VEGETATION COMPONENTS, NUTRIENT STATUS AND SOIL CHARACTERISTICS OF HOMESTEAD GARDENS

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ABSTRACT: Nutrient status and soil characteristics were studied in Homestead Gardens in Ikot Umiang Ede in Etinan Local Government Area, Akwa Ibom State. The systematic sampling method was used to sample the vegetation in 5m x 5m quadrats. A total of 20 soil samples were collected and soil physiochemical properties were analyzed using standard analytical procedures. The results have shown that the soil was slightly acidic with pH mean value of 6.19 $\pm$ 0.04. Organic carbon, total nitrogen and potassium were low with mean values 6.55 $\pm$ 0.34, 0.57 $\pm$ 0.04 and 0.22 $\pm$ 0.003cmol/kg respectively. Among the heavy metals, iron had the highest mean value of 32.75$\pm$2.37. The soil had high sand content of 85.15 $\pm$ 0.85% and low silt and clay contents 6.58± 0.27 and 8.28$\pm$ 0.73, respectively. Plants were identified to species level. Frequency, density, height, basal area and crown cover were also determined for each species. 45 species of plants were identified in all belonging to 31 families and 42 genera. The result showed that *Dacryodis edulis* and *Musa sapientum* were the most dominant species with 25% frequency each. The density of the plant species were in the order *Musa sapientum*>*Colocasia antiguorum*>*Dacryodes edulis*>*Lasienthera africana*>*Raphia hookeri*>*Cocos nucifera*. *Artocarpus heterophylla* had the highest height while *Colocasia antiguorum* was the shortest plant. *Mangifera indica* had the highest basal area of 0.87 $\pm$ 0.11m^2/ha while *Vernonia amygdalina* had the smallest basal area of 0.001$\pm$0.0006m^2/ha. *Mangifera indica* had the highest crown cover 189.39 $\pm$ 24.34m^2/ha while *Lasienthera africana* had the smallest crown cover of 0.54$\pm$0.17m^2/ha. Linear regression of soil parameters and vegetation components showed that soil characteristics affected the abundance and distribution of vegetation components, indicating that they play a major role in plant species distribution

INTRODUCTION

Homestead garden is a type of garden that is connected to a farmhouse with adjoining building and land (Houghton, 2009) or a space that adjoins a house or estate and buildings. However, gardens are planned spaces, usually outdoors, set aside for the display, cultivation and enjoyment of plants and other forms of nature which can incorporate both natural and manmade materials (Turner, 2005). These are excellent forms of an agro forestry system. In many countries women are the main actors in home gardening and food is mainly produced for home use (Killion, 1992). Food crops rather than cash crops predominate in the homestead gardens of southeastern Nigeria and there is a diversity of tree species. Homestead gardens with their intensive and multiple uses provide a safety net for household when food is scarce. These gardens are not only important sources of food, fodder, fuel, medicines, spices, herbs, flowers construction but for materials and income in many countries, they are also important for the *in-*

situ conservation of a wide range of unique genetic resources for food and agriculture. Many homestead gardens uncultivated as well as neglected and under-utilized species could make as important contribution to the dietary needs of local communities. In addition to supplementing diet in times of difficulty, homestead gardens promote whole-family and whole-community involvement in the process of providing food. Children, the elderly, and those caring for them can participate in this infield agriculture, incorporating it with other household tasks and scheduling. This tradition has existed in many cultures around the world for thousands of years (Thomas, 1992, Heidelberg, 2006).

A garden can have aesthetic, functional, and recreational uses (Tom, 2005). The availability of plant accessible nutrients, such as nitrogen, can be influenced by tree species composition in the homestead gardens. For example, the presence of low quality litter, in terms of a high lignin content compared to nitrogen, can reduce the rate of the nitrogen release into the system to a very low level (Finzi and Canham, 1998). The large amount of litter on the soil surface of some homestead gardens support a high activity of soil macro fauna including earthworms, which improve soil physical condition such as porosity, soil structure and moisture availability. The organic residues from the litter form an important source of energy for soil fauna (Abdusalam and Sreekumar, 1991; Finzi and Canham 1998). Productivity and features of homestead gardens can be illustrated with an example from Nigeria. In the high population areas of Nigeria (> 1000 people km^{-2}), 29% of the cultivated area is in compound gardens, which produce 50% of the animal crop output. In monetary terms these gardens produce 5-10 times more income than is obtained from the distant crop fields and with returns to labor of 4 – 8 times greater (Watson, 1990; Leaky, 1998).

The hypothesis is that soil characteristics and nutrient status are the banes of soil fertility, which bring about variety of produce obtained from homestead gardens. Hence, there is need to examine the nutrient levels and physical characteristics of the homestead gardens. The specific objectives of the study are to explain the vegetation components of homestead gardens and their nutrient status and thus relate soil characteristics in the Homestead gardens to vegetation components.

