIES OF SOILS OF DIFFERENT PARENT MATERIALS IN ABIA STATE, SOUTH EASTERN NIGERIA.

Okechi, Onwuka[1*]
[1]Department of Soil Science and Meteorology, College of Crop and Soil Sciences, Michael Okpara University of Agriculture Umudike, PMB 7627 Umuahia, Abia State, Nigeria.
Email.onwukaokechi@gmail.com

ABSTRACT
The mineralogy and erodibility indices of some soils of different parent materials in Abia State, South Eastern Nigeria were studied.Soil samples were collected from Umudike, Bende, Ameke and Owerrinta representing soils formed on coastal plain sands, shale, sandstone and alluvium parent materials, respectively. The experiment was a 4 x 3 factorial experiment in a randomized complete block design with three replications. The soil samples were analysed for their physical, chemical and mineralogical properties. Soils were generally low in pH, organic matter, base saturation and effective Cation Exchange Capacity. It could be deduced from the study that the soils were erodible with CFI range of 36.60 to 66.38 and MWD range of 3.30, 3.54 to 3.95. The soil minerals were determined using x-ray diffraction analysis. The data obtained were subjected to ANOVA, regression and correlation statistical analysis. The minerals identified include quartz, hematite, magnetite, kaolinite, microcline, albite, iroxide, and montmorrilonite. Most of the minerals were primary minerals especially fieldspars. The soils also contained some oxides of iron. Base on the percentage intensity of the minerals in the soil studied, it can be arranged in order as: quatz > kaolinite > microcline > albiite > hematite > ironoxide > magnetite > montemorilonite > iron oxide hydroxid. The soils were dominated by quartz and kaolinite. The soils from alluvium parent material had montemorrillonite in reasonable quanitity. Base on the mineralogy of the soils studied, the soils of Abia State should be less erodible than observed due to their high iron oxide and kaolinite which encourages aggregate stability and increase resistance to erosive forces. Soils high in oxides of iron and aluminium, as well as kaolinitic clay, has been found to be more aggregated compared to soils dominated by montmorillonite and illite clay minerals. The high erodibility observed from the study may be due to unsustainable land use which destroyed vegetative cover, reduced soil structural stability and organic matter content thereby making the soil very susceptible to erosive forces. Good soil management practices should be encourage especially in soil of Owerrinta that has montemorilonite to avoid extremely high soil losses and adverse erosion.

Keywords: Erodibility indices, soil mineralogy, parent material,

INTRODUCTION
Since 1991, Abia state has witnessed increased economic and infrastructural activities with obvious consequences on soil exposure and its attendant soil degradation. Soil erodibility is the degree of susceptibility of the soil to erosion. It is an estimate of the ability of soils to resist or succumb to erosion, based on their physical, chemical and mineralogical characteristics (Ojo and Johnson, 2010. Erodibility has been measured using direct and indirect indices such as water dispersed clay (WDC), clay flocculation index (CFI), aggregated silt and clay (ASC), clay dispersion index (CDI) and clay dispersion ratio (CDR). The clay-dispersion ratio (CDR) derived from the clay contents, water dispersed clay (WDC) and the clay dispersion index (CDI) have been successfully used to predict erosion by water. Igwe (2005) remarked that the clay-dispersion ratio and dispersion index were found to be good indices for predicting erodibility in some soils of southeastern Nigeria. Soils developed from different parent materials are different and soil characteristics depend on parent rock characteristics (Pellek, 1986).There are different types of parent materials in Abia state, they include coastal plain sands, shale,alluvium, sandstone etc. Soil mineralogy is one of the most important factors to consider in studying soil erodibility because of its impact on aggregate stability, soil seal formation, water absorption and resistance to erosive forces (Wischmeier and Smith, 1978). This work studied the erodibility indices of soils formed under different parent materials in relation to their mineralogy in Abia State. Good knowledge of the mineralogy and erodibility indices of soils formed from different parent materials will help in adopting sustainable soil management systems. This will also help to curb the menace of soil degradation and help to boost food production in Abia state. The objective of the study was to determine the erodibility indices and mineralogy of the soils formed on different parent materials in Abia State.

