Variation in the Physico-Chemical Properties of Badagry and Ikorodu Soils, Lagos Nigeria

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Abstract

This study examined the variation in the physico-chemical properties of soils in Badagry and Ikorodu, Lagos to establish the effect of season and location on soil physical and chemical properties. Soil samples were taken at depths of 0-20cm from 26 and 36 points respectively at Badagry and Ikorodu using soil auger and collected in polythene bags The soil samples were analyzed for their texture, structure, pH, and the availability of some basic soil nutrients such as Nitrogen, Organic Carbon, Potassium, Phosphorus, etc) in accordance with Standard analytical procedures. The study revealed that the physico-chemical properties of soil in the areas under focus do not significantly vary among the variables (location, season and vegetation cover) probably because of the similarities in geology, climate and vegetation types..

1.0 Introduction

The main threats to soils are increasing urban areas, road building and industrial development, erosion, acidification, accumulation of pollutants, organic matter loss and deteriorating soil structure (Aweto, A.O. and Ekuigbo U.E, 1994). Soil contamination by heavy metals can originate from a number of sources including geological parent material, industrial processes (atmospheric emission, waste disposal, and effluent disposal) and farming practices. Contaminants usually seep down into the soil and even remain long after the contaminant has left the surface of the soil. Land use pattern has also had a significant impact on the quality of the soil in a typical environment.

The maintenance of natural systems or soil fertility in tropical forest ecosystems is achieved by high and rapid circulation of nutrients through the fall and decomposition of litter which is a function of the season. The decomposed litter is also the basis of many food chains in tropical forests and is a principal source of energy for the biota of the forest floor and soil, where the trophic chain of detritus predominates (Spain, 1984; Ola-Adams and Egunjobi, 1992; Oliveira and Lacerola, 1993; Regina *et al*., 1999). Decomposition is a key process in the control of nutrient cycling and formation of soil organic matter (Berge B. and McClaugherty, 2002).

There is abundant literature, in the humid tropics, on soils physico-chemical and biological changes following deforestation and subsequent land cultivation (Ghuman and Lal, 1991; Juo *et al*, 1995; San José and Montes, 2001; Koutika *et al*., 2002; Schroth. *et al*., 2002; Whitbread. *et al.*, 2003; Sisti *et al*., 2004; Tchienkoua and Zech, 2004; Walker and Desanker, 2004). Extensive work has been done on the conversion of natural forests into agro-forests and cultivated land systems (Lal, 2001; Walker and Desanker, 2004), as well as with soil organic matter dynamics in African tropical forests (Moyo, 1998; Rishirumuhirwa and Roose, 1998; Walker and Desanker, 2004). This study, however, examines the seasonal variations in the physicochemical properties of soil in two distinct ecosystems, the coastal/hydromorphic soil in Badagry and the upland soil in Ikorodu area of Lagos.
In order to establish the prevailing quality of the soil in the study area, soil samples were collected and analysed. Soil samples were collected from two distinct locations (Badagry and Ikorodu) using a Garmin Global Positioning System (GPS) 12 XL™.

For the purpose of this paper, soil sample were taken during the two distinct prevailing seasons in the country, the wet and dry season, so as to assess the effect of the prevailing weather condition to the concentration of soil nutrients and the physical state of the soil.

Lagos, the most populated state in the country was selected as the area of study. However, the study was further streamlined to two major areas in Lagos, namely Badagry and Ikorodu local government areas.

Two main vegetation types are identifiable in Lagos State: Swamp Forest of the coastal belt and dry lowland rain forest. The swamp forests in the state are a combination of mangrove forest and coastal vegetation developed under the brackish conditions of the coastal areas and the swamp of the freshwater lagoon and estuaries. Red mangrove (sometimes attaining heights of 592m) as well as mangrove shrubs, stilt rooted trees with dense undergrowths and raffia and climbing palms are characteristic of the swamp forest zone. Of course, on the seaward side of this zone, wide stretches of sand and beaches exist. Although a small amount of pit props and fuel material emanate from the swamp forest zone in Lagos State, it is of no significance in the lumber economy of Nigeria.

Lying to the north of the swamp forests is the lowland (tropical) rain forest zone. This zone, which stretches from the west of Ikeja through Ikorodu to an area slightly north of Epe, has been modified by man. Yet this is the area of the state where such economically valuable trees as Teak (*tectona grandis*), *tripochiton*, *seletrocylon* (Arere), *Banclea diderrichil* (Opepe) and *Terminahia* (Idigbo) are to be found. The creeks, lagoons and rivers act as arteries which carry huge quantities of logs from out of state sources to Lagos.

Lagos State is endowed with very little arable land. Altogether, four soil groups are identifiable. On the western half of the coastal margin, juvenile soils on recent windborne sands occur. The rest of the coastal area towards the east is covered also by juvenile soils on fluviomarine alluvium (mangrove swamp).

