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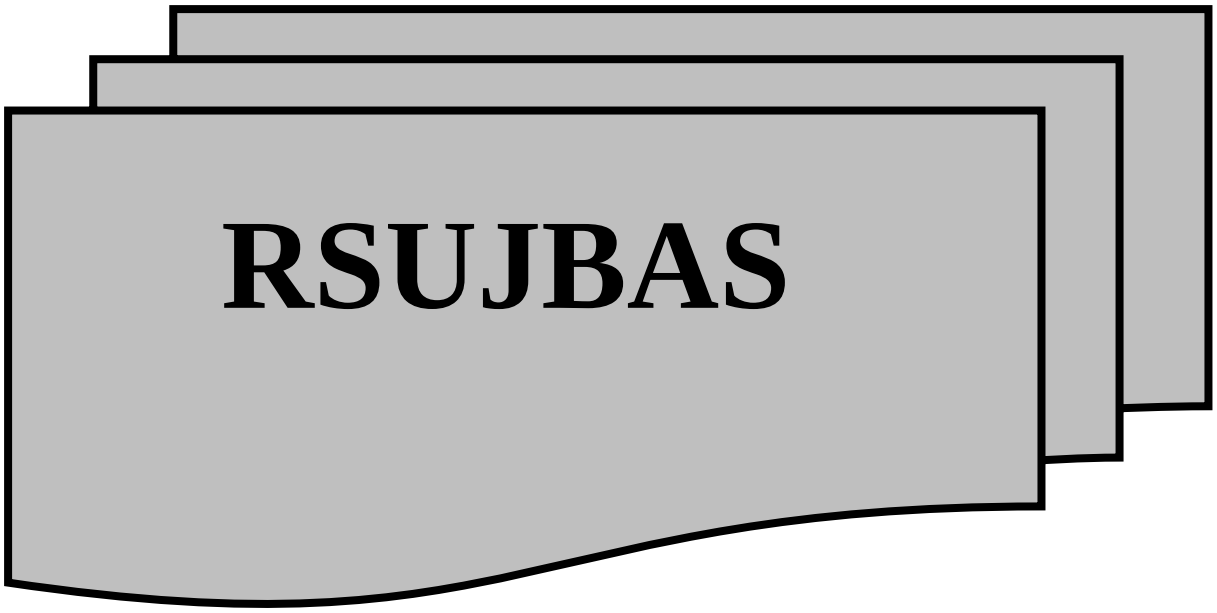

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IMPACT OF DEFORESTATION ON SOIL PROPERTIES IN EASTERN OBOLO REGION OF AKWA IBOM STATE: IMPLICATION FOR REGIONAL DEVELOPMENT PLANNING

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ABSTRACT

Deforestation has been a major environmental challenge affecting the resilience and distribution of forests across Niger Delta region. The study examined the impact of deforestation on soil properties in communities in Eastern Obolo region of Akwa Ibom State, Nigeria. The population of the study consisted of thirty-six (36) communities out of which a sample size of five communities were randomly selected using the simple random sampling technique. The study adopted the experimental research design. The nature and source of data was through the primary and secondary sources. Soil samples were collected from five deforested communities: Okoroete, Kampa, Elile, Amadaka, and Okombokwo and a composite control collected from three (3) locations in Kampa, Amadaka, and Elile at a depth of 0-15cm and 15-30cm in an independent random sampling method using a soil auger. A total of six (6) soil samples were collected and analyzed with a standard method for physicochemical parameters and macronutrients. Data acquired from the laboratory was subjected to statistical analysis (T-test and ANOVA) including range, mean, standard deviation and variance. Results of the study indicated that there is a significant variation between deforested land and soil properties as there has been a decrease in fertility index and macro nutrients which degrade the soil properties. To reduce deforestation, the study recommended among others that government should reactivatve the use of other sources of energy such as kerosene, biogas, and electricity for domestic and industrial use to minimize the use of firewood; laws, policy, and legislative and regulatory measures, education, implementation and monitoring should be enforced in the region.