MATERIALS AND METHODS
DESCRIPTION OF THE STUDY AREA
The study was conducted on some soils of Abia State, South Eastern Nigeria. The study locations include Umudike, Bende, Ameke and Owerrinta representing soils formed on coastal plain sands, shale, sand stone and alluvium parent materials, respectively. These soils are mainly ultisols and are acidic in nature with pH less than 5.5 (Ahn. 1993).

The soils are not particularly fertile and are prone to much leaching because of heavy rainfall. The main ecological problems in Abia state are soil degradation and erosion. The rainy season starts from March and extends to October with bimodal peaks in July and September, and a short break in August. The dry season starts in November and lasts till February. The mean annual rainfall of Abia State is between 2200mm to 2400mm. The minimum temperature is about 21^{o}C while the maximum is about 29^{o}C on average annually. Umudike lies within latitude 05^{o}28′N to 05^o 47′N and longitude 07^o 32′E to 07^{o}54′E with mean annual rainfall of about 2106mm (climatedata.org.2019). Bende lies within latitude 05^o 32′N to 05^o 55′N and Longitude 07^{0}33′E to 07^{0}63′E with mean annual rainfall of about 2200mm. Ameke lies within latitude 05^0 28′N to 05^0 53′N and Longitude 07^0 28′E to 07^0 73′E with mean annual rainfall of about 2130mm.Owerrinta lies within latitude 05^0 21′N to 05^0 24′N and Longitude 07^{0}32′E to 07^{o}42′E with mean annual rainfall of about 2226mm (climatedata.org.2019).

EXPERIMENTAL DESIGN

The experiment was a 4 x 3 factorial in a randomized complete block design with three replications. The factors include: the four locations (Umudike, Bende, Owerrinta and Ameke), and three depths (0-15cm, 15-30cm and 30-45cm).

3.3SOIL SAMPLING AND PREPARATION

Soil samples for the study were collected at three depths, 0-15cm, 15-30cm and 30 – 45 cm inUmudike, Bende, Owerrinta and Ameke with soil auger. Umudike, Bende, Owerrinta, and Ameke represent soils formed on coastal plain sand, shale, alluvium, and sandstones, respectively. Undisturbed soil samples were collected from the locations at the three depths with a core sampler for the determination of bulk density and hydraulic conductivity.

The auger samples from the different sampling units were divided into two portions. The first portion was air dried and sieved through 2mm mesh for determination of particle size distribution, organic carbon, and some other chemical properties. The other portion was air dried and passed through a 4mm mesh for the determination of water stable aggregates and mean weight diameter.

DETERMINATION OF SOIL PROPERTIES

Texture

Particle size distribution was determined by Gee and Or (2002) method, using sodium hexametaphosphate as dispersing agent.

Microaggregate stability

This was determined using the amount of silt and clay in calgon – dispersed as well as water – dispersed samples during particle size analysis described by Gee and Or (2002). Hence the various microaggregate stability indices were calculated thus

Dispersion ratio(%) = $\frac{\%(silt+clay\ (H_2O)}{\%(Silt+clay(calgon)} X\ 100$ ………………………1

Aggregate silt + clay (%) = % (silt+ clay)(calgon) - % (silt+ caly)(H_20)) ……………….2

Clay Flocculation Index (CFI)% = $\frac{\%clay\ (calgon)-\%clay(H_2O)}{\%Clay\ (calgon)}$ x 100 ……………..3

Clay dispersion index (CDI)% = $\frac{\%\ Clay\ (H_2O)}{\%Clay\ (calgon)}$ x100 ………………………………….4

Mean weight diameter (MWD) and water stable aggregates (WSA): These were determined by the wet-sieving method of Kemper and Rosenau (1986).

Saturated hydraulic conductivity (Ksat): This was determined by the constant head method explained by Klute and Dirksen (1986)

Bulk Density (BD) This was determined using the core method as described by Anderson and Ingram (1993).

