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Research Paper

Statistical Analyses of the Physiochemical Properties of Derived Savanna, Rainforest Landscapes of Delta State Nigeria

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Abstract
The derived savanna landscape of Delta state situated within the rainforest region are always considered with apathy as they are viewed as idle, marginalized or abandoned landscapes. The study therefore focused on statistical analysis of the physiochemical properties of the derived savanna, rainforest and fallow landscapes of Delta state. The statistical analysis gave impetus for the derivation of Soil Fertility Index (SFI). The hypothesis formulated to guide the study was tested using the one-way Analysis of Variance (ANOVA). This was used to test the variation between soil physiochemical parameters of the various landscapes at 0.05 significance level. Specifically, the study found out that the physiochemical parameters of the landscapes studied are significantly correlated. Thus, implying basic similarities in soil fertility and soil constituent tendencies between the landscapes.

Keywords: *Physiochemical Properties; Derived Savanna; Rainforest; Fallow Landscapes; Statistical; Delta State and Nigeria.*

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I. INTRODUCTION

The numerous physiochemical constituents of soil are constantly responding to the dynamics of prevailing vegetation cover as well as anthropological induced disturbances (Karlen: 2014). A combination of these factors determines the soil quality dynamics found beneath the vegetation cover. Derived Savanna as the name implies is a vegetation of environmental revolt; it is an alien vegetation cover that exists within the rainforest belt (Alakpodia, 1999). Soil physiochemical parameters have been an issue of notable concern among the various categories of land users. This concern is informed by the premium placed on the soil / vegetation relationship as postulated in the "soil vegetation model" (Areola, and Aweto: 1979), which states that a casual relationship exists between the nature of soil in each vegetation community. Enaruvbe and Afeturi (2013) pointed out that, the major determinants of soil fertility, soil capability and soil suitability are dependent on the availability of soil physiochemical properties in the right quantity at a given period, which consist of soil micro and macro nutrients whose indices are used to determine soil fertility.

The soil of the rainforest is already adjudged to be fertile, largely due to the volume of litter fallthat readily improves organic matter content of the rainforest vegetation and its locational advantage. The valid role of soil in the development of ecosystem services cannot be undermined. To this effect, the statistical study of soil physiochemical parameters of various vegetation cover is paramount in an era where the issues of sustainable development and food security are taking the centre stage in the aspect of environmental management and ecosystem services for human sustainability (Agbogidi and Arinze, 2014).

Heather (2011) regarded the excessive depletion of the rainforest as a subtle menace which could impair the sustenance of vegetation cover as well as lowers the resource value and potentials of soil fertility and soil capability. A systemic and quantitative evaluation of the physiochemical properties of derived savanna, rainforest and fallow landscapes of Delta State is therefore a sustainable ameliorant in combating and mitigating issues of soil fertility and soil capability. Given the peculiarity of the derived savanna vegetation in the rainforest, a quantitative investigation into the physiochemical parameter status of the soil is imperative to determine the suitability of the soils for arable farming.

The major land cover synonymous with the vegetation of Delta state is the rainforest type of vegetation. However, the derived savanna vegetation also exists in nearly all parts of the state. Researchers have been curious about the physiochemical soil parameter status of the derived savanna as they are usually adjudged as marginal, idle and abandoned landscapes, whereby they oscillate between flooded landscapes during the rainy season and torched by bush fires during the dry season. Ogunleye (2018) opined that the scientific study of soil physiochemical parameters of derived savanna vis a vis the rainforest is indispensible to addressing the subtle menace of forest depletion and soil deterioration in the rainforest region. Umeri (2017) stated that if a proper evaluation of the derived savanna soil is carried out on regular basis, researches conducted would be able to establish if the soil is functioning at full potentials both for precision agriculture and other general and specific arable land use.

Furthermore, Ighodaro (2017) advocated the use of alternative landscapes as support system for the forest estate to avert the impending risk of soil depletion, soil impoverishment, soil desiccation and general soil degradation. A statistical analysis of the rainforest, derived savanna and fallow landscapes is therefore an imperative for a valid analytical statistical enquiry to ascertain the full functional fertility potentials of the landscape under consideration, with a view to justifying the use of the derived savanna as alternative landscape for arable farming as opined by Clayton (1996). He stated that integrated use of derived savanna landscapes will increase the carrying capacity of the environment and also reduce environmental hazards of indiscriminate forest depletion.

Studies conducted by authors like Mellisa and Scoones (2015) corroborate the need for scientific enquiry on the nature of physiochemical soil parameters of the derived savanna landscapes, in relation to other landscapes. The study thus emphasized the productive potentials of the derived savanna in other climes. Sassen (2013) also pointed out the need to investigate the productive potentials of the derived savanna landscapes. Furthermore, Adamu, Jerome and Msaky (2015) emphasized the vulnerability and susceptibility of the rainforest to anthropogenic disturbances in the absence of proper soil resource evaluation. The study also advocated the use of alternative landscapes in order to safe guard the soils and vegetation of the rainforest.

In order to mitigate ecological overshoot induced by ecological footprints from anthropogenic activities. A detailed and elaborate quantitative evaluation of soil physiochemical parameters is imperative, especially in the 21st century when issues of land grab, food insecurity and demand for cultivable arable farmlands are on the increase.