Keywords*: Impact, deforestation, soil, properties, Eastern Obolo, development, planning.*

INTRODUCTION

Deforestation has been a major environmental challenge affecting the resilience and distribution of forests across the regions of the world especially the Akwa Ibom state in Nigeria. Deforestation is the act or process of clearing of forests for a variety of reasons or purposes (e.g. farming, lumbering, mining/mineral exploitation, industrial, institutional and residential building animal grazing, recreational stadium, open fields, etc.) without immediate replacement or replanting of trees, shrubs, and grasses (Ukpere, et.al., 2017). Forest is often perceived as a stock resource, a free good, with the land as something freely available for conversion to other uses without recognition of the consequences. For this reason, many forest ecosystems have been degraded into less diverse and stable ones (Aruofor, et.al., 2018).

The Eastern Obolo region of Akwa Ibom State in the Niger Delta region is naturally endowed with luxuriant tropical and equatorial rain forests and mangrove swamp forests. Unfortunately, these forests are rapidly disappearing as a result of uncontrolled high rate of deforestation in the region.

Igwe (2009) and Naluba (2017) refers to Region as the unit area formed by common condition of geologic structure, soil, surface relief, drainage, vegetation and animal life. Planning is a process in which a society induces change in itself. It involves the application of scientific knowledge in order to solve the problems of a social system (Arokoyu and Adeyemo, 2002). Development describes the process of economic and social transformation. Sustainable human development is development that not only generates economic growth, but also distributes its benefits equitably; that generates environment rather than destroying it (Naluba, 2013). Eastern Obolo region is blessed with abundant natural resources, both human and material. At the global level, over the years, the world has experienced unprecedented loss of its forests particularly in tropical areas. Sambe, et. al. (2018) Posits that the world forest resources have continued to reduce mainly due to anthropogenic impacts caused by the need to meet the demand for industrial and social development necessary for economic growth. Goldewijk and Ramankutty (2004) stated that the rate of deforestation increased globally between 1700 and 1990 especially in South East Asia, Sub-Saharan Africa and South America. Decreasing forest area in the tropical regions in the recent years are caused by anthropogenic factors such as growing population, the need for more agricultural land, expanded demand for fuel and commercial wood extraction, economic development, technological advancement, and a change in social and political situations (Fellman, et. al., 2005; Enaruvbe, and Ige-Olumide, 2004; Fabuji, 2011). Other anthropogenic factors apart from the above include illegal and poorly regulated timber extraction, social and environmental conflicts, increasing urbanization and industrialization (FAO, 2011; Ephraim, 2021). Other factors are natural in nature.

Forest removal raises some principal global concerns and host of local ones. First on the worldwide basis, forests play a major role in maintaining oxygen and carbon balance of the earth. Humans and their industries consume oxygen; vegetation replenishes it through photosynthesis and the release of oxygen back into the atmosphere as a by-product. At the same time, plants extract the carbon from atmospheric carbon(IV) oxide, acting as natural retaining sponges for the gas so important in the greenhouse effect (Norton, 2007). Second global concern is also related to climate. Forests destruction change surface and air temperatures, moisture content and reflectivity. Also, it brings about the loss of a major part of the biological diversity of the earth (Fellman, et al, 2005; Norton, 2007).

Forests and woodlands are great assets not only to Nigerians but to all the regions of the world. It provides goods and services in the national economic development and sustenance of the livelihood of the dwellers. They have been recognized as important resource base for Nigerian

socio –economic development since it provides many benefits and opportunities to both rural and urban dwellers (Sogbon, et,al, 2017). Rain forest resources play a major role in the survival of life on the surface of the earth by providing a wide variety of highly valuable ecological, economic and social services such as carbon sequestration, conservation of biological diversity, soil and water conservation, agricultural production systems, improvement of urban and rural aesthetic conditions, provision of employment and enhanced livelihoods (Naluba, 2020; Maton, et al, 2019).