The soil pH was measured in water using a glass electrode pH meter at a soil liquid ratio of 1: 2.5 (Thomas, 1996).

Organic carbon was determined using the wet oxidation method of Walkley and Black (1934).

Mineralogical Analysis

The qualitative determination of the mineralogical properties of the soil samples using X-ray diffraction were carried out at Sci-Ba Laboratory and Scientific Consultant, Cape Town South Africa. About 2g of each soil sample was dried, pulverised and milled using McCrone Mill with agate grinding element in a Jar. The unique grinding action of the mill rapidly reduces the soil particles to sub-micrometer sizes and mixes the sample for homogenisation required for qualitative analytical methods (Approximately 10 µm). Pre-analysis sample preparation procedures included the removal of soluble salts and gypsum by washing out according to the method of Konze and Rich 1959. Carbonates were removed by neutralisation with sodium acetate (pH =5), according to Grossman and Millet 1961, while organic matter was removed by oxidation with H_2O_2. These samples were saturated with Magnesium (Mg2+) and Potassium (K+) using magnesium chloride ($MgCl_2$) and potassium chloride (KCl) solutions. About 0.5 g of dried and prepared soil sample each was used for the X-ray analysis. The X-ray studies were performed with Siemens D5000 diffractometer using Cuką radiation with Iron (fe) filter (λ = 1.5409A) at 40 kv and 30 mA, at a scan rate of 20 per minute . The diffraction patterns were obtained with the aid of computer, while the 2Ɵ, d-values and peak intensities yielded by the powder patterns were used to identify the minerals. The interpretation of the diffractograms obtained for each sample was done by comparing the peaks obtained with those of standard minerals established by Brown 1980.

Data Analysis

Statistical analyses were performed using SPSS version 16. The data were analyzed using analysis of variance (ANOVA),and correlation. Fisher's Least Significant Difference (LSD) was used to determine significant difference among the means.

RESULTS AND DISCUSSION

The physical properties of the soils studied are shown in table 1. There were differences in physical properties of the soils at different depths. Sand sized particles dominated in all the soils. The high value of the sand fraction compared to the silt and clay fractions is typical of soils of Southeastern Nigeria. This is due to high leaching of clay and silt due to high rainfall predominant in the Abia State. The average percentage sand ranges from 64.20% to 86%, the mean percentage silt ranges from 2.07% to 15.35% and the clay percentage ranges from 9.40% to16.87%. Ugwu*et al* (2016) reported that soils with high percentage sand are more erodible because of low binding and inter-binding forces that help in resisting detachability of soil by water.Clay content increases with depth for the all the locations studied, with the highest clay content found in 30-45cm.The mean percentage total porosity for the soils were 34.34%,36.37, 37.23%, and 49.05% for Ameke, Owerrinta, Umudike and Bende, respectively. The mean saturated hydroconductivity were 1.86cm/hr, 6.22cm/hr, 7.76cm/hr and 8.32cm/hr for Ameke, OwerrintaUmudike and Bende, respectively. Porosity influences rate of infiltration and percolation and both are factors which affect the disposition of a soil to erosion (Idah*et. al.,* 2008).Low porosity encourages water erosion because it seriously restricts water entry into the soil. Porosity less than 50% is not desirable (Chris-Emenyonu, and Onweremadu, 2011). The mean bulk densities of the soils were 1.55mg/m^3, 1.62mg/m^3, 1.66mg/m^3, and 1.71mg/m^3 for Umudike, Owerrinta, Bende andAmeke respectively. The low bulk density of coastal plain sand of Umudike might be due to high mean percentage sand fraction. There was significant increase in bulk density with depth for all the soils studied. The low bulk density at the top soil (0-15cm) may be due to relatively higher organic carbon and low clay content at the top soil. This is because clay may have been translocated from top soil to subsoil via lessivage (Ojanuga, 2003). Oguike and Mbagwu (2009) reported that increase in Organic carbon decreases soil bulk density significantly. The MWD of the soils are 3.30, 3.54, 3.73 and 3.95mm for Umudike, Ameke, Bende and Owerrinta, respectively. In terms of soil depth, 30 – 45cm had the highest MWD .The increase in MWD in deeper soils might be because of higher clay content with depth increase. Le Bissonnas (1990) opined that soils with high clay content have greater structural stability and higher MWD. The mean CFI of the soils ranges from 36.60 to 66.38 with Umudike having the highest CFI.Igwe *et al.(*1995)claimedthatCFI ranked highest among other micro and macro aggregate indices in predicting potential soil loss in some soils of Southeastern Nigeria. The DR of the soils were 40.83%, 44.30%, 45.44% and 48.35% for Owerrinta, Bende, Ameke and Umudike, respectively. The CDI of the soils ranges from 40.63 to 66.06 with the soil of Owerrinta having the highest CDI. Soils with lower DR and CDI were more aggregated and less susceptible to soil erosion. Igweand Udegbunam (2008) stated that the higher the CDI and DR the more the ability of the soil to disperse while the higher the CFI the better aggregated the soil. Both CDI and DR decreased with soil depth. The decrease in CDI and DR with depth may be as result of low clay content at the top soil compared to the subsoil. The ASC were 11.99%, 14.68%, 14.78% and 22.81% for Bende, Ameke, Owerrinta and Umudike, respectively. The soil of the Umudke showed high ASC while the soil of the Bende showed low ASC. Le Bissonnais, Y. (1990) stated that soil high in ASC are less susceptible to rain splash and erosive forces than soil low in ASC. The ASC of the soils increased with depth