Thirdly, a narrow and rather discontinuous band of mineral and/or organic hydromorphic soils occurs in the middle and northern-eastern sections of the state. The fourth group, occurring in two rather tiny and discontinuous patches along the northern limits of the state, consists dominantly of red ferrallitic soils on loose sandy sediments. Specifically, the study areas selected in Lagos lie between 6˚46''N and 2˚23''E with an elevation of about 19ft at Badagry and 6˚36''N and 3˚00''E with an elevation of about 47ft at Ikorodu. Badagry falls into the ecological zone of wetland soils and lies on the coast where inland water empties into the Atlantic Ocean. It has a geologic origin of deltaic basis and tidal flats (FADAMA, 2011). The natural vegetation is mangrove. The floras of the area consist of *Rhizophora* mangle and *Rhizophora racemosa* (otherwise referred to as red mangrove and black mangrove respectively). These two species are strongly zoned, with the former occupying areas closer to the water while the latter are in the upper reaches. Other species occurring to a lesser extent include *Avicennia Africana*, *Laguncularia racemosa*; plus the palms *Prodococcu wateri* and *Ancistrophylum opacum.*

Ikorodu on the other hand, has some parts falling into wetland zone and its other part falling into rainforest ecological zone. Its soils developed from recent alluvium and coastal plain sands (FADAMA, 2011). It is a forested area in which very tall trees abound. Some of the common trees are *Afromosia Laxiflora, Burkea africana, Daniella oliveri and Laoberlinia doka.*

The study areas exhibit similar climatic conditions. They are characterised by a humid tropical climate characterized by distinct dry and wet seasons with moderate mean annual rainfall which varies between 1381.7 mm and 2733.4 mm in recent time from one location to the other. However, the average rainfall across Lagos for over 25 years is estimated at about 2,500mm. There are two discernible seasons (rainy and dry seasons) but there is hardly a month without precipitation in Lagos. A double maxima of rainfall regime are recognizable from March to early July and the other from September to early November with a break in late July and August. The maximum temperature ranges between 29^{o}C - 34^{o}C, the lowest being in the month of July and the highest in February. The minimum temperature varies between 24^{o}C - 28^{o}C. The relative humidity is generally high and rarely below 70 % throughout the year. During the wet season months, the south west winds prevail as the front moves to the north. But as from October when the front moves south wards, the northeast winds sweep in the dry season. Lagos State, however, experiences predominantly south-westerly wind and sea breezes all year round.

