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Plant Diversity and Nutrient Variations in Erosion Site

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ABSTRACT

Plant diversity and nutrient variations in an erosion site were studied. The parameters measured included number of plant species, frequency and density in each quadrat along 3 transects identified as transect-below, middle, and above. Soil samples were collected for determination of physicochemical properties. The results showed that 14 plant species were identified in transects-below and middle; and 13 plant species in transect-above. Generally, number of plant species (diversity) was slightly higher in transect-below than other transects and most of the plant species identified were annuals with negligible height and cover. Physicochemical analyses showed that the soil pH was neutral in transect-below and middle to slightly acidic in transect-above. Total Nitrogen was very low with a mean value of 0.01 ± 0.00% in the middle transect and 0.02 ± 0.00% in transect-below and above. Available phosphorus showed increasing trend from transect-below (18.61± 2.99 mg/kg) to transect-above (21.25± 1.23mg/kg). Effective Cation Exchange Capacity was low and invariably low Exchangeable Basic Cations were obtained in the 3 transects. Iron had a greater portion in all transects among the micronutrients. Clay and silt contents were low while sand had the highest proportion in all transects. Soil texture was sandy loam. Analysis of variance performed on the soil parameters showed that they were significant at p=0.05. The results revealed that number of plant species and plant nutrients were influenced by the processes of erosion.

Key words: *Plant Diversity, Soil Erosion, Akwa Ibom, Soil Physicochemical, Variance*

1. INTRODUCTION

The top soil regarded as a 'nutrient pool' for most plants, however, is the part of the soil which is destroyed and transported away by water or wind – a process termed soil erosion – leaving exposed the sub-soil which contain very few nutrients and which therefore cannot give adequate crop yield. Erosion is defined as the removal of soil, sediment, regolith, and rock fragments from the landscape. Most landscapes show obvious evidence of erosion. In order for erosion to occur, three processes must take place: detachment, entrainment and transport (Pidwirny, 2008). Erosion also requires a medium to move materials. Wind, water, and ice are the environmental media primarily responsible for erosion. The process of erosion stops when the transported particles fall out of the transporting medium and settle on a surface. This process is called deposition. According to Adinna (2001), the effects of soil erosion in the environment can be simply defined as environmental degradation. This means lowering of the production and other services or utility qualities of the entire landscape. Soil erosion acts on vegetation through the removal of nutrients stored in the soil; also through the removal of seeds, fragments of plants or even entire plants. Therefore, soil erosion has the potential to affect species establishment and persistence, and as a consequence, it also influences the species composition and its spatial distribution (Schlesinger *et al.*, 1990). Extensive work in erosion has been carried out especially in southeastern part of Nigeria. Landscape studies in the rainforest belt of southeastern Nigeria is important considering the spate of erosion in the area. Studies by Oti (2002), Igwe (2003) and Onweremadu (2007) have revealed the effects of erosion on plant nutrients and productivity. However, much was not done on plant species.

The significance of the study is to assess plant diversity, nutrient variation and relate the vegetation attributes with the soil properties in the erosion site.

2. MATERIALS AND METHODS

The study was carried out at Nduetong Oku in Uyo Local Government Area of Akwa Ibom State. Akwa Ibom State is situated between Latitude $4^0$31 and $5^0$30N and Longitudes $7^0$20 and $8^0$20E. It has a total land area of about 8,412km^2. The area has characteristically two seasons: dry and wet season. Dry season of the area occurs between November and April while the wet season stretches between May and October. Rainfall is heavy and ranges from 2,000mm to 3,000mm, depending on the area. Mean temperature of the area is usually uniformly high throughout the year with slight variations between 25^0C and 28^0C, relative humidity is high between 75% and 85%. The study was conducted in a gully erosion site during the raining season (DGRPUU, 2009).

2.1. Vegetation and Soil Sampling:

Systematic sampling method was used in sampling the vegetation using 2m by 2m quadrat in 3 segments of the gully site identified as Transect- Above, Middle and Below depending on the gradient. Plants encountered were enumerated and identified to species level (Cochran, 1963). The number of individuals of each species, frequency and density of species found were determined. Two (2) soil samples were obtained to a depth of 20cm in each quadrat

using soil auger, bulked together, put in properly labelled polythene bags and conveyed to the Soil Science Laboratory of the University of Uyo for analyses to determine the soil physicochemical properties. A total of 18 quadrats (5 from Transects- Above, 6 from Middle and 7 from Below), were used in the soil sampling

2.2. STATISTICAL ANALYSIS

One-way analysis of variance (ANOVA) were uses for the analysis and Duncan Multiple test were used to separate the means, using SPSS version 17.