Soil chemical properties.

Soil chemical constituents affect the resistance of soils to forces generated by agents of erosion(Chris-Emenyonu, and Onweremadu, 2011). Data obtained on chemical properties are presented on Table 2. The mean pH, for the soils ranges from 4.0 to 5.3. Low soil pH characterizes tropical soils that have always been subjected to severe weathering and leaching due to high rainfall and ambient temperature (Lal, 1979). The organic matter content was generally low in all the soils.The organic matter was 1.31%, 1.39%, 1.41% and 1.99%. Soil organic matter has been reported to act as an aggregating or disaggregating material in soil (Mbagwu and Bazzoffi, 1998). Therefore, a soil with high organic matter will be resistance to soil crusting and compaction, have high fertility status, better root growth of crops, and improved crop yields. The low organic matter content of the soils indicates poor aggregate stability and predisposes the soil to dispersion and erosion (Brady and Well, 2002). The soil organic matter decreased with depth for all the soils. Soil depth of 0-15cm had the highest level of organic matter while 15-30cm had and 30-45cm depth had the lowest organic matter content. The decrease in organic matter content down the depths could be related to high residue concentration at the top soil by leaf falls, plant deposits and root density (Balesdent*et al,* 2000). The total nitrogen of the soils was below the critical level of 0.15% for all the soils. The mean total nitrogen ranges from 0.06 to 0.08. The phosphorus level of the soil ranges from 9.17 to11.36 mg/kg. The potassium value of the soils were below the critical level of 2.0cmol/kg for optimum crop production. The potassium level of the soils ranges from 0.09 to 0.17. The low phosphorus and potassium level of the soils might be as a result of low organic matter contents of the soil and high leaching and weathering caused by high rainfall and temperature which is predominant in the Southeastern Nigeria. The soils were low in CEC and base saturation for all the soils. Cation exchange capacity and base saturation decreases with depth. This might be due to decrease in organic matter content with depth.

Table 1 Some physical properties of soils under study.