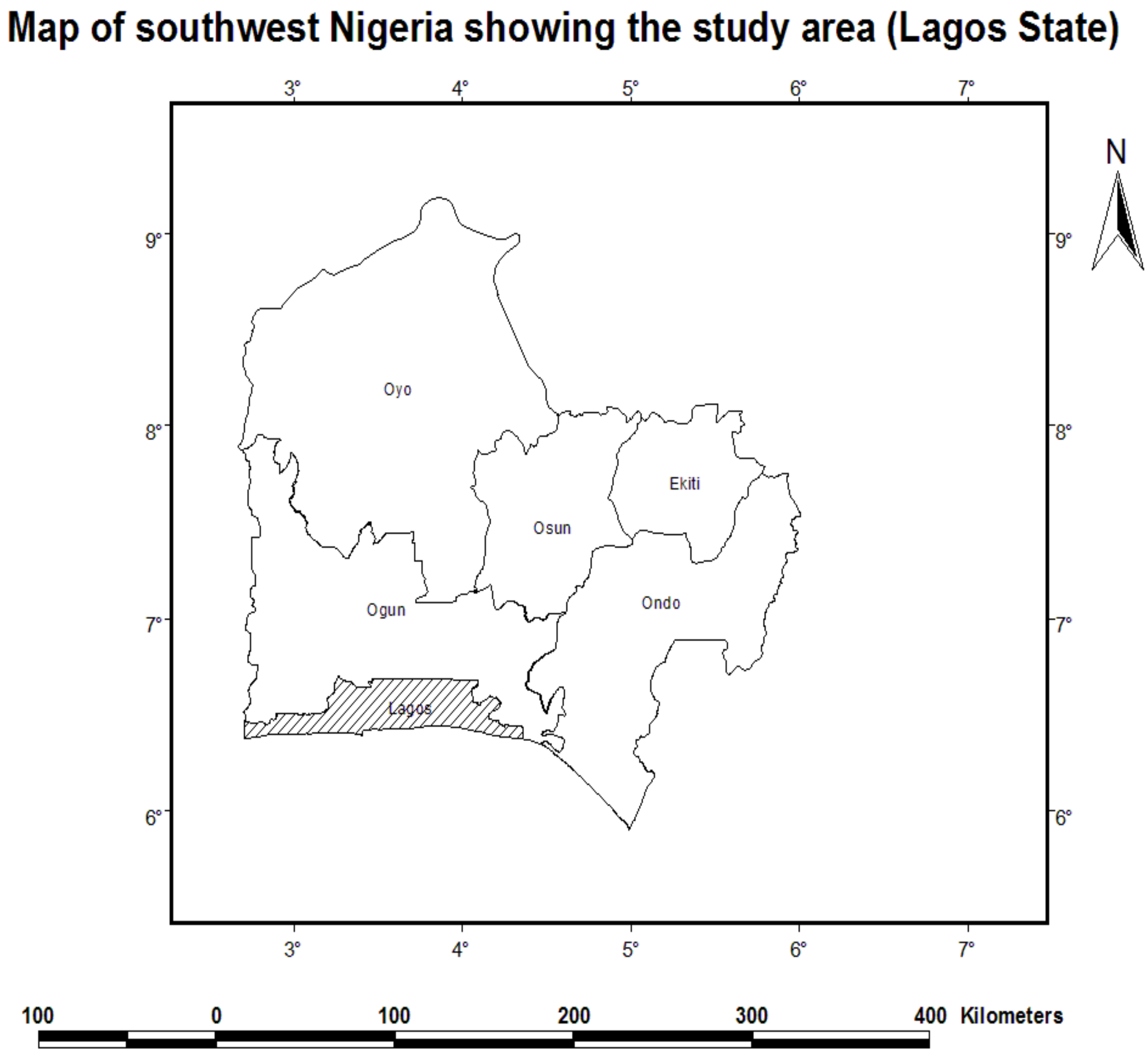
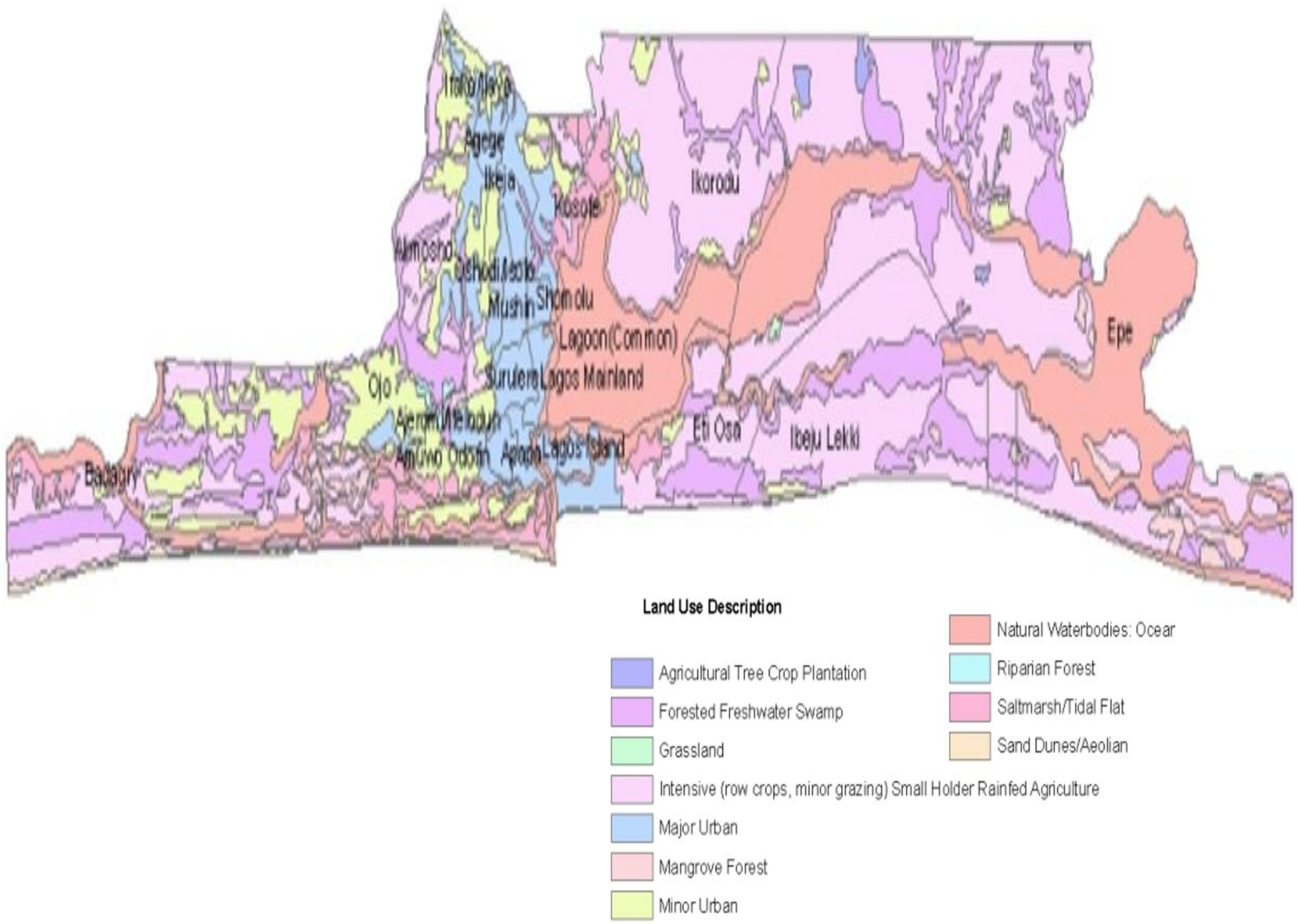


Fig 1: Map of Southwest Nigeria showing the study area (Lagos State)