In Nigeria, fuelwood is the most dominant and widespread source of energy used for domestic purposes (Yemi and Tajudeen, 2016). In Africa, Fuelwood and charcoal amount for more than 90% of fuelwood utilization (Kio, 1987). The emerging situation have implication for regional planning. It calls for caution in order to sustain wood energy trade and consumption.
Eastern Obolo region of Akwa Ibom State in the Niger Delta region of Nigeria is naturally endowed with luxuriant tropical and equatorial rainforest and mangrove swamp forests. Unfortunately, these forests are rapidly disappearing as a result of uncontrolled high rate of deforestation in the region. The large scale deforestation is caused by growing population, the need for agricultural land, urbanization, industrialization, expanded demand for fuel and commercial wood extraction.

Since fuelwood is a major source of energy in rural households in Eastern Obolo communities of Andoni local government of Akwa Ibom state, it therefore becomes necessary to examine in this work the impact of deforestation on soil properties in Eastern Obolo region of Akwa Ibom state. The impact of deforestation on soil properties have very strong implication for regional development planning not only in Akwa Ibom state but in other regions of Nigeria.

Thus, the aim of this sturdy is to analyze the impact of deforestation on soil properties in communities of Eastern Obolo region of Akwa Ibom state.

The significance of this study is that it will enable the communities in the study area and others to know more about the impacts of fuelwood harvesting on soil as it affects the physical, chemical and biological properties in the region so as to avoid further degradation which may lead to poor yield and productivity in farming activities upon which the region depends on.

2.0 Materials and Methods

2.1 Geography of the study area

The study area was Eastern Obolo region of Akwa Ibom state, located between latitude $4^{0}33^{1}$N and $4^{0}50^{1}$N, longitude $7^{0}45^{1}$E and $7^{0}55^{1}$E and about 650m above sea level in the tropical mangrove forest belt East of the Niger Delta region of Nigeria. The region lies in the mouth of the Atlantic Ocean. Coastal water of eastern of Eastern Obolo drains into the Atlantic Ocean and is connected to Qua Iboe River Estuary at the east and Imo River Estuary at the west. The region has a total landmass of 117,008km^2 and an estimated shoreline of about 184km long. It is bounded in the North by Mkpat Enin, Onna in the North East and Ikot Abasi in the SouthEast in Akwa Ibom State. Figure 1.0 & 1.1 shows the study area.

The climate of the region experience two seasons: the dry season (October to May) and wet season (April to October) with an annual rainfall averaging about 2500mm. The vegetation is dominated by mangrove species (Rhizophora mangle, Avicenia africana) and the highly invasive nipa palm (Nypafruiticans). The inter-tidal zone bordering the creek when exposed at low tide reveals a clay, peat and/or sandy substratum. Beyond the tidal mud flats are highly elevated land with soil and luxuriant growth of tangled vegetation fringed with scrambling edges, ferns, and epiphytic ferns such as Phymatodes. The dominant trees are cabbage tree,

Christmas bush, boundary tree (Dvacaena arborea), blood tree (Harlen ganamadascariensis) and oil palm tree (Elaeis guineensis). Cultivated tree plants such as mango (Mangifera endica), African pear (Dacryodes edulis), bush mango (Irvingia gabonesis), coconut palm (Cocos nucifera) and African bread fruit(Treculia africana) are common around the communities.

The population of the region is 60542 which was projected to 2018 with 36 communities. The people are a mixture of Andoni and Iko extractions. Eastern Obolo has its headquarters at Okoroete. The forest reserve include mangrove, iroko, raffia, rubber, kolanut, coconut, peas, and mango. The indigenes are predominantly fishermen with over 65% involved in fishing activities. Their traditions contain elements of Bonny, Opobo and Ibibio culture. Their economic activities are characterized by fishing which leads to the constant and eminent utilization of fuel wood for the preservation of their produce. Map of the study area is shown in Fig. 1.0 and fig. 1.1.