Location	Depth	Sand (%)	Silt (%)	Clay (%)	Texture	TP(%)	Ksat Cm/hr	BD	MWD	CFI	DR	CDI	ASC	AWC
Umudike	0-15cm	71.20	17.40	11.40	Sandy loam	39.24	11.94	1.68	2.94	59.86	56.14	40.48	17.46	14.92
	15-30cm	73.20	13.42	13.40	Sandy loam	36.98	8.42	1.72	3.24	67.07	53.72	43.28	13.45	14.13
	30-45cm	69.20	15.24	15.40	Sandy loam	35.47	2.91	1.24	3.72	72.20	35.19	38.13	37.53	11.83
Mean		**71.20**	**15.35**	**13.40**		**37.23**	**7.76**	**1.55**	**3.30**	**66.38**	**48.35**	**40.63**	**22.81**	**13.63**
Ameke	0-15cm	73.20	19.40	7.40	Sandy loam	35.47	3.36	1.76	3.01	34.03	56.65	56.29	6.02	13.61
	15-30cm	71.20	17.40	11.40	Sandy loam	33.96	1.68	1.77	3.63	45.52	41.75	34.90	4.01	10.75
	30-45cm	65.20	19.40	9.40	Sandy loam	33.58	0.53	1.61	3.99	69.19	37.92	31.13	4.01	9.89
Mean		**69.87**	**18.73**	**9.40**		**34.34**	**1.86**	**1.71**	**3.54**	**49.58**	**45.44**	**40.77**	**4.68**	**11.42**
Ben de	0-15cm	71.20	11.40	17.40	Sandy loam	53.20	10.41	1.44	3.73	55.72	45.47	54.61	5.06	13.32
	15-30cm	58.20	22.40	19.80	Loamy	47.16	7.65	1.71	3.09	65.72	43.44	54.61	13.45	17.14
	30-45cm	63.20	23.4	13.40	Sandy loam	46.79	6.89	1.82	4.36	50.17	43.99	40.17	17.46	17.01
Mean		**64.20**	**19.07**	**16.87**		**49.05**	**8.32**	**1.66**	**3.73**	**57.20**	**44.30**	**49.80**	**11.99**	**15.82**
Owerrinta	0-15cm	85.20	3.40	11.40	Loamy sand	44.15	9.19	1.49	3.42	26.00	47.92	81.35	13.45	13.87
	15-30cm	87.20	1.40	11.40	Loamy sand	39.62	6.12	1.61	3.79	47.52	40.17	52.81	15.45	14.09
	30-45cm	87.20	1.40	11.40	Loamy sand	26.41	3.36	1.76	4.63	36.29	34.39	64.03	15.45	10.31
Mean		**86.53**	**2.07**	**11.40**		**36.73**	**6.22**	**1.62**	**3.95**	**36.60**	**40.83**	**66.06**	**14.78**	**12.76**
LSD(0.05) Depth		8.87	1.792	1.526		4.979	0.980	0.1931	0.415	6.01	5.80	6.64	1.681	1.641
LSD(0.05) Location		10.25	2.069	1.762		5.749	1.132	0.2229	0.479	6.94	6.70	7.67	1.941	1.895
LSD(0.05) Depth & Location		17.75	2.069	3.052		9.957	1.960	0.3861	0.829	12.02	11.60	13.29	3.362	3.282

Table 2.The chemical characteristics of the soils.