Lagos State

Fig2 : *showing Administrative Map of Lagos State*



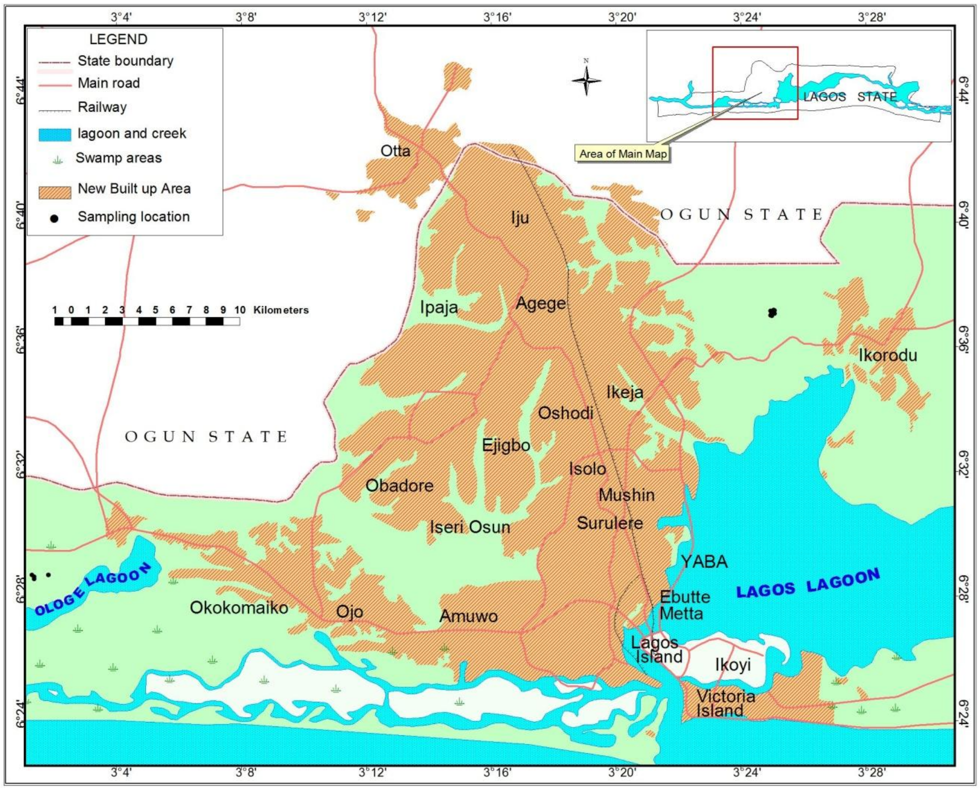


Fig 3: Map showing sampling points

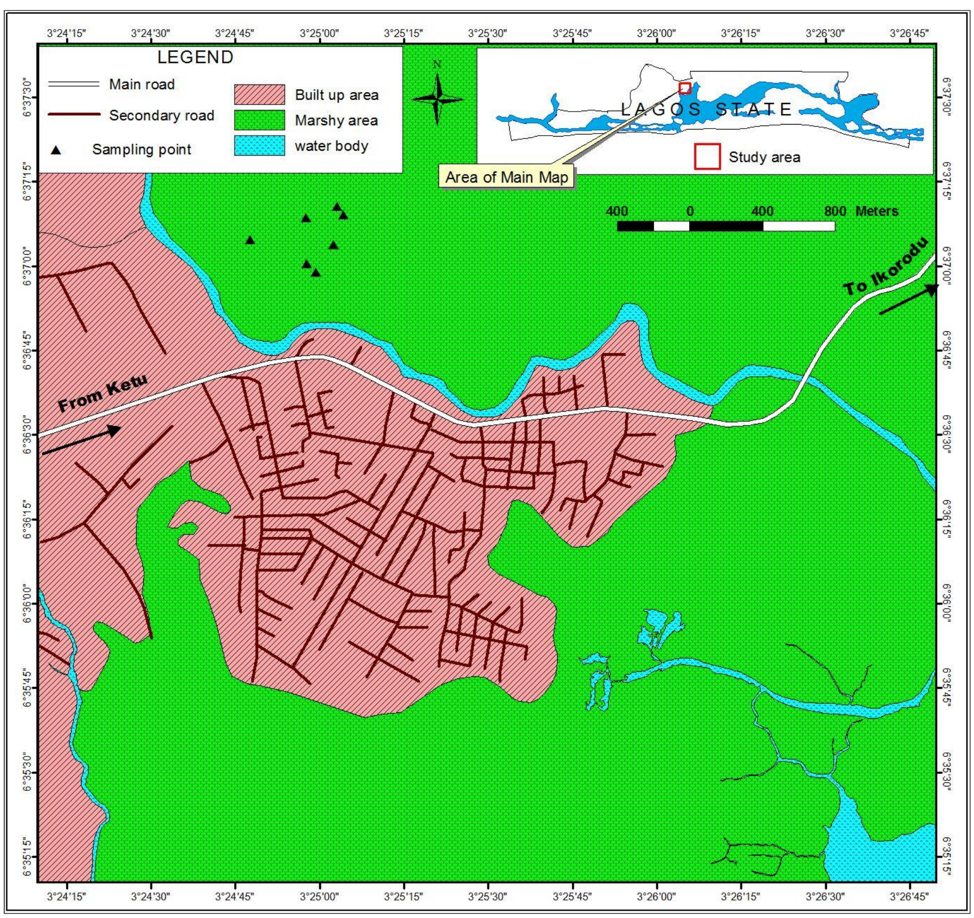


Fig 4: Map showing sampling points

1.1 Sampling and Analytical Procedure

A total of 27 and 36 soil samples were taken at Badagry and Ikorodu respectively at depth of 0-20cm, with the aid of a soil auger. 9 soil samples each were collected during the dry and wet seasons and 9 soil sample each were collected from cleared areas and forested areas at Ikorodu. 7 soil samples were collected during the dry season and 6 soil samples during the rainy season at Badagry and 7 soil samples each from cleared areas and forested areas at the same location. These samples were collected in polythene bags and transferred to the laboratory for analysis. The soil samples were analyzed in accordance with Standard analytical procedures (British Standards [BS] and American Society for Data Testing)

For soil textural analysis, soil sample collected was subjected to mechanical analysis for particle size and soil textural classification. The mechanical analysis was carried out on the soil samples by the Bouyoucos method to determine the various sizes of particles present in the fine earth (i.e. particle < 2mm) of the soil using international scale of: 50g of the air-dried 2mm sieved soil were placed into container of a high-speed stirrer. This was followed by the addition of 25ml of 5% calgon and stirred with high speed for 15 minutes. The content of the container was then transferred to a 1 litre cylinder (tall form), diluted to mark and stirred for one minute with a wooden paddle. This was followed by inserting a Bouyoucos soil hydrometer for 20 seconds before reading the International Silt and Clay ($<20\mu$) after 4 minutes, 48 seconds and International Clay ($<2\mu$) after 5 hours.