Conceptual Framework

The scientific enquiry would be hinged on the soil quality dynamics concept. The soil quality dynamics concept is a framework for evaluating soil quality (Umeri, 2017). The framework illustrates that soil quality can be evaluated at various scales. It also states that soil quality can be seen in two different perspectives;

First, as inherent characteristics of a soil, or as the condition of "health" of the soil. Inherent soil quality is controlled by soil formation processes; this accounts for the inherent ability of each soil to function. The inherent characteristics can be defined by a range of parameter values that are used as indicators of the ideal condition for soil to perform specific functions.

On the other hand, the second method for evaluating soil quality is based on the assumption that if soil is functioning at full potentials for specific land use, the peculiarity under certain soil conservation and management practices, may yield excellent quality; whereas if soil is functioning below its potentials, conclusions could be reached that such soil could be grouped as impaired soil or poor quality soil.

Soil quality dynamics therefore, requires measuring the current state of soil fertility as an indicator and comparing the results to known desired values that conform to the threshold values. Ighodaro (2017) emphasized the relevance of soil quality dynamics concept, stating that it's potential to proffer solutions to constrained, underutilized or depleted soils could influence the prospective contributions of agriculture to green economy.

The soil dynamics concept is therefore an appropriate pivot to hinge this research. This is because, it advocates the sustainability of soil resources through appropriate management and conservation practices which focuses on the fertility capability and sustainability statuses of the soils. The soil dynamics concept also refers to the ability of the soil to support plant growth and cultivation without depleting or degrading the environment. It is also rated as the capacity of soil to function within managed eco-system boundaries to sustain plant and animal productivity. Other factors such as maintenance and enhancement of water and air quality to support the sustainability of the environment and conservation of natural resources are also embedded in the Soil Quality Concept (Karlen et tal 1997).

Study Area

The study is carried out in Delta state, Nigeria with its main focus on three ecosystems, derived Savanna, fallow landscapes and rainforests.

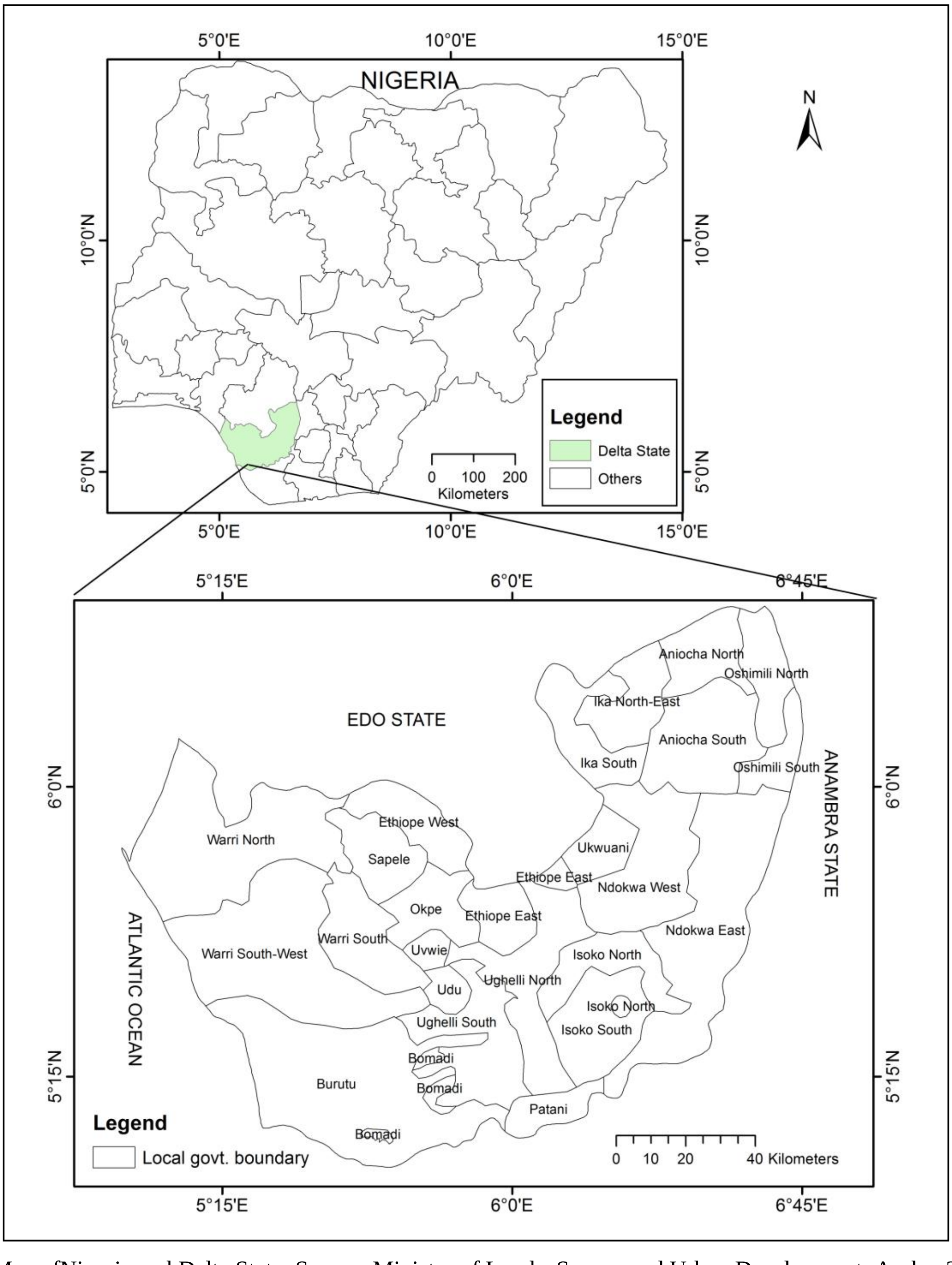

Fig.1: Map ofNigeria and Delta State. Source, Ministry of Lands, Survey and Urban Development, Asaba. 2018

II. LOCATION AND SIZE

Delta lies between latitude 5^0 15^1 N and 6^0 0^1N and longutudes 5^0 15 E and 6^0 45^1 E (see Fig 1 Nigeria showing the location of Delta state). Delta state has a geographical area of about 17,440 square kilometre (Dittimi, 1995). Delta state has a wide coastal belt, inter-laced with complicated channels of water bodies such as rivulets, streams and numerous tributaries which constitute part of the Niger Delta through which the River Niger finds its way into the sea (Awaritefe, 2013).