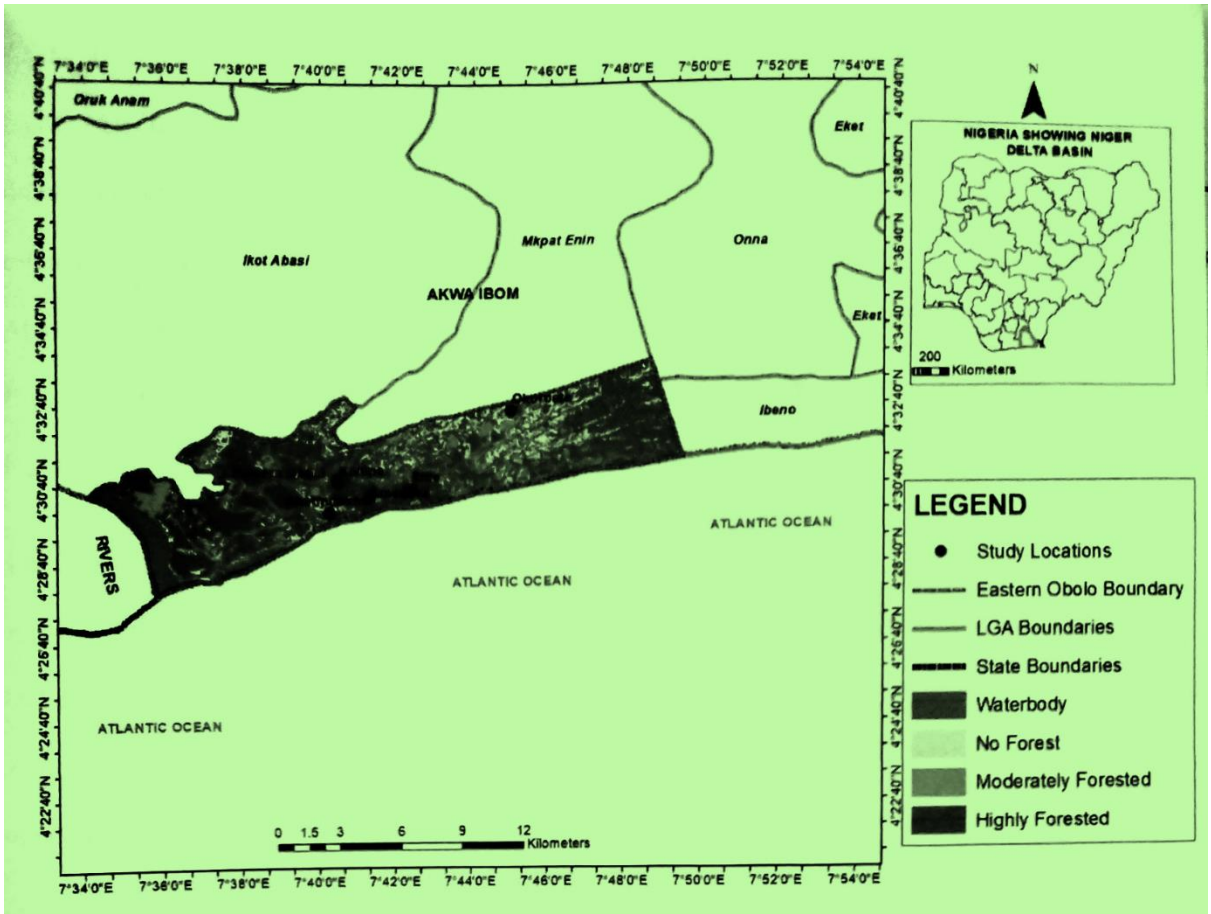