3. RESULTS AND DISCUSSION

Verma and Agarwal (2007) pointed out that density gives an idea of degree of composition. Thus, the vegetation characteristics (frequency, density and diversity) of plant species in the erosion site reflected the species response to environmental factors. Most of the plant species were annuals with negligible heights and coverage; also most genera and families had single species (Tables 1, 2 and 3). Few plant species were dominant, for example *Chromoleaena odorata* and *Pteridium aquilinum*, suggesting that though the plant species here are influenced by run-off process, the mechanism of transmission of their propagules could favour the abundance of these species. From the analysis of variance on the soil physicochemical properties, sand, clay and iron contributed to its significance as shown in Table 4. Sand which has large voids does not retain nutrients. Thus Webster and Wilson (1980) have stated that soil texture influences the nutrient status and water holding capacity of the soil. This in turn affects plant distributions. The predominance of sand particles is as a result that runoff sieves out organic substances and fine grained materials leaving behind mere gravel in lateritic laked surfaces (Orgban *et al.*, 1999). Maineville *et al.* (2006) stated that removal of epipedal layers may lead to subsoil exposure, and consequently heavy metals concentration. This is reflected here in the values of iron (Table 4). According to Onweremadu *et al.* (2007), erosion induced degradation has a greater influence in soil pH, organic carbon and total nitrogen. In this study, organic carbon was generally low. Nitrogen (N) content is at the lower extreme; while it falls below the range in the Transect-Middle, as stated by Shukla and Chandel (2008), that N contents in surface mineral soil is about 0.02 – 0.5% and that soil N occurs as part of organic molecules. This could possibly be as a result that runoff has succeeded in washing away the top soil in which organic matter and nutrients are concentrated.

Table 1: Vegetation Characteristics of Transect – Above

Plant Species	Family	Freq. (%)	Density (Stems/ha)
Chromolaena odorata	Asteraceae	100	11000 ±2.40
Combretum zenkeri	Combretaceae	40	8500±6.54
Cyperus haspan	Cyperaceae	20	3500±3.13
Dracaena arborea	Liliaceae	20	1500±1.34
Icacina trichantha	Icacinaceae	20	1000±0.89
Ipomoea involucrate	Convolvulaceae	40	3000±1.78
Lannea acida	Anacardiaceae	20	1000±0.89
Mangifera indica	Anacardiaceae	20	500±0.44
Napoleona vogellii	Fabaceae	20	500±0.44
Penninsetum purpureum	Poaceae	20	1500±1.34
Pentaclethra macrophylla	Fabaceae	20	500±0.44
Pteridium aquilinum	Dennstaedfiaceae	40	15000±9.59
Senna alata	Fabaceae	20	1000±0.89

Table 2: Vegetation Characteristic of Middle Transect

Plant Species	Family	Freq. (%)	Density (Stems/ha)
Alchornea cordifolia	Euphorbiaceae	67	5000±2.09
Asystasia gangetica	Acanthaceae	17	825±0.80
Baphia nitida	Fabaceae	33	4150±3.20
Chromolaena odorata	Asteraceae	50	3325±1.96
Combretum zenkeri	Combretaceae	17	1250±1.22
Commelina benghalensis	Commelinaceae	17	1250±1.22
Dissotis rotundifolia	Melastomataceae	33	7500±4.69
Ipomoea involucrate	Convolvulaceae	33	2075±1.32
Pennisetum purpureum	Poaceae	17	2075±2.03
Pteridium acquilinum	Dennstaedfiaceae	67	7900±4.91
Scleria nanmanniana	Cyperaceae	17	825±0.80
Senna alata	Fabaceae	17	400±0.40
Urena lobata	Malvaceae	33	1650±1.02
Uvaria chamae	Annonaceae	33	2075±1.59