MATERIALS AND METHODS

The study was conducted in homestead gardens at Etinan in Etinan Local Government Area, Akwa Ibom State (AKS). AKS is situated between Latitude $7^0$30 and $7^0$3N and Longitudes $7^0$31 and $8^0$3E. The topography is plain/flat and the surrounding lands and cultivated. The dry season of the area is between November and April while the wet season starts from May to October. Rainfall is heavy ranging from 3,000mm along the coast and decreases to 2000mm on the north fringe. Temperature is uniformly high throughout the year with slight variation between 25^0C and 28^0C. Relative humidity is high between 70% and 80%.

Vegetation and Soil sampling

Systematic sampling method was used in sampling the area (Knight, 1978), species were sampled in 5m x 5m site. A total of 20 soil samples were collected from 20 sites. Plants were enumerated and species were properly identified to the species level. Vegetation measurement includes the frequency of plant species, density, basal area, height and the crown cover of the plant species encountered. Tree height was measured with a Hagar Altimeter. Diameter at breast height was measured with a girthing tape; crown cover was obtained by the crown diameter method (Mueller Dambois and Ellenberg, 1974). In each of the quadrats two soil samples were obtained to a depth of 40cm using soil auger. The soil samples were put in plastic bags and transferred to the soil science laboratory for further treatment and analysis.

Physicochemical Analysis of Soil Samples:

Soil samples were analyzed following the standard procedures outlined by the Association of Official Analytical Chemist (AOAC, 1975). Soil pH was measured using Beckman's glass electrode pH meter (Meclean, 1965). Organic Carbon by the Walkey Black wet oxidation method (Jackson, 1962), available Phosphorus by Bray P-1 method (Jackson, 1962). The total Nitrogen content was determined by Micro-Kjeldahl method (Jackobson, 1992). Soil particle size distribution was determined by the hydrometer method (Udo and Ogunwale, 1986) using mechanical shaker and sodiumhexametaphosphate as physical and chemical dispersants. Exchange Acidity was determined by titration with 1N KCL (Kamprath, 1967). Total Exchangeable Bases were determined after extraction with 1M NH_4OAc (One molar ammonium acetate solution). Total Exchangeable Bases were determined by EDTA titration method while sodium and Potassium were determined by photometry method. The Effective Cation Exchange Capacity (ECEC) was calculated by the summation method (that is summing up of the Exchangeable Bases and Exchange Acidity (EA). Base Saturation was calculated by dividing total Exchangeable Bases by ECEC multiplied by 100. Heavy metals were analysed using Unicam 939 Atomic Absorption Spectrometer (AAS).

RESULTS

The summary of the mean vegetation attributes in the homestead gardens are represented in Table 1. The result, showed the structural characteristics of component species in homestead gardens. Table 2 shows herbs and shrubs encountered in the homestead gardens. The result showed that 45 plant species were identified from the study area, the plant species belong to 31 families and 42 genera. Among the species identified *Dacryodes edulis* and *Musa sapientum* were the most dominant with 25% frequency of occurrence followed by *Anthonotha macrophylla, Artocarpus heterophylla, Carica papaya, Citrus sinensis, Colocasia antiguorum, Elaeis guienensis, Ficus exasperata, lrvingia gabonensis, Lasienthera africana, Senna alata* and *Vernonia amygdalina* were the least with 5% frequency of occurrence. The density of the plant species encountered were in the order of *Musa sapientum>Colocasia antiguorum>Dacryodes edulis>Lasienthera africana>Raphia hookeri>Cocos nucifera. Artocarpus* h*eterophylla* was the tallest plant with a height of 20 ± 0.0m while *Colocasia antiguorun* was the shortest plant with 0.5 ± 0.08m as its height. *Mangifera indica* had the highest based area of $0.87\pm0.11m^2$/ha while *Vernonia amygdalina* had the smallest basal area of $0.001\pm0.0006m^2$/ha. *Mangifera indica* had the highest crown over of $189.39\pm24.34m^2$/ha while *Lasienthera africana* had the smallest crown cover of $0.54+0.17m^2$/ha.

Table 3 shows the summary of the mean soil parameters of the homestead gardens. The soils of the study area (Ikot Umiang Ede) were slightly acidic with low nutrient values. The texture of the soil was sandy loam.