Vegetation

The outlay of vegetation types in Delta State ranges from mangrove swamp forest, fresh water swamp forests, typical lowland rainforest and the derived Savanna landscapes (grasslands). The derived Savanna landscapes are sometimes referred to as vegetation of environmental revolt (Alakpodia, 1999). The mangrove vegetation is characterized by swampy grounds often separated by narrow bodies of water and creeks. Dominant species of trees in the area includes red mangrove *rhizopora racemosa*. The mangrove trees grow in tidal waters. The stilt roots growing out of water makes it impenetrable.

The fresh water swamp is located much more inland than the mangrove vegetation. It The dominant species of trees found within this zone include *raphia Specie, calamus species, Irvingia gabonensis, Termilania specie* and others.

The tropical lowland rainforest occurs inland from the fresh water swamp forest with a reasonable number of tree species such as wood climbers and creepers, and undergrowth. The forest occurs in layers. The trees of the tropical rainforest are known for their characteristic evergreen nature. The derived Savanna landscape (grassland vegetation) occurs in scattered patches all over the state. The grassland of Delta state are known to be treeless and dominated by grasses such as *impera cylindrical, Loudeita orundinacea, Panicum maximum and Hyperrheria* species (Aweto, 1987).

III. MATERIALS AND METHODS

The study adopted the survey design. Delta state was stratified into three zones namely Delta north, Delta central and Delta south based on existing geopolitical categorizations. The following landscapes, rainforest, derived savanna and fallow located within each zone was the focus.

Thirty soil samples were collected from within each landscape type within each zone in the study area. The soil samples collected totaled ninety in all. The soil samples underwent laboratory analysis for the following physiochemical parameters namely pH, Matter content, total Nitrogen, Available Phosphorous. ExchH, ExchALH, Calcium, Magnesium, Potassium, Sodium, Sand, Silt Clay, and ECEC. Anova (Analysis of Variance) statistical test was used to test the significance of variation of the physiochemical properties among derived savanna, fallow and rainforest landscapes. This was done at the 0.05 sig. level.

IV. DISCUSSION OF RESULTS /FINDINGS

The results of the physiochemical parameters for the three zones in the study area is shown in Table1

Table 1. Soil parameters values of the different landscapes in the various zones

	Delta Central			**Delta North**			**Delta South**		
Soil Parameters	Rainforest	D.Savanna	Fallow	Rainforest	D.Savanna	Fallow	Rainforest	D.Savanna	Fallow
pH	5.31	5.22	4.79	4.12	4.48	4.33	4.94	4.18	4.99
OC (%)	2.43	2.17	3.61	2.11	4.29	2.40	3.40	2.41	2.93
Total Nitrogen (%)	0.26	0.24	0.39	0.23	0.48	0.27	0.37	0.27	0.32
Avail. Phosphorus (ppm)	6.11	7.25	9.51	58.53	7.64	40.77	13.44	33.98	13.39
Calcium (cmol/kg)	0.26	0.42	0.64	0.64	0.31	1.29	0.91	0.27	1.20
Sodium(cmol/kg	1.36	1.57	1.69	1.90	1.60	1.79	1.79	1.93	1.64
Magnesium (cmol/kg	0.52	0.46	0.54	1.09	0.36	0.75	0.58	0.55	0.88
Potassium (cmol/kg)	0.13	0.10	0.19	0.17	0.10	0.13	0.16	0.11	0.13
Sand (%)	74.80	78.20	79.80	84.20	84.80	79.40	74.40	77.20	77.32
Silt (%)	16.60	11.40	10.80	8.40	9.40	15.40	15.40	10.20	14.00
Clay (%)	8.60	10.40	8.80	7.40	5.80	11.20	10.20	12.60	8.68
ECEC	2.31	2.56	3.06	4.34	2.37	3.95	3.37	2.90	3.92
SFI	9.89	10.00	10.32	14.43	10.14	13.47	10.75	12.22	10.78

Source: Author's Fieldwork, 2019

Table 2 shows the mean physiochemical parameter values for the three landscapes across the study area.