Location	Depth	pH	O.M	N (%)	P (mg/kg)	K (cmol/kg)	Ca	Mg	Na	TAE	TEB	ECEC	B.S (%)
Umudike	0-15cm	4.80	1.91	0.09	11.50	0.11	3.22	1.08	0.17	1.50	4.58	6.08	75.32
	15-30cm	4.40	1.14	0.05	8.52	0.07	1.96	0.82	0.14	1.01	2.99	4.00	74.75
	30-45cm	4.20	0.88	0.04	7.50	0.07	1.22	0.66	0.10	0.80	2.05	2.85	71.92
Mean		**4.47**	**1.31**	**0.06**	**9.17**	**0.08**	**2.13**	**0.85**	**0.14**	**1.10**	**3.21**	**4.31**	**74.00**
Amaeke	0-15cm	4.30	1.79	0.10	11.81	0.21	4.12	1.09	0.10	2.12	5.52	7.64	72.25
	15-30cm	4.10	1.56	0.07	8.19	0.18	3.15	0.98	0.08	1.92	4.39	6.31	69.57
	30-45cm	4.00	0.81	0.06	8.00	0.10	2.66	0.78	0.07	1.50	3.61	5.11	70.64
Mean		**4.13**	**1.39**	**0.08**	**9.33**	**0.16**	**3.31**	**0.95**	**0.08**	**1.85**	**4.51**	**6.35**	**70.82**
Bende	0-15cm	5.50	2.57	0.08	11.21	0.20	3.50	0.75	0.08	1.31	4.53	5.84	77.56
	15-30cm	5.90	1.87	0.06	9.45	0.16	2.88	0.62	0.06	0.98	3.72	4.7	79.14
	30-45cm	4.50	1.52	0.06	7.22	0.15	1.90	0.55	0.05	0.77	2.65	3.42	77.48
Mean		**5.30**	**1.99**	**0.07**	**9.29**	**0.17**	**2.76**	**0.64**	**0.06**	**1.02**	**3.63**	**4.65**	**78.06**
Owerrinta	0-15cm	4.50	2.02	0.07	12.45	0.10	2.49	1.30	0.07	1.24	3.96	5.2	76.15
	15-30cm	3.90	1.08	0.06	11.41	0.09	2.22	1.00	0.04	0.96	3.35	4.31	77.72
	30-45cm	3.70	1.14	0.06	10.21	0.07	2.00	0.81	0.04	0.67	2.92	3.59	81.33
Mean		**4.00**	**1.41**	**0.06**	**11.36**	**0.09**	**2.24**	**1.04**	**0.05**	**0.96**	**3.41**	**4.37**	**78.40**
LSD(0.05) Depth		0.56	0.224	0.009	1.297	0.018	0.3659	0.118	0.012	0.17	0.51	0.680	8.98
LSD(0.05) Location		0.64	0.257	0.011	1.498	0.021	0.4225	0.136	0.015	0.19	0.59	0.785	10.37
LSD(0.05) Depth & Location		1.11	0.445	0.019	2.595	0.036	0.7319	0.236	0.024	0.35	1.01	1.360	17.96

Mineralogy of the soils studied

The soil minerals identified from the x-ray defraction include quartz, hematite, magnetite, kaolinite, microcline, albite, iron oxide, iron oxide hydroxide and montemorrilinite. Most of the minerals are primary minerals (quartz and fieldspars). Clay minerals like kaolinite and montemorrilonte were also identified. The soils also contained some Oxides of iron. The sample of graph of (x-ray defractogram) the minerals identified and their intensity (y %) in the different soils are shown in figures 1 below . The mean of the different mineral intensities/counts (%) in the soils were summarized in Table 3.

Base on the percentage intensity of the minerals in the soil studied, it can be arranged in order as: quatz > kaolinite > microcline > albiite > hematite > ironoxide > magnetite > montemorilonite > iron oxide hydroxide. The high presence of quartz and kaolinite is a strong indication that the soils are highly weathered. According to previous studied by Jungerius and Levelt (1964) and *Igwe et al.*, (2009) the high quartz and kaolinite present in the soils could be due to high rainfall and temperatures in the agro ecological zone that could lead to intensive weathering.

Base on the mineralogy of the soils studied, the soils of Abia State should be less erodible than observed due to their high iron oxide and kaolinite which encourages aggregate stability and increase resistance to erosive forces. Soils high in oxides of iron and aluminium, as well as kaolinitic clay, are more aggregated compared to soils dominated by montmorillonite and illite clay minerals (Troeh, 2000). The high erodibility observed in these soils could be due to poor soil management and low organic matter in the soil. Fufa*et al*, (2002) suggested that the effect of clay content in stabilizing soil structure and reducing erodibility is much more dependent on a soil's content of organic matter and not vice versa.

figure 1: x-ray defractogramof mineral fraction of soils of 30-45cm depth in Umudike