The temperature of the suspension was taken after each reading and 0.3 units added or (subtracted) for every degree above (or below) 19.50C. After the second hydrometer reading, most of the suspension was decanted, refilled with water, paddled and allowed settling for 4 minutes 48 seconds before decanting again. This procedure was repeated until the supernatant liquid was clear. The sand residue was then transferred to a weighed porcelain basin and weighed again to obtain the weights of sand (coarse + fine sand), silt and clay percentages in the 50g soil were then calculated. On the other hand, for Chemical Properties, the pH values of the soil samples were determined in the laboratory using a HH4 Ionoscope pH meter. The pH was determined by pouring 1:2.5 soil water suspensions that had been stirred and allowed to equilibrate for about 1 hour into the electrode.

For Exchangeable cation, 2.5g portions of finely ground representative samples were shaken in a conical flask with 25ml of 1N ammonium acetate for about 1 hour and filtered into plastic cups. The filtrate was used for the determination of sodium (Na+), Potassium (K+), Calcium (Ca^{2+}) and Magnesium (Mg^{++}), using a Flame photometer. The concentrations of the cations were calculated after due note of the dilution factors and expressed either in parts per million (ppm) or milligrams equivalent per 100g soil (meq/100g soil). Also, heavy metal content of the sample was determined using Perkin Elmer 2380 double beam Atomic Absorption Spectrophotometer while Carbon was determined by the wet combustion method of Walkey and Black (1934). 1g of finely ground representative sample was weighed in duplicate into each beaker and rotated gently to wet the soil sample completely. This was followed by the addition of 20ml of conc. H_2SO_4 using a graduated cylinder, taking a few seconds only in the operation. The beaker was rotated again to effect complete oxidation and allowed standing for 10 minutes before dilution with distilled water to about 200-250mL. 25 ml of 0.5N ammonium sulphate was then added and titrated with 0.4N Potassium permanganate.

For total Nitrogen**,** 2.5g of a representative air dried soil were accurately weighed into Tecator digestion flasks and a catalyst mixture containing selenium, CuSO4 and Na2SO4 was added followed by 10ml of concentrated sulphuric acid. The contents of the flask were mixed by gentle swirling and then digested on a Tecator block until the digest became clear. Heating was continued for another one hour before the digest was allowed to cool. The digest was then transferred quantitatively with distilled water to a 150ml conical flask and made up to mark with distilled water. Aliquot of this was analysed and the percentage Nitrogen content of the soil was then calculated after taking into account, the different dilution factors. Also, available phosphorus in the soil sample was determined by weighing 1g of sample into an extraction flask. This was followed by the addition of 10ml of Bray P-1 extraction solution (0.25N HCl & 0.2N NH4F and shaking immediately for 1 minute and filtered. 5mL of the filtrate was then measured into 250ml volumetric flask and diluted to about 220ml with distilled water followed by 4ml of ascorbic acid solution (0.056g ascorbic acid in 250ml molybdate – tartarate solution) and diluted to mark. This was allowed to wait for at least 30 minutes for full colour development before reading from at 730nm and lastly electrical conductivity of the soil sample was determined on the filtrate obtained after filtering the suspension used for the pH determination.

1.2 Data Analysis

In collecting the soil data, the experimental design used was a three-factor factorial experiment in completely randomised design. The three factors are location (Ikorodu and Badagry), season (rainy and dry), and vegetation cover (cleared and forested). Consequently, the analysis of variance (ANOVA) procedure was carried out to determine the variations that exist in the soil properties at the study sites. The analysis involved testing for significant differences between levels of each factor and the interactions between the factors. The General Linear Model analysis was done using Statistical Package for Social Scientists (SPSS).

1.3 Results Of Analysis Of Soil Samples

Detailed results of the data analysis are presented in Appendix 4 while a summary of the ANOVA table is shown below (Table 1-20).