Table 3: Vegetation Characteristic of Transect-Below

Plant Species	Family	Freq. (%)	Density (Stems/ha)
Alchornea cordifolia	Euphorbiaceae	43	3550±2.22
Aspilia Africana	Asteraceae	29	3200±2.35
Chromolaena odorata	Asteraceae	86	5000±1.15
Commelina benghalensis	Commelinaceae	14	1425±1.50
Cyperus difformis	Cyperaceae	14	3550±3.77
Diplazium sammatii	Anthyricaceae	29	10000±7.65
Dissotis rotundifolia	Melastomataceae	43	7125±4.09
Fimbristylis hispidulas	Cyperaceae	29	3200±2.21
Ipomoea involucrate	Convolvulaceae	29	2125±1.57
Kyllinga erecta	Cyperaceae	14	1050±1.13
Pennisetum purpureum	Poaceae	43	7125±4.48
Pteridium aquilinum	Dennstaedfiaceae	57	8925±4.50
Schwenckia americana	Solanaceae	14	1425±1.50
Senna alata	Fabaceae	14	700±0.74

Table 4: Summary of Mean (±SE) of Physicochemical Properties of Soils in the Study Site

Parameter	Transect Above	Middle Transect	Transect Below
pH	6.53±0.03^{a}	6.63±0.05^{a}	6.76±0.02^{a}
Ec (ds/m)	0.03±0.00^{a}	0.02±0.00^{a}	0.02±0.00^{a}
Org. Carbon (%)	0.98±0.22^{a}	0.56±0.14^{a}	0.86±0.13^{a}
Total Nitrogen (%)	0.02 ±0.00^{a}	0.01±0.00^{a}	0.02±0.00^{a}
Av. P. (mg/kg)	21.25±1.23^{a}	20.04±1.58^{a}	18.61±2.99^{a}
Exchangeable Ca. (cmol/kg)	4.32±0.55^{a}	4.93±0.61^{a}	3.54±0.38^{a}
Ex. Mg (cmol/kg)	1.68±0.08^{a}	1.60±0.14^{a}	1.60±0.08^{a}
Ex. K (cmol/kg)	0.26±0.03^{a}	0.30±0.03^{a}	0.24±0.03^{a}
Ex. Na (cmol/kg	0.04±0.00^{a}	0.05±0.00^{a}	0.04±0.00^{a}
Ex. A (cmol/kg)	1.91±0.17^{a}	2.16±0.06^{a}	1.98±0.05^{a}
ECEC (cmol/kg)	8.21±0.48^{a}	9.05±0.64^{a}	7.41±0.38^{a}
BS (%)	76.22±2.93^{a}	75.52±1.87^{a}	72.03±1.43^{a}
Fe (Mg/l)	19.33±5.59^{a}	13.48±0.76^{b}	21.71±1.37^{a}
Zn (mg/l)	3.55±0.37^{a}	3.78±0.22^{a}	3.79±0.26^{a}
Cu (mg/l)	1.09±0.02^{a}	1.38±0.15^{a}	1.37±0.03^{a}
Mn (mg/l)	1.56±0.20^{a}	1.67±0.17^{a}	1.69±0.16^{a}
Pb (mg/l)	2.84±0.19^{a}	3.66±0.06^{a}	4.82±0.17^{a}
Sand (%)	77.24±1.60^{a}	83.50±0.42^{b}	80.55±0.80^{ab}
Silt (%)	4.60±0.80^{a}	5.40±0.51^{a}	3.11±0.68^{a}
Clay (%)	18.16±1.60^{a}	11.09±0.42^{b}	16.33±0.57^{a}
Soil Texture	Sandy Loam	Loamy Sand	Sandy Loam

Note: Means with same superscript are not significantly different.

Table 5: Number of Plant Species (diversity) at Point of Sampling along the 3 Transects

Quadrat	Number of plant species
1	5
2	6
3	6
4	5
5	4
6	3
7	3
8	6
9	5
10	5
11	5
12	2
13	3
14	4
15	3
16	4
17	5
18	4