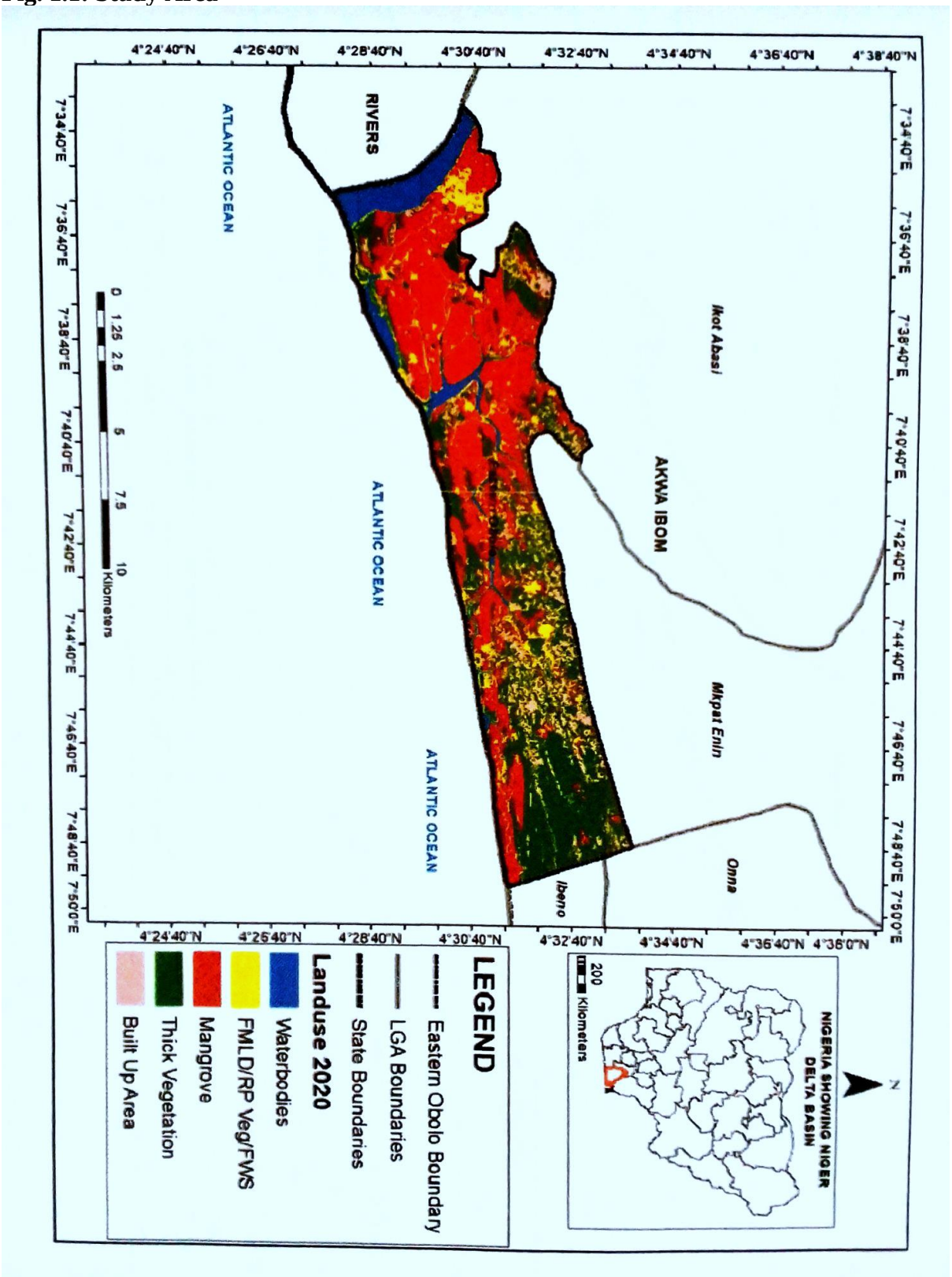