Table 2. Soil parameter mean values for the three landscapes (Rainforest, Derived Savanna, fallow landscapes)

	Rainforest	Derived Savanna	Fallow	Standard	Source
pH	4.79	4.63	4.70	5 – 6	SFCC (Sanchez et al, 1982)
OC (%)	2.64	2.96	2.98	3 – 8%	Miller & Donahue (1990)
Total Nitrogen (%)	0.29	0.32	0.32		SFCC (Sanchez et al, 1982)
Phosphorus	26.03	16.29	21.22		SFCC (Sanchez et al, 1982)
Ca	0.74	0.33	1.04		SFCC (Sanchez et al, 1982)
Mg	0.74	0.45	0.72		SFCC (Sanchez et al, 1982)
K	0.16	0.10	0.15	> 0.20 meq/ 100g	SFCC (Sanchez et al, 1982)
Na	0.16	0.17	1.70		SFCC (Sanchez et al, 1982)
ECEC	3.34	2.60	3.64	> 4 meq/ 100g	SFCC (Sanchez et al, 1982)
Sand	77.8	80.06	78.84	Not loamy sand or sand	SFCC (Sanchez et al, 1982)
Silt	13.4	10.3	11.4	Not loamy sand or sand	SFCC (Sanchez et al, 1982)
Clay	8.73	9.60	9.56	Not loamy sand or sand	SFCC (Sanchez et al, 1982)

Source: Author's Fieldwork, 2019

The One-Way-ANOVA results showed that there is a significant variation among the various landscapes in the following parameters. Exchangeable acidity (p=0.020), Exch (0.027), Exch Alt (0.031), calcium (0.041), magnesium (0.013), ECEC (0.004). See Table 3.

Table 4 shows the post-Hoc test results of the ANOVA showing the significant variation among the various landscapes as shown in table 1.

The significant variation observed in the ExchAcidity is seen to occur between the rainforest and the fallow landscapes P sig value of 0.006. In the case of Exch ALH the variation is seen to occur among the three landscapes that between the rainforest and derived Savanna (P sig is = 0.046) and rainforest and fallow landscapes (P. sig is = 0-013). The difference between the rainforest and the derived Savanna for the ExchALH as seen in the P sig is relatively minimal when compared with that of the rainforest and fallow.

A significant variation in the calcium content is seen to occur between the Rainforest and the Derived Savanna with (P. Sig=0.046). the variation is however seen to be minimal as can be inferred from the aforementioned P sig value. In the case of the magnesium content, the significant variation is observed between the Rainforest and Derived Savanna with (P sig= 0.0009).

The aforementioned confirmed that a significant variation exists in the soil physiochemical parameters of the various landscapes P.03 level of significance.

Table 3. Main table for the hypothesis

Soil Parameter	F	Sig.
pH	1.005	.370
OrgC	.619	.541
TotalNitrogen	.744	.478
AvailPhosphorus	1.202	.306
ExchAcidity	4.085	.020*
ExchH	3.785	.027*
ExchALH	3.625	.031*
Calcium	6.004	.004*
Magnesium	4.606	.013*
Potassium	2.246	.112
Sodium	.046	.955
Sand	.416	.661
Silt	1.316	.274
Clay	.324	.724
ECEC	5.754	.004*

Sig at 0.05 sig level

Table 4. Post – Hoc test for Anoval results

Dependent Variable	(I) VegType	(J) VegType	Std. Error	Sig.
pH	Rainforest	DerivedSavanna	.11477	.160
		Fallow Landscape	.11477	.457
	DerivedSavanna	Rainforest	.11477	.160
		Fallow Landscape	.11477	.504
	Fallow Landscape	Rainforest	.11477	.457
		DerivedSavanna	.11477	.504
OrgC	Rainforest	DerivedSavanna	.334048	.357
		Fallow Landscape	.334048	.322
	DerivedSavanna	Rainforest	.334048	.357
		Fallow Landscape	.334048	.943
	Fallow Landscape	Rainforest	.334048	.322
		DerivedSavanna	.334048	.943
TotalNitrogen	Rainforest	DerivedSavanna	.03631	.286
		Fallow Landscape	.03631	.303
	DerivedSavanna	Rainforest	.03631	.286
		Fallow Landscape	.03631	.971
	Fallow Landscape	Rainforest	.03631	.303
		DerivedSavanna	.03631	.971
AvailPhosphorus	Rainforest	DerivedSavanna	6.280233	.125
		Fallow Landscape	6.280233	.446
	DerivedSavanna	Rainforest	6.280233	.125
		Fallow Landscape	6.280233	.434
	Fallow Landscape	Rainforest	6.280233	.446
		DerivedSavanna	6.280233	.434
ExchAcidity	Rainforest	DerivedSavanna	.21845	.264
		Fallow Landscape	.21845	.006
	DerivedSavanna	Rainforest	.21845	.264
		Fallow Landscape	.21845	.090
	Fallow Landscape	Rainforest	.21845	.006
		DerivedSavanna	.21845	.090
ExchH	Rainforest	DerivedSavanna	.20353	.368
		Fallow Landscape	.20353	.008
	DerivedSavanna	Rainforest	.20353	.368
		Fallow Landscape	.20353	.076
	Fallow Landscape	Rainforest	.20353	.008
		DerivedSavanna	.20353	.076
ExchALH	Rainforest	DerivedSavanna	.02878	.046
		Fallow Landscape	.02878	.013
	DerivedSavanna	Rainforest	.02878	.046
		Fallow Landscape	.02878	.604
	Fallow Landscape	Rainforest	.02878	.013
		DerivedSavanna	.02878	.604
Calcium	Rainforest	DerivedSavanna	.205671	.049
		Fallow Landscape	.205671	.149
	DerivedSavanna	Rainforest	.205671	.049
		Fallow Landscape	.205671	.001
	Fallow Landscape	Rainforest	.205671	.149
		DerivedSavanna	.205671	.001
Magnesium	Rainforest	DerivedSavanna	.103839	.009
		Fallow Landscape	.103839	.938
	DerivedSavanna	Rainforest	.103839	.009
		Fallow Landscape	.103839	.011
	Fallow Landscape	Rainforest	.103839	.938
		DerivedSavanna	.103839	.011
Potassium	Rainforest	DerivedSavanna	.025978	.050
		Fallow Landscape	.025978	.728
	DerivedSavanna	Rainforest	.025978	.050
		Fallow Landscape	.025978	.105
	Fallow Landscape	Rainforest	.025978	.728
		DerivedSavanna	.025978	.105
Sodium	Rainforest	DerivedSavanna	.082401	.847