Table 1: Analysis of Variance table for Soil Reaction (Sand)

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	0.095	0.095	16.179*	0.000
Season (S)	1	0.372	0.372	63.483*	0.000
Forest Type (FT)	1	0.022	0.022	3.739ns	0.058
LxS	1	0.001	0.001	0.219ns	0.642
LxFT	1	0.214	0.214	36.448*	0.000
SxFT	1	0.001	0.001	0.125ns	0.725
LxSxFT	1	0.000	0.000	0.058ns	0.810
Error	54	0.317	0.317	0.006ns	
Total	61	0.994			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*

Source: *Field Data 2010*

Table 2: Analysis of Variance table for Soil Reaction (Silt)

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	0.014	0.014	2.649ns	0.109
Season (S)	1	0.062	0.062	11.750ns	0.001
Forest Type (FT)	1	0.047	0.047	9.022ns	0.004
LxS	1	0.001	0.001	0.161ns	0.689
LxFT	1	0.094	0.091	17.214*	0.000
SxFT	1	3.73E-005	3.73E-005	0.007ns	0.933
LxSxFT	1	8.34E-005	8.34E-005	0.016ns	0.900
Error	54	0.284	0.005		
Total	61	0.476			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*

Source: *Field Data 2010*

Table 3: Analysis of Variance table for Soil Reaction (Clay)

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	0.026	0.026	9.612ns	0.003
Season (S)	1	0.095	0.095	35.391*	0.000
Forest Type (FT)	1	0.008	0.008	2.834ns	0.098
LxS	1	0.000	0.000	0.091ns	0.764
LxFT	1	0.010	0.010	3.808ns	0.056
SxFT	1	0.001	0.001	0.359ns	0.552
LxSxFT	1	0.001	0.001	0.218ns	0.166
Error	54	0.145	0.003		
Total	61	0.293			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*

Source: *Field Data 2010*

Table 4: Analysis of Variance table for Soil Reaction (Organic Carbon)

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	0.000	0.000	0.330ns	0.568
Season (S)	1	0.001	0.001	1.410ns	0.240
Forest Type (FT)	1	0.002	0.002	2.114ns	0.152
LxS	1	0.002	0.002	2.123ns	0.151
LxFT	1	0.000	0.000	0.541ns	0.465
SxFT	1	0.001	0.001	1.532ns	0.221
LxSxFT	1	0.002	0.002	1.969ns	0.166
Error	54	0.046	0.001		
Total	61	0.053			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

Table 5: Analysis of Variance table for Soil Reaction (Nitrogen)

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	7.11E-006	7.11E-006	1.302ns	0.259
Season (S)	1	71.92E-006	71.92E-006	29.352*	0.000
Forest Type (FT)	1	93.79E-006	93.79E-006	40.694*	0.000
LxS	1	7.09E-008	7.09E-008	0.013ns	0.910
LxFT	1	9.14E-006	9.14E-006	1.674ns	0.201
SxFT	1	7.42E-008	7.42E-008	0.014ns	0.908
LxSxFT	1	7.94E-007	7.94E-007	0.146ns	0.704
Error	54	0.000	5.46E-006		
Total	61	0.000			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

Table 6: Analysis of Variance table for Soil Reaction Phosphorus

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	5613.031	5613.031	290.923*	0.000
Season (S)	1	214.716	214.716	96.244*	0.000
Forest Type (FT)	1	3493.909	3493.909	181.089*	0.000
LxS	1	0.586	0.586	0.030ns	0.862
LxFT	1	2770.054	2770.054	143.572*	0.000
SxFT	1	4.036	4.036	0.209ns	0.686
LxSxFT	1	4.233	4.233	0.219ns	0.641
Error	54	1041.871	19.294		
Total	61	14140.108			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

Table 7: Analysis of Variance table for Soil Reaction (Potassium),mg/kg

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	0.011	0.011	0.096ns	0.758
Season (S)	1	84.036	84.036	20.005*	0.000
Forest Type (FT)	1	120.184	120.184	41.671*	0.000
LxS	`	0.201	0.201	1.823ns	0.183
LxFT	1	11.515	11.515	104.358*	0.000
SxFT	1	0.409	0.409	3.702	0.060
LxSxFT	1	0.049	0.049	0.443	0.508
Error	54	5.958	0.110		
Total	61	19.185			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

Table 8: Analysis of Variance table for Soil Reaction (moisture)

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	0.001	0.001	3.071ns	0.088
Season (S)	1	0.001	0.001	1.948*	0.000
Forest Type (FT)	1	0.002	0.002	4.670*	0.000
LxS	1	0.000	0.000	1.136	0.291
LxFT	1	0.036	0.036	95.397*	0.000
SxFT	1	0.000	0.000	1.003ns	0.321
LxSxFT	1	0.000	0.000	0.812ns	0.372
Error	54	0.021	0.000		
Total	61	0.065			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*

Source: *Field Data 2010*

Table 9: Analysis of Variance table for Soil Reaction (pH)

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	7.158	7.158	28.194*	0.000
Season (S)	1	0.089	0.089	0.350ns	0.557
Forest Type (FT)	1	0.364	0.364	1.433ns	0.237
LxS	1	0.539	0.539	2.124ns	0.151
LxFT	1	4.163	4.163	16.398*	0.000
SxFT	1	0.716	0.716	2.821ns	0.099
LxSxFT	1	0.973	0.973	3.832ns	0.055
Error	54	13.710	0.254		
Total	61	26.724			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*

Source: *Field Data 2010*

Table 10: Analysis of Variance table for Soil Reaction (Conductivity, Ns/cm)

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	10136.148	10136.148	11.669ns	0.001
Season (S)	1	17060.459	17060.459	19.640*	0.000
Forest Type (FT)	1	4313.501	4313.501	4.966ns	0.030
LxS	1	2783.981	2783.981	3.205ns	0.079
LxFT	1	9561.860	9561.860	11.007ns	0.002
SxFT	1	4231.006	4231.006	4.871ns	0.032
LxSxFT	1	2224.140	2224.140	2.560ns	0.115
Error	54	46908.365	868.673		
Total	61	95727.048			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*