Fig. 1.0: Study Area

Fig. 1.1: Study Area



2.2: Research Methodology

The study employed the experimental research design. The nature and sources of data was through the primary and secondary sources. The primary source of the data involved field survey of which the samples were collected, tested and analyzed. Eastern Obolo occupied an area of 538.5km^2 with 36 communities. To get the sample frame, soil samples were taken with soil auger at 0-15cm and 15-30cm depths of the soil from six (6) communities. All samples were assumed to be independent of one another. In each of the land, several transects were also established for the identification of the different types of land in the area. This was also done subjectively to ensure adequate coverage of each land across the region under study. The sample size was restricted to six communities in the region with a composite control from another three non-deforested communities. The sampling technique used in selecting the five communities from the 36 communities was the simple random sampling method. The method of data collection and instrumentation was by taking soil samples with a soil auger at 0-15cm and 15-30cm depths of the soil. The method used in analyzing the hypothesis was through the One-Way Analysis of Variance (ANOVA) and the One Sample T-test. The observed samples were compared with the composite control.

2.3: Methods for Analysis of physicochemical parameters

Each sample was properly labeled at the site before movement to the laboratory. The collected samples were analyzed for major physical and chemical soil quality parameters. In the analysis of physicochemical parameters, the study made use of standard procedure instruments like ASTM D7503-10, APHA 4500-NC, ASTM D2974 and APHA 4500 P.E. Specifically, the methods used for the various parameters are Colour (By viewing), pH (Potentiometric pH meter), Organic carbon, (Wet oxidation), Available nitrogen (Alkaline permagnate), Available potassium (Flame photometry), Electrical conductivity (conductometry).

3.0: Results

3.1: Presentation of Data

The result for analyzing the impact of deforestation on soil properties in communities of Eastern Obolo region of Akwa Ibom state are displayed below for the six (6) different communities which includes the control.

Table 3.1: Values of fertility index of deforested land

Physico-chemical parameters	SD Okoroete	SD Kampa	SD Elile	SD Amadaka	SD Okomobokho	Mean	Standard deviation	Ctrl. Composite
Cation exchange capacity, Meq/100g	46.33	82.29	43.21	37.20	38.34	49.474	18.71249	48.53

Source: Field research, 2022.