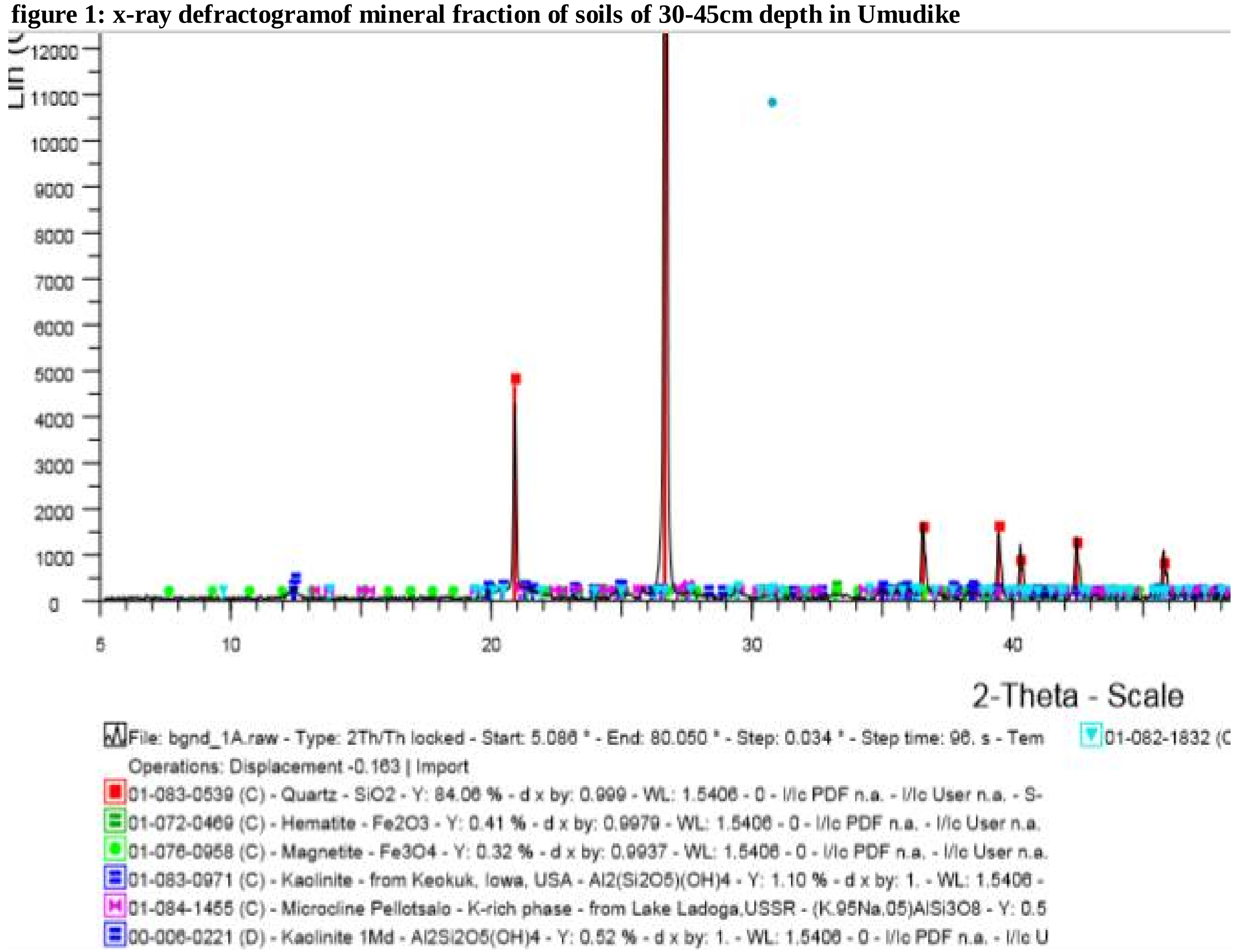

Table 3: The mean of the different mineral intensities/counts (%)