		Fallow Landscape	.082401	.766
	DerivedSavanna	Rainforest	.082401	.847
		Fallow Landscape	.082401	.916
	Fallow Landscape	Rainforest	.082401	.766
		DerivedSavanna	.082401	.916
Sand	Rainforest	DerivedSavanna	2.4893	.365
		Fallow Landscape	2.4893	.677
	DerivedSavanna	Rainforest	2.4893	.365
		Fallow Landscape	2.4893	.623
	Fallow Landscape	Rainforest	2.4893	.677
		DerivedSavanna	2.4893	.623
Silt	Rainforest	DerivedSavanna	1.9640	.114
		Fallow Landscape	1.9640	.296
	DerivedSavanna	Rainforest	1.9640	.114
		Fallow Landscape	1.9640	.588
	Fallow Landscape	Rainforest	1.9640	.296
		DerivedSavanna	1.9640	.588
Clay	Rainforest	DerivedSavanna	1.2158	.478
		Fallow Landscape	1.2158	.498
	DerivedSavanna	Rainforest	1.2158	.478
		Fallow Landscape	1.2158	.974
	Fallow Landscape	Rainforest	1.2158	.498
		DerivedSavanna	1.2158	.974
ECEC	Rainforest	DerivedSavanna	.31338	.022
		Fallow Landscape	.31338	.337
	DerivedSavanna	Rainforest	.31338	.022
		Fallow Landscape	.31338	.001
	Fallow Landscape	Rainforest	.31338	.337
		DerivedSavanna	.31338	.001

Discussion of Results of Each the Soil Physiochemical Parameters in the Three Landscapes under study

Phosphorous

The Phosphorous content for the Rainforest soil in Delta North zone ranked the highest above all the landscape soils in all the zones. For the fallow landscapes, the phosphorous content is highest in all the fallows of the Delta North. It ranked highest over other zones.

In Delta South, the Phosphorous content in the Derived Savanna ranked higher than the Rainforest and Fallow Landscapes within this zone. For Delta Central, the Phosphorous content across all the landscapes was relatively low compared to what was observed in Delta North and South (see fig.2).

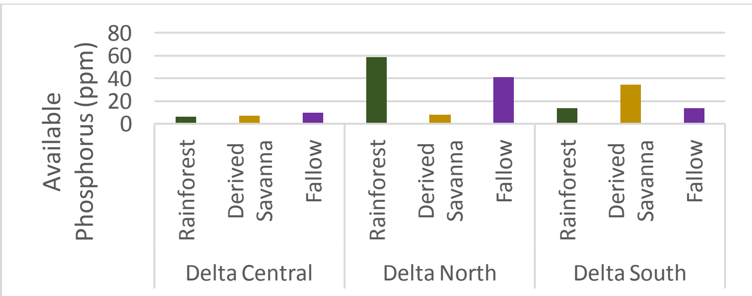

Fig. 2. Available Phosphorus for the zones

Organic carbon

The Organic Carbon content for the three landscapes in the various zones of Delta State for the derived Savanna in Delta North has the highest value of organic content of the different landscapes in the different zones. In Delta Central, the fallow landscapes have the highest organic content followed by that of the Rainforest. However, the difference between the Organic content of the Rainforest and the Derived Savanna is minimal as seen in figure 3. In Delta south, the Organic content in the Rainforest and the fallow are higher than that of the Rainforest.

Remarkably however, the organic carbon content in the Derived Savanna in Delta North ranks highest of all the landscapes in all the zones. This affirms that the Derived Savanna possess the soil fertility potentials for sustainable arable farming.

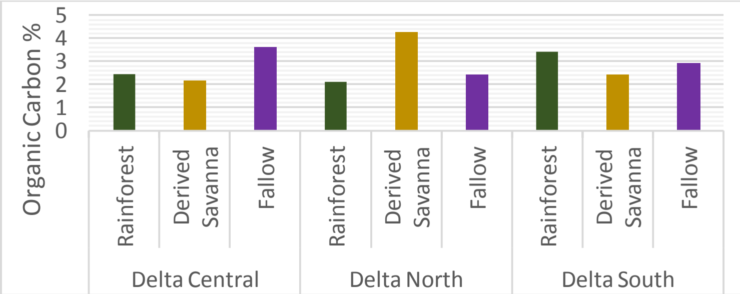

Fig. 3. Organic Carbon content

pH

The pH of the derived Savanna in Delta Central is higher than that of the other Savanna in other zones. The pH of the soils of the Derived Savanna in Delta Central is similar to that of the rainforest as the variation between the pH of the derived Savanna and that of the rainforest soil is marginal as seen in figure 4 with the pH tending towards alkalinity. In the Delta North zone, the pH of the Derived Savanna is higher than that of the rainforest and fallow landscapes being slightly acidic but tending towards alkalinity. In Delta South, however, the pH of the Derived Savanna is lower than that of the Rainforest and fallow, being acidic while the others are tending towards alkalinity.From table 4 above, the minimum mean value for soil pHin the study area is 3.77 while the maximum is 5.14 which is generally within the range of acidic soils.