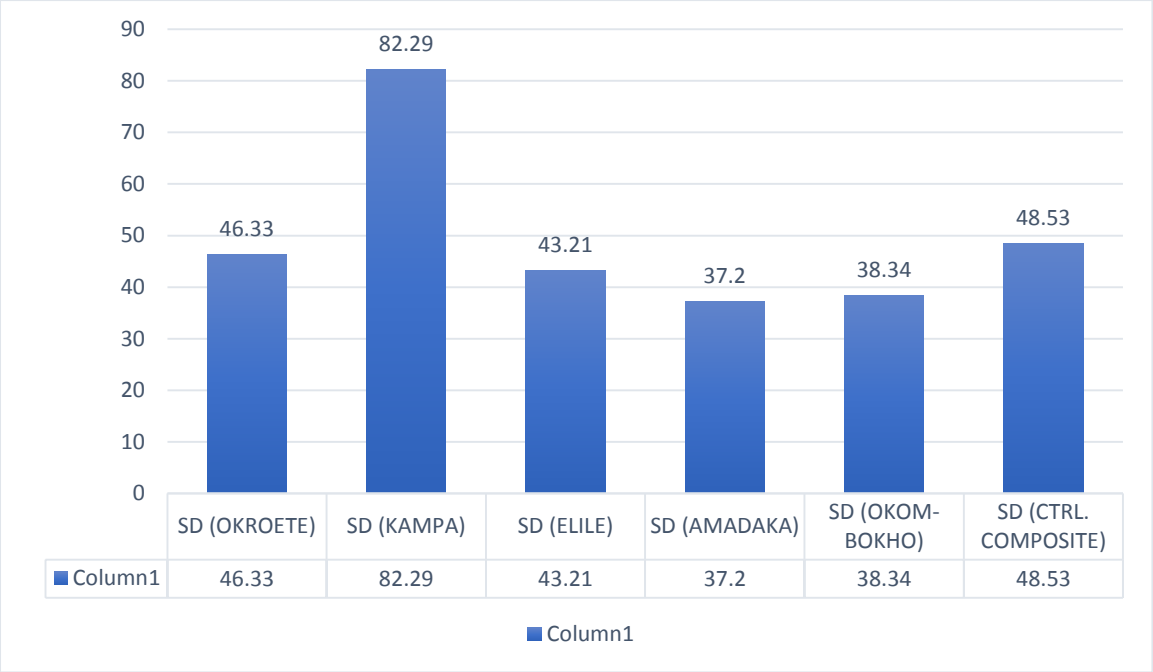


Fig. 3.1: Cation exchange capacity, Meq/100g and the corresponding values for the different locations.

Fig. 3.1 shows the pictorial display for cation in exchange capacity in meq/100g for all six (6) observed locations. The value ranges from 38.34g to 46.33g when compared with the control composite with a mean and standard deviation of 49.474 ± 18.71249.

Table 3.2: Values of macro-nutrients of deforested lands.

Macro-nutrients	SD Okoroete	SD Kampa	SD Elile	SD Amadaka	SD Okombokho	Mean	Standard deviation	Ctrl. Composite
Total Nitrogen Mg/kg	193.8	206.5	185.4	306.6	71.59	192.778	83.49514	296.5
Available phosphorous Mg/kg	9.31	8.19	1.00	3.61	9.35	6.292	3.783533	6.46
Total organic carbon (%)	1.31	0.59	<0.01	0.33	0.28	0.6275	0.4749	0.86
Total organic matter (%)	2.25	1.01	<0.01	0.57	0.48	1.0775	0.8152	1.48
Cation exchange capacity, Meg/100g	46.33	82.29	43.21	37.20	38.34	49.474	18.71249	48.53

Source: Fieldwork, 2022.

Table 3.2 shows the laboratory analytical report of the micro-nutrient under deforested land for all the six (6) observed sampled locations which include the control using standard procedure instrument like APHA 4500-NC, ASTM D2974 and APHA 4500 P.E. Four micronutrients

were analyzed with SD Okoroete showing values slightly higher when compared with the control composite sample for un deforested land for available phosphorus (9.31), total organic carbon (1.31), and total organic carbon matter (2.25).

3.2: Analysis and Testing of Hypothesis

Hypothesis one

Ho1: There is no significant variation between soil fertility index on deforestation nutrients in communities of Eastern Obolo region of Akwa Ibom State. The one sample T-test statistical tool is used in testing this hypothesis.

Table 3.3: Determination of the significant variation between soil fertility index on deforestation area in communities of Eastern Obolo region of Akwa Ibom State.

Locations	Cation exchange capacity, Meq/100g	Control composite
SD Okoroete	46.33	48.53
SD Kampa	82.29	48.53
SD Elile	43.21	48.53
SD Amadaka	37.20	48.53
SD Okombokho	38.34	48.53

Source: Fieldwork, 2022.

Decision: From Table 3.2 above, it was noticed that the one sample T-test calculation (using Excel) gave a calculated value of 0.1128 while the table value was 2.131846786 at 0.05 significant level. Since the calculated t-value of 0.1128 is lower than the t-critical one tail value of 2.131846786 at 0.05 level of significance, we accept the null hypothesis which states that there is no significance variation between soil fertility index on deforestation nutrients in communities of Eastern Obolo region.

Hypothesis Two (Ho2): There is no significant variation between soil macronutrients on deforestation area in communities of Eastern Obolo region of Akwa Ibom State.

Table 3.4: Determination of the significant variation between soil macro-nutrients on deforestation in communities of Eastern Obolo region.