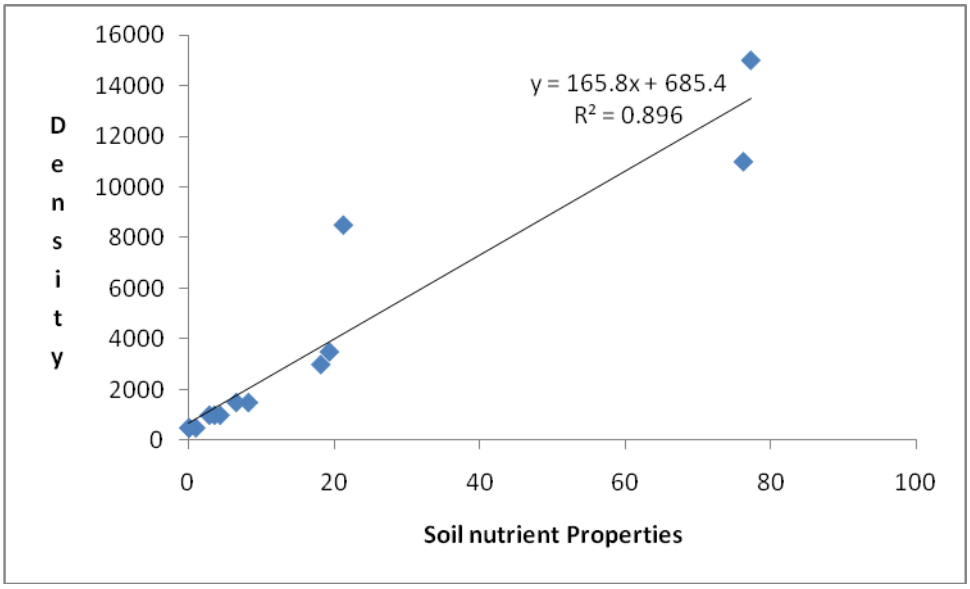

Fig. 1: Relationship between density and soil nutrient Properties in transect above

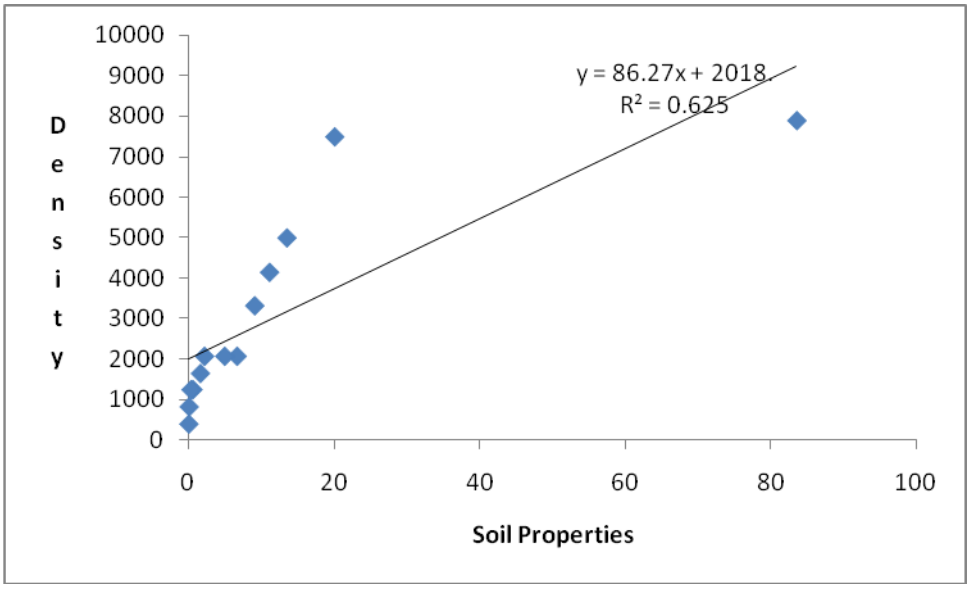

Fig. 2: Relationship between density and soil nutrient Properties in transect Middle