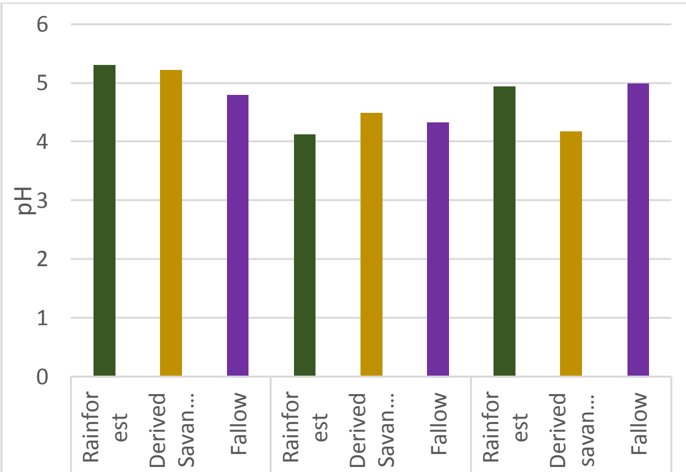

Fig. 4. pH for the zones

Total Nitrogen

The Total Nitrogen content of the Derived Savanna in Delta North ranks the overall highest of all the landscapes in all the zones in Delta North. The Total Nitrogen content of the Rainforest soil ranks lowest. In Delta Central, the Total Nitrogen content of the Derived Savanna is lower than that of the Rainforest and fallow. The Total Nitrogen content in Delta South is lower than that of the Rainforest and the fallow in Delta North, the soils in the Rain Forest have the lowest Total Nitrogen content, while that of the Derived Savanna is higher than both the fallow and rainforest. This phenomenon could be due to other environmental factors which are not linked to soil parameters. The implication of this is that the Derived Savanna soils possess the potential of having an abundance of Total Nitrogen content, which is a basic requirement for the sustenance of plant growth and hence arable farming activities (see fig. 5)

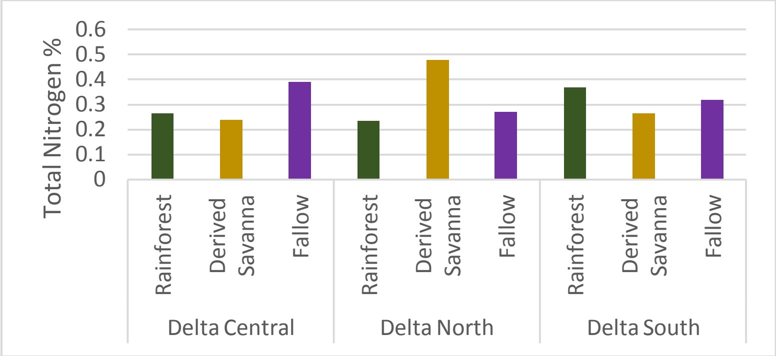

Fig. 5. Total Nitrogen for the zones

Calcium

The calcium content of the Rainforest soils in Delta North and South are observed to be relatively higher than those of the other landscapes. The calcium content of the Derived Savanna in both Delta North and South zones are, however, relatively lower than those of the other landscapes. Remarkably, the calcium content in Derived Savanna in Delta Central is higher than that of the Rainforest but lower than that of the fallow landscape (see fig.6).

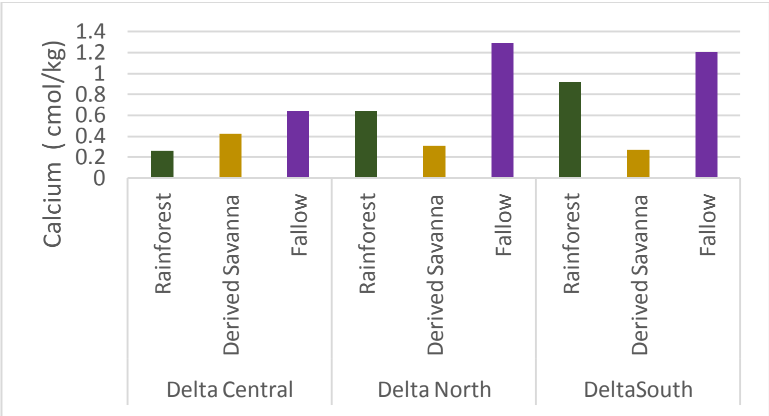

Fig. 6. Calcium for the zones

Sodium

The sodium content of the Derived Savanna in Delta Central and Delta North are slightly higher than that of the Rainforest soils. This further shows the capability of the soils of the derived Savanna, of replicating the characteristic of the Rainforest soils of being fertile. The value of the fallow is seen to be consistent for all the landscapes in all the zones (see fig. 7).

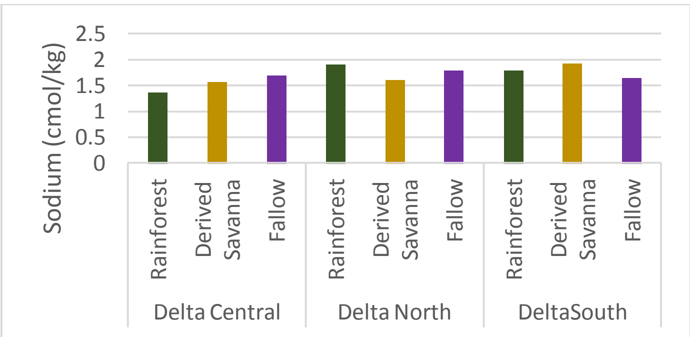

Fig. 7. Sodium for the zones

Potassium

The potassium content values for the derived Savanna soils are generally relatively lower than the other landscapes in all the zones. In Delta Central, the potassium content of the fallow is highest followed by that of the Rainforest. In Delta North and South, the potassium content in the Rainforest is higher than that of the

Derived Savanna and fallow. However, the variation/difference between the potassium content of the fallow and that of the Derived Savanna is marginal (see fig. 8).