Table 3.4 Model Summary[b] of Y and X_S

Model Square	R	R Square	Adjusted R Square	Std. Error of the Estimate	Est. R Change	F	df1	df2	Sig
1	.957[a]	.916	.914	.29260140	.916	609.767	5	392	.100

a. Predictors: (Constant), Total Nitrogen Mg/kg, Available phosphorous Mg/kg, Total organic carbon (%), Total organic matter (%), Cation exchange capacity, Meg/100g

b. Dependent Variable: Non-deforested soil.

Table 3.5: ANOVA[b] of Y and Xs

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	365.439	4	52.206	609.767	.100[a]
	Residual	33.561	392	.057		
	Total	399.000	399			

a. Predictors: (Constant), Total Nitrogen Mg/kg, Available phosphorous Mg/kg, Total organic carbon (%), Total organic matter (%), Cation exchange capacity, Meg/100g

b. Dependent Variable: Non-deforested soil

The analysis of variance (ANOVA) statistical tool was used in analyzing the second hypothesis. From Table 3.4, using Excel, the calculated P-value was found to be 0.000 while at 0.05 level of significance. Hence, the null hypothesis which states that there is no significant variation between soil macronutrients on deforestation area in communities of Eastern Obolo region was accepted and the alternate hypothesis rejected.

3.3: Discussion

For objective one (1), the fertility index or cation exchange capacity in meq/100g were determined as shown in Table 3.1. All the observed parameters were tabulated and compared with control composite. All the observed area is said to be within the limit for the control composite. For objective two (2), laboratory analytical report of macronutrients under deforested lands are seen in Table 3.2. Four parameters were analyzed with samples from five different locations which are SD Kampa, SD Elile, SD Amadaka, and SD Okorombokho. The observed parameters are said to be within the control composite for non-forested land. Though there is a slight variation for the location, SD Okoroete for available phosphorus mg/kg. Total organic carbon and total organic matter which was said to be higher than the control composite. SD Okorombokho also observed value higher for available phosphorus.

Also, from the calculation for the variance using T-test and ANOVA, all the two null hypothesis were accepted while the alternative hypotheses were rejected.

This implies that there is significant variation between soil fertility index on deforestation area in the region. It also implies that there is significant variation between soil micronutrients on deforestation area in the region. This implies that deforestation have affected the soil fertility and soil micronutrients in the region. The forest loss implies that wildlife and marine animals are being threatened by rapid environmental changes. These changes have implications for food security and supply of forest goods and services as fertile agricultural land is lost to urbanization and infrastructural development (FAO, 2005).

3.4: Conclusion and Recommendation

The impact of deforestation on soil properties have very strong implications for regional development planning not only in the Obolo region of Akwa Ibom State but to other regions in the Niger Delta and Nigeria in general. Therefore, for the growth and sustainable development of the forest resources of the Obolo region and other deforested regions of Nigeria, and to reduce deforestation in the region, the study recommends the following:

1. There should be proper planning, strict implementation, education as well as mitigation measures to enhance or stabilize soil properties under different land use patterns.

2. Government should reactivate the use of other sources of energy such as biogas and electricity for domestic and industrial use to minimize the use of firewood.
3. Operation cut one, plant two trees should be introduced and implemented in rural and urban regions of the state.
4. The populace should be educated and properly enlightened on the short and long-term consequences of deforestation and also sensitized on the importance of conservation.
5. There should be stringent policies for the protection of forests from deforestation to enhance and maintain good soil properties in the region.
6. The regional development planners should properly guide the natural resources managers in evaluating the pattern of deforestation. This will serve as a basis for formulating policies aimed at mitigating forest loss and by extension, biodiversity loss in the region.
7. There is the need for the government to employ more field staff for effective monitoring of forest reserves and also to promote programs that encourage afforestation in the region.
8. Laws, policies, and legislative and regulatory measures should be effectively enforced and should be such that they encourage local people and institutional participation in forestry management and conservation in the region.

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