Source: *Field Data 2010*

Table 11: Analysis of Variance table for Soil Reaction (Sodium), mg/kg

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	0.100	0.100	7.854ns	0.007
Season (S)	1	52.117	52.117	12.236*	0.000
Forest Type (FT)	1	88.17	88.17	21.324*	0.000
LxS	1	0.004	0.004	0.292ns	0.591
LxFT	1	0.009	0.009	0.746ns	0.392
SxFT	1	0.007	0.007	0.536ns	0.467
LxSxFT	1	0.010	0.010	0.818ns	0.370
Error	54	0.684	0.013		
Total	61	0.951			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*

Source: *Field Data 2010*

Table 12: Analysis of Variance table for Soil Reaction (Calcium), mg/100g

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	34.531	34.351	2.880ns	0.095
Season (S)	1	46.019	46.019	22.170*	0.000
Forest Type (FT)	1	71.449	71.449	35.964*	0.000
LxS	1	1.271	1.271	1.106ns	0.746
LxFT	1	1190.804	1190.804	99.323*	0.000
SxFT	1	1.987	1.987	0.166ns	0.686
LxSxFT	1	19.289	19.289	1.604ns	0.210
Error	54	647.419	11.989		
Total	61	2139.098			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

Table 13: Analysis of Variance table for Soil Reaction (magnesium), mg/100g

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	6.916	6.916	5.776ns	0.020
Season (S)	1	60.899	60.899	18.751*	0.000
Forest Type (FT)	1	96.918	96.918	25.777*	0.000
LxS	1	0.915	0.915	0.764ns	0.386
LxFT	1	100.811	100.811	84.187*	0.000
SxFT	1	0.409	0.409	3.702ns	0.060
LxSxFT	1	1.199	1.199	1.001ns	0.322
Error	54	64.663	1.197		
Total	61	196.224			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

Table 14: Analysis of Variance table for Soil Reaction (Sulphate), mg/100g

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	1416.015	1416.015	47.414*	0.000
Season (S)	1	151.331	151.331	5.067ns	0.028
Forest Type (FT)	1	1109.731	1109.731	41.674*	0.000
LxS	1	25.626	25.626	0.858ns	0.358
LxFT	1	14.958	14.958	0.501ns	0.482
SxFT	1	4.976	4.976	0.167ns	0.685
LxSxFT	1	14.201	14.201	0.476ns	0.493
Error	54	1612.698	29.865		
Total	61	3382.592			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

Table 15: Analysis of Variance table for Soil Reaction (Chloride), mg/100g

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	530.951	530.951	160.187*	0.000
Season (S)	1	19.394	19.394	5.851ns	0.019
Forest Type (FT)	1	8.937	8.937	2.696ns	0.106
LxS	1	30.653	30.653	9.248ns	0.004
LxFT	1	0.069	0.069	0.021ns	0.885
SxFT	1	4.362	4.362	1.316ns	0.256
LxSxFT	1	1.353	1.353	0.403ns	0.526
Error	54	178.987	3.315		
Total	61	779.480			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

Table 16: Analysis of Variance table for Soil Reaction (Iron),mg/100g

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	13.496	13.496	4.070ns	0.049
Season (S)	1	88.041	88.041	26.549*	0.000
Forest Type (FT)	1	0.004	0.004	0.001ns	0.974
LxS	1	9.093	9.093	2.742ns	0.104
LxFT	1	0.288	0.288	0.087ns	0.769
SxFT	1	1.888	1.888	0.569ns	0.454
LxSxFT	1	1.167	1.167	0.352ns	0.555
Error	54	179.071	3.316		
Total	61	287.342			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

Table 17: Analysis of Variance table for Soil Reaction (Manganese), mg/100g

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	0.955	0.955	6.386n	0.014
Season (S)	1	0.009	0.009	0.057ns	0.812
Forest Type (FT)	1	0.105	0.105	0.701ns	0.406
LxS	1	0.083	0.083	0.556ns	0.459
LxFT	1	0.026	0.026	0.174ns	0.678
SxFT	1	0.000	0.000	0.002ns	0.961
LxSxFT	1	0.009	0.009	0.059ns	0.809
Error	54	8.075	0.150		
Total	61	9.278			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

Table 18: Analysis of Variance table for Soil Reaction (Zinc), mg/100g

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	73.826	73.826	34.877*	0.000
Season (S)	1	48.051	48.051	22.700*	0.000
Forest Type (FT)	1	6.181	6.181	2.920ns	0.093
LxS	1	38.805	38.805	18.333*	0.000
LxFT	1	2.490	2.490	1.176ns	0.283
SxFT	1	0.058	0.058	0.027ns	0.869
LxSxFT	1	0.446	0.446	0.210ns	0.648
Error	54	114.304	2.117		
Total	61	274.028			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

Table 19: Analysis of Variance table for Soil Reaction (Lead), mg/100g

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	2.000	2.000	11.470ns	0.001
Season (S)	1	2.012	2.012	11.539ns	0.001
Forest Type (FT)	1	0.118	0.118	0.678ns	0.414
LxS	1	7.662	7.662	43.942ns	0.000
LxFT	1	1.188	1.188	6.813ns	0.012
SxFT	1	1.336	1.336	7.664ns	0.008
LxSxFT	1	0.217	0.217	1.246ns	0.269
Error	54	9.416	0.174		
Total	61	22.117			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