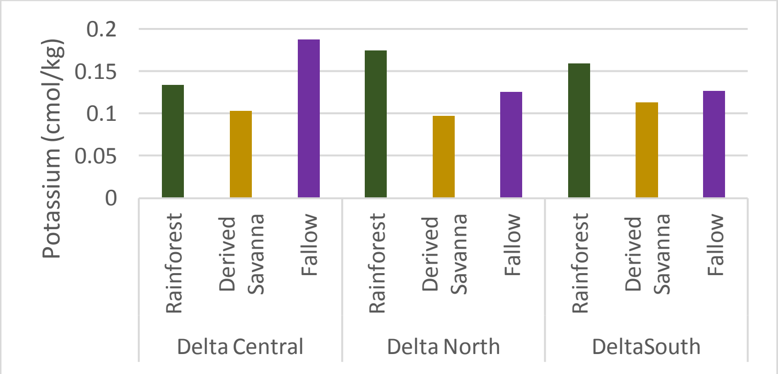

Fig. 8. Potassium for the zones

Magnesium

The magnesium content of the Derived Savanna in both the Delta Central and Delta South varies only marginally from that of the Rainforest. The magnesium content of fallow in Delta Central ranks higher than that of the other landscapes. The variation in the magnesium content of the three landscapes in this zone is however marginal.

In Delta North, the magnesium content in the Rainforest is relatively much higher than that of the other landscapes. In Delta South, the magnesium content is relatively higher than that of the Rainforest and Derived Savanna (see fig. 9).

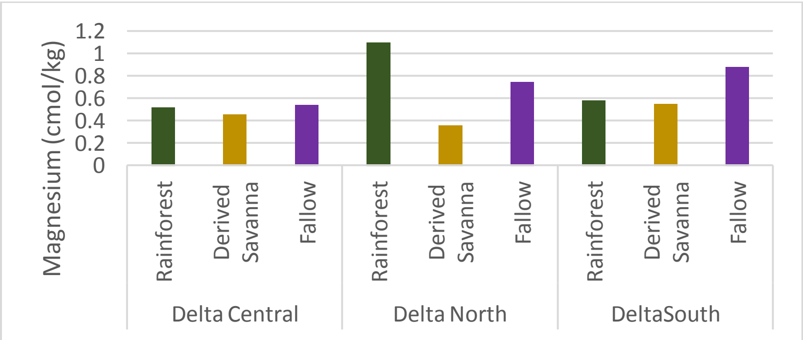

Fig. 9. Bar graph for Magnesium

Sand

The sand content in the Derived Savanna in Delta North ranks highest than all the other landscapes in all the zones. In Delta Central, the sand content of the Derived Savanna ranks second highest, after the fallow, while that of the Rainforest is lowest (see fig.10).

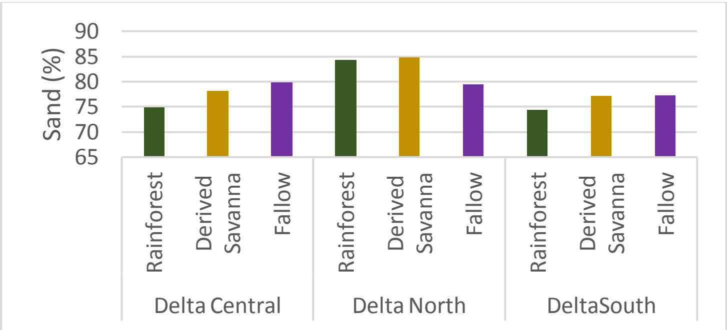

Fig. 10. Sand for the zones

Silt

The silt content of the Rainforest ranks highest followed by that of the Derived Savanna, which varies slightly from that of the fallow.

In the case of the Delta North, the silt content of the fallow is relatively higher than the other landscapes. This is followed by that of the Derived Savanna and then that of the Rainforest.

The silt content of the Derived Savanna ranks lowest of the three landscape in Delta South. The highest is that of the Rainforest, which is followed by that of the fallow (see fig 11).

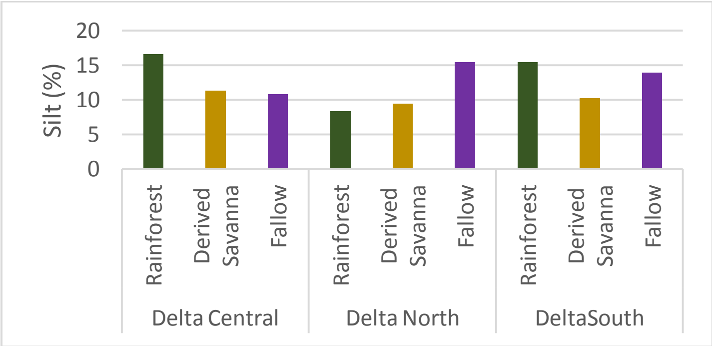

Fig. 11. Silt for the zones

Clay

The clay content of the Derived Savanna in Delta South ranks highest of all the landscapes across the three zones. This is followed by that of the Rainforest and then the fallow (see. Fig.12).