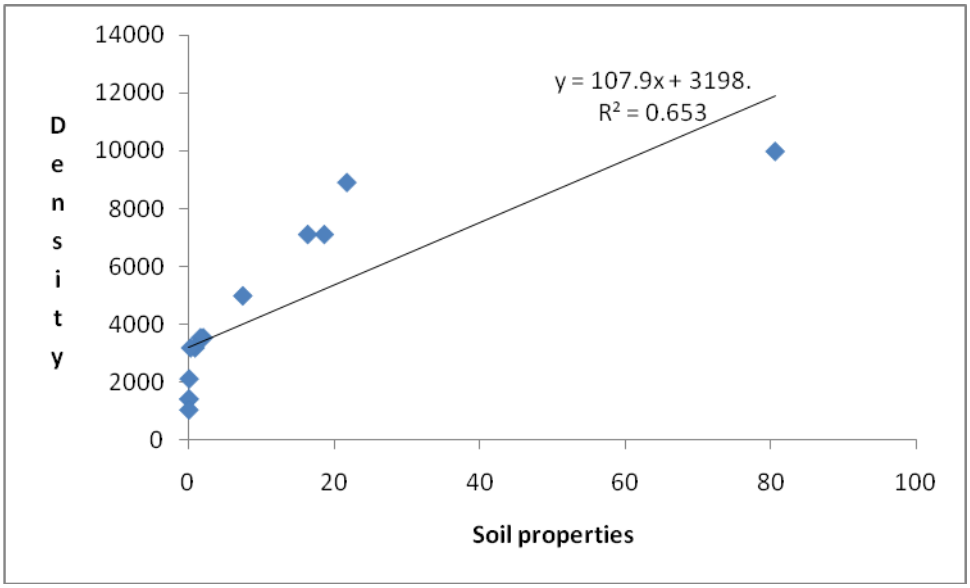

Fig. 3: Relationship between density and soil nutrient Properties in transect below

4. CONCLUSION AND RECOMMENDATION

Within the erosion site, there was poor vegetation which led to low organic matter accumulation that resulted in low concentration of nutrients. From the result, it shows that the processes of erosion influence the distribution of plant species and plant nutrients availability. Therefore, it is recommended that further studies should be carried out to check and control soil erosion in this part of the country as one of the ways to maintain ecological functions of biodiversity in general.

REFERENCES

[1]. Pidwirny, M., 2008. 'Soil Erosion and Deposition'. *In*: Cleveland, C. J. (Ed.). *Encyclopedia of Earth.* http://www.eoearth.org/article/soil_erosion_and_deposition. Retrieved 10-11-2014.

[2]. Adinna, E. N., 2001. *Environmental Hazard and Management*. Snaap Press Ltd., Enugu. 321p.

[3]. Schlesinger, W. W., Reynolds, J. F., Cunningham, G. L., Huenneke, L. F., Jarrell, W. M., Virginia, R. A., Whitford, W. G., 1990. Biological Feedbacks in Global Desertification. *Science*, 247: 103-247.

[4]. Oti, N. N., 2002. Discriminant Functions for Classifying Erosion Degraded Lands at Otamiri, Southeastern Nigeria. *Agron. Sci*., 3:34-40.

[5]. Igwe, C. A., 2002. Soil Degradation Response to Soil Factors in Eastern Nigeria. *Proceedings of the 28th Annual Conference of Soil Science Society of Nigeria at National Root Crop Research Institute*, Umudike, Nigeria. pp. 228-234.

[6]. Onweremadu, E. U., Akamigbo, F. O., Igwe, C. A., 2007. Chemical Factors in Erosion-induced Soil Degradation in Owner-managed Farms in Central Southeastern Nigeria. *Nature and Science*, 5(2): 22-29.

[7]. Department of Geography and Regional Planning, University of Uyo (2009). Akwa Ibom State Database Documentation Profile. Uyo: Ibom Press Ltd. pp. 48 – 56.

[8]. Cochran, W. G., 1963. *Sampling Techniques, 2nd Edition*. Wiley Eastern Limited, New Delhi, 413p.

[9]. Verma, P. S., Agarwal, V. K., 2007. *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology*. Schand and Company Ltd, New Delhi. 790p.

[10]. Webster, C. C., Wilson, P. N., 1980. *Agriculture in the Tropics*, 2nd Edition. Longman Group Ltd., New York. 640p.

[11]. Orgban, P. I., Babalola, O., and Vins, P. N., 1999. "Assessment of Soil Properties and Effects of Drainage and Fertilizer on Growth and Yield of Maize in South Western Nigeria''. *Int. J. of Tropical Environment*, 1(1):1-14.

[12]. Maineville, N., Webb, J., Lucott, M., Davidson, R., Betancount, O., Cueva, E., Megler, D., 2006. Decrease in Soil Fertility and Release of Mercury following Deforestation in the Andean Amazon, Napo River Valley, Ecuador. *Sci. Total Environs*, 368:88-98.

[13]. Shukla, R. S., Chandel, P. S., 2008. *Plant Ecology including Ethnobotany and Soil Science.* Schand and Company Ltd. New Delhi. 544p.