Table 20: Analysis of Variance table for Soil Reaction (Copper), mg/100g

Source of Variation	Degrees of freedom	Sum of Squares	Mean Squares	F-calculated	Sig.
Location (L)	1	44.310	44.310	74.433*	0.000
Season (S)	1	15.031	15.031	25.250*	0.000
Forest Type (FT)	1	4.923	4.923	8.269ns	0.006
LxS	1	24.653	24.653	41.414*	0.000
LxFT	1	0.248	0.248	0.416ns	0.522
SxFT	1	3.275	3.275	5.502ns	0.023
LxSxFT	1	0.425	0.425	0.714ns	0.402
Error	54	32.146	0.595		
Total	61	120.769			

** denotes "significant" at 0.05 level while ns denotes "not significant" at 0.05 level.*
Source: *Field Data 2010*

1.4 Discussions and Conclussions

From the Data analyzed, it is discovered that the parameters involved react differently to the main effects which are; location (Ikorodu and Badagry), seasons (wet and dry) and vegetation cover (cleared and forested).

1.4.1 Effect of Location

Analysis of variance as shown in Table 1 reveals that that Location (L) is highly significant to sand i.e. there is significant difference in sand of Ikorodu and Badagry while Table 2 indicates that there are no significant differences in silt of Ikorodu and Badagry. For clay in Table 3, it shows that Location (L) is not significant, meaning that there is no significant different in clay of Ikorodu and Badagry. Organic carbon in Table 4 indicates Location (L) is not significant to organic carbon content of Ikorodu and Badagry while Table 5 also shows no significant difference in the Nitrogen content of the two sites. i.e. Ikorodu and Badagry. Table 6 also indicates that Location (L) is highly significant to Phosphorous (Bray II), ppm content of the two sites while Table 7 shows that Location (L) is not significant to Potassium level of the two sites. Table 8 revealed that there is no significant difference in soil moisture content of the two sites. For Table 9, it shows that there is significant difference in soil P^H of Ikorodu and Badagry. Tables 10, 11, 12 and 13 indicates that there are no significant difference in conductivity, sodium mg/kg, calcium, and magnesium mg/100g of the two sites. Tables 14 and 15 show that there are significant differences in sulphate mg/100g and chloride, mg/100g at the two sites while Table 16 indicates that there are no significant differences to iron and manganese mg/100g of the two sites. Table 18 also indicates that there is significant difference in zinc, mg/100g of Ikorodu and Badagry respectively. Table 19 shows that Location (L) is not significant to lead, mg/100g of Ikorodu and Badagry while Table 20 indicates that Location (L) is not significant to Copper, mg/100g.

1.4.2 Seasons (Dry and Wet)

Analysis of variance from Tables 1 and 2 indicate that there are no significant differences in sand and silt while Table 3 shows that Seasons (S) are significant, meaning that there is significant difference in clay of Ikorodu and Badagry. For Tables 4 and 5, it shows that Seasons (S) are highly significant to organic carbon and nitrogen content of the soil, while Tables 6 and 7 indicates that Seasons (S) are not significant to Phosphorous and Potassium level in the study areas. Table 8, shows that Seasons (S) are significant to soil moisture content of the two areas, while Table 9 indicates that Seasons (S) are not significant to P^H content of the study area. Meanwhile, Table 10 indicates that Seasons (S) are highly significant to conductivity of the study areas. Tables 11, 12, 13 and 14 shows that Seasons (S) are not significant to sodium, mg/100g, calcium, magnesium, mg/100g and sulphate, mg/100g. Table 15, indicates that Seasons (S) are not significant to chloride while Table 16, shows that Season is highly significant to iron. Table 17 indicates that Seasons (S) is not significant to manganese, mg/100g. for Tables 18 are highly significant to zinc mg/100g . Table 19 indicates that Season (S) are not significant to lead, mg/100g while Table 20 shows that Seasons (S) are highly significant i.e. there is significant difference in copper mg/100g, in the two seasons.

1.4.3 Vegetation Cover (Cleared and Forested)

Analysis of variance from Tables 1, 2 and 3 show that there are no significant differences for sand, silt and clay in cleared land and forested land.

Tables 4, 5 and 6 all indicated that there are significant differences in organic carbon, nitrogen and phosphorous (Bray II) between the Forest Type (FT) of the study areas. Table 7 shows that Forest Type (FT) are not significant to Potassium level in the study areas, while Table 8 indicates that Forest Type (FT) are highly significant to moisture content of the study areas. Table 9,10,11,12,13,14,15, 16, `17, 18, 19 and 20 shows that Forest Types are not significant to P^H, conductivity, sodium mg/kg, calcium, magnesium, mg/100g, sulphate, mg/100g, chloride, mg/100g, iron, mg/100g, manganese mg/100g, , zinc mg/100g, lead mg/100g and copper mg/100g of the study areas.

1.5 Conclusion

Results and discussion have revealed that the physico-chemical properties of soil in the areas under focus do not significantly vary among the variables. The non statistical variation in the physical and chemical properties of soil across location, season and vegetation covers could be attributed to the fact that the two area are under the same geological formation of sedimentary rock, under similar tropical climate and vegetation types with little micro climate differences , especially around the coastal settlement of Badagry Therefore, management intervention like, soil enriching intercropping or inter-rotational planting, manuring and composting, fertilizer application etc. would be useful.

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