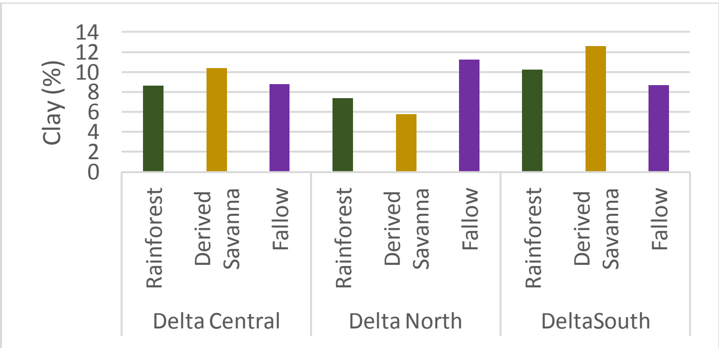

Fig. 12. Clay for the zones

ECEC

In Delta Central, the ECEC of the derived Savanna ranks remarkably higher than that of the rainforest. The ECEC of the fallow, is however higher than both the rainforest and Derived Savanna.

In Delta North, the ECEC of the derived Ssvanna is much lower than that of the other landscapes, with that of the Rainforest ranking the highest.

The ECEC of the Derived Savanna varies slightly lower than that of the Rainforest in Delta South. The ECEC of the fallow, however ranks highest than those of the other landscapes.

The slight variation between the ECEC of the Rainforest and Derived Savanna observed in the Delta Central and Delta South further affirms the potentials of Derived Savanna to replicate the characteristics of the Rainforest, which is adjudged to be fertile based on the integrity and its undisturbed state. The variation from this norm in Delta North may be as a result of other unsearched extreme environmental factors (see figs 13 and 14).

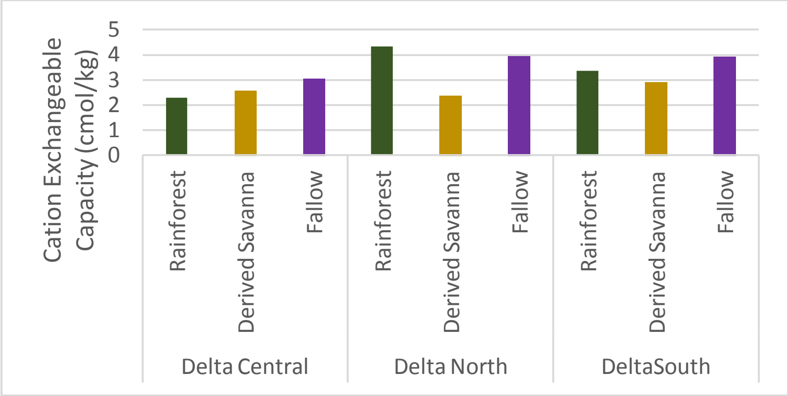

Fig. 13. ECEC for the zones

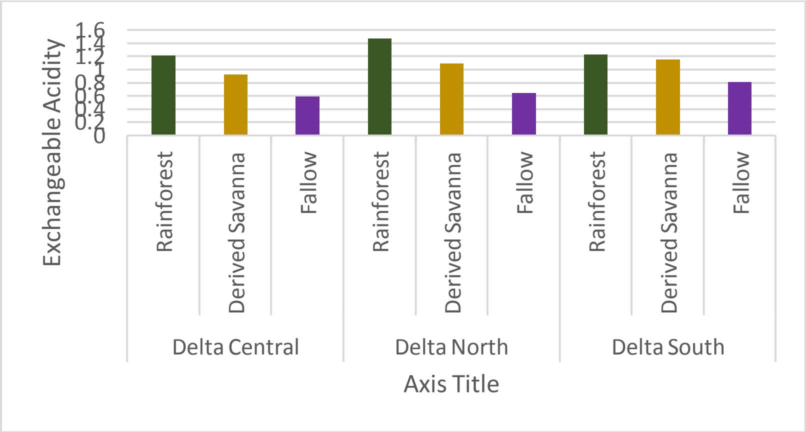

Fig. 14. Exchangeable Acidity for the zones

Policy Implication

There is a significant similarity in terms of contributions of soil physiochemical parameters in all the landscapes. This implies that soil physiochemical parameters of the derived savanna are comparable to the fallow and rainforest landscapes. The specific characteristics and peculiarities of the physiochemical parameters of the soils were identified, Specifically, the study reveals that the soils of the derived savanna are suitable for arable farming. The study also found out that the soil constraints in the study area are site specific and that each location site would require its special soil conservation measures based on the soil fertility index and soil capacity classification. Also the relevant characteristics and peculiarities of the physiochemical parameters were identified. The study confirmed that the soils of the three landscapes in the various zones studied are generally acidic as the rainfall within the soil pH level of 4.62-4.79 falls below the threshold standard values of 5-6.

The major policy implication of the study is that the soils of the derived savanna landscapes have comparable productive capacity for arable farming. In other words, the derived savanna vegetation landscapes of Delta state which are usually viewed as idle, abandoned and marginalized landscapes is an erroneous opinion of the soil capacity of the landscape.

Thus policy makers should note that derived savanna landscapes are cultivable arable landscapes which could be profitably harnessed for agricultural purposes.

V. CONCLUSION

The study examined the statistical analysis of the physiochemical properties of derived savanna, fallow and rainforest landscapes of Delta State, The study indicates that there are similarities and differences in the physiochemical properties of soils in the three landscapes. Specifically, the study justified the use of derived savannas as cultivable arable landscapes, having confirmed through the statistical analysis that they have comparable productive potentials with other landscapes in the study area.

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