Depth	Location	Quartz	Hematite	Magnetite	Kaolinite	Microcline	Albite	Iron oxide	Montemorilonite	IOH
0-15cm	Umudike	79.29	0.01	0.00	0.69	0.20	0.20	0.10	0.00	0.14
	Ameke	73.33	0.13	0.16	0.91	0.22	0.17	0.27	0.00	0.00
	Bende	74.50	0.26	0.00	0.77	0.17	0.11	0.06	0.00	0.00
	Owerrinta	74.3	0.0	0.0	0.9	0.6	0.2	0.0	1.5	0.0
	Mean	**75.36**	**0.11**	**0.04**	**0.81**	**0.3**	**0.17**	**0.11**	**0.37**	**0.04**
15-30	Umudike	73.73	0.01	0.00	0.57	0.11	0.16	0.12	0.00	0.16
	Ameke	71.10	0.17	0.12	0.88	0.31	0.19	0.34	0.00	0.00
	Bende	72.66	0.41	0.04	0.81	0.23	0.16	0.09	0.00	0.00
	Owerrinta	72.40	0.06	0.00	0.89	1.13	0.12	0.04	1.42	0.00
	Mean	**72.47**	**0.16**	**0.04**	**0.78**	**0.44**	**0.16**	**0.15**	**0.35**	**0.04**
30-45	Umudike	68.37	0.06	0.01	0.60	0.19	0.24	0.13	0.00	0.16
	Ameke	72.163	0.235	0.248	0.760	0.265	0.165	0.318	0.000	0.000
	Bende	68.86	0.41	0.02	0.78	0.20	0.10	0.13	0.00	0.00
	Owerrinta	65.61	0.11	0.00	0.91	0.89	0.15	0.11	2.09	0.00
	Mean	**68.75**	**0.2**	**0.07**	**0.76**	**0.39**	**0.16**	**0.17**	**0.52**	**0.04**
LSD(0.05) Depth		8.75	0.026	0.013	0.094	0.05	0.02	0.020	0.09	0.008
LSD(0.05) Location		10.11	0.030	0.015	0.109	0.05	0.02	0.024	0.11	0.010
LSD(0.05) Depth & Location		17.51	0.053	0.026	0.189	0.10	0.04	0.041	0.19	0.017

CONCLUSION

Soil erosion is a major environmental problem in South-eastern Nigeria especially Abia State. This work studied the mineralogy and erodibility indices of some soils of Abia State formed on different parent materials.It could be deduced from the study that the soils were erodible with CFI range of 36.60 to 66.38 and MWD range of 3.30, 3.54 to 3.95. Soils were generally low in pH, organic matter, base saturation and effective Cation Exchange Capacity. This is an indication that the soils are highly leached and under the influence of erosion due to high rain fall and temperature which is predominant in the area. The minerals identified include quartz, hematite, magnetite, kaolinite, microcline, albite, iroxide, and montemorrilinite. Most of the minerals are primary minerals and fieldspars. Clay minerals like kaolinite and montemorrilonte was also identified. The soils also contans some Oxides of iron. From the graph (x-ray defractogram) it can be observed that the soils are dominated by quarz and kaolinite. This is in line with the findings of Igwe *et al*, (2009). Only the soil of owerrinta had montemorrillonite in reasonable quanitity.Base on the mineralogy of the soils studied, the soils of Abia State should be less erodible than observed due to their high iron oxide and kaolinite which encourages aggregate stability and increase resistance to erosive forces. Soils high in oxides of iron and aluminium, as well as kaolinitic clay, are more

aggregated compared to soils dominated by montmorillonite and illite clay minerals (Troeh, 2000). The high erodibility observed from the study might be majorly due to unsustainable land use management which destroys vegetative cover, reduces soil structural stability, reduce organic matter content and makes the soil very susceptible to erosive forces.
From the study, low organic matter content was one of the major factor that predisposed the soil to high erodibility. The use of organic manure should be encouraged especially in the continuously cultivated arable soils. Mulching is also necessary to reduce the direct impact of the raindrop on the soils. Deep tillage operations should also be discouraged to avoid further disruption of soil structure, which predisposes the soils to erosion.

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