Relationship between Vegetation Characteristics and Soil Parameters

Figures 1, 2, 3, 4 and 5 showed relationships between soil parameters and vegetation attributes (Density, Frequency, Height, Basal Area and Crown Cover). The relationship between the variables showed positive results indicating that as the soil nutrients increases the vegetation attributes also increased. But it was inversely positive for basal area, indicating that basal area needs just little amount of the soil nutrients for its species distribution. The positive results between these variables shows that the soil parameters play a major role in the plants species distribution

Table 1: Summary of mean (±) vegetation attribute of homestead garden

Plant Species	Authors	Family	Frequency (%)	Density (stems/ha)	Height (m)	Basal area (m^2/ha)	Crown cover (m^2/ha)
Anthonotha macrophylla	P. Beaur	Fabaceae	5	80 ± 0.00	8 ± 0.00	0.03 ± 0.00	132.67 ± 0.00
Artocarpus heterophyllus	Linn	Moraceae	5	80 ± 0.00	20 ± 0.00	0.81 ± 0.00	94.99 ± 0.00
Carica papaya	Linn	Caricaceae	5	80 ± 0.00	120 ± 0.00	0.05 ± 0.00	7.07 ± 0.00
Citrus sinensis	L. osbeck	Rutaceae	5	80 ± 0.00	5 ± 0.00	0.01 ± 0.00	3.14 ± 0.00
Cocos nucifera	Linn	Arecaceae	20	320 ± 0.00	9.25 ± 2.14	0.18 ± 0.05	47.25 ± 9.69
Colocasia antiguorum	L. Schott	Araceae	5	1600 ± 0.00	0.54 ± 0.08		2.44 ± 0.91
Dacryodes edulis	H. S. Lam	Burseraceae	25	480 ± 0.20	8.9 ± 1.18	0.07 ± 0.02	31.53 ± 8.24
Dannethia tripetala	G. E. Schatz	Annonaceae	10	160 ± 0.00	9 ± 2	0.03 ± 0.01	12.76 ± 3.14
Elaeis guinensis	Jacq	Palmae	5	80 ± 0.00	10 ± 0.00	0.76 ± 0.00	94.99 ± 0.00
Eugenia owerriensis	Linn	Myrtaceae	10	160 ± 0.00	12.5 ± 1.5	0.14 ± 0.05	59.37 ± 35.62
Ficus exasperate	Vahl	Moraceae	5	80 ± 0.00	15 ± 0.00	0.20 ± 0.00	94.99 ± 0.00
Irvingia gabonensis	O'Rorke Baill	Irvingaceae	5	80 ± 0.00	15 ± 0.00	0.35 ± 0.00	122.66 ± 0.00
Lasienthera africana	Sofowora	Icacinaceae	5	480 ± 0.00	1.35 ± 0.08	0.002 ± 0.0004	0.54 ± 0.17
Mallotus oppositifolius	Mull. Arg	Euphorbiaceae	10	160 ± 0.00	5.5 ± 0.5	0.01 ± 0.01	7.27 ± 2.36
Mangifera indica	Linn	Anacardiaceae	10	160 ± 0.00	16.5 ± 1.5	0.87 ± 0.11	189.39 ± 24.34
Musa paradisiacal	Linn	Musaceae	10	160 ± 0.00	3.05 ± 0.95	0.04 ± 0.02	3.14 ± 0.00
Musa sapientum	Linn	Musaceae	25	2480 ± 2.63	4.18 ± 0.25	0.012 ± 0.003	9.98 ± 1.87
Raphia hookeri	P. Beau V.	Arecaceae	20	400 ± 0.25	11.4 ± 1.4	0.20 ± 0.06	11.4 ± 1.4
Senna alata	Linn	Fabaceae	5	80 ± 0.00	5 ± 0.00	0.02 ± 0.00	9.62 ± 0.00
Vernonia amygdalina	Schreb	Asteraceae	5	160 ± 0.00	2.5 ± 0.5	0.001 ± 0.0006	1.5 ± 0.27

Table 2: Herbs and shrubs encountered in the homestead garden

Species	Author	Family
Abelmoschus esculentus	L moench	Malvaceae
Annanas comosus	(L) merrill	Bromeliaceae
Ageratum conyzoides	Linn	Asteracase
Asphilia africana	Petit Thouars	Asteraceae
Baphia nitida	Lodel	Fabaceae
Capsicum annum	Linn	Capsiceae
Calopogonium mucunoides	Desv	Fabaceae
Costus afer	Ker-Gawl	Costaceae
Chromolaena odorata	l. King & H. E. Robins	Asteraceae
Commelina	Linn	Commelinaceae
Eremomastak polysperma	Benth	Diosioreaceae
Glyphaea brevis	Spreng	Tiliaceae
Gnetum africanum	k. Schum	Gnetaceae
Heinsia crinata	(Afzel G. Taylor)	Rubiaceae
Justicia insularis	T. Andres	Acanthaceae
Larpotea ovalifolia	Schumach	Urticaceae
Lonchocarpus cyanescens	(Siebold & Zucc)	Urticaceae
Lonchorcarpus griffonianus	(Baill) Dunn	Fabaceae
Manihot ultilisima	Stephen K	Euphorbiaceae
Pandiaka involucrata	Hook. F	Amaranthaceae
Pteris excelsa	Nobi	Orliczkowate
Rauvolfia vomitoria	Afzel	Apocynaceae
Telfairia occidentalis	Hook. F	Curcubitaceae
Urena lobata	Linn	Malvaceae

Table 3: Mean (± SD) physical and chemical properties of soil in homestead garden of Ikot Umiang Ede, Etinan L. G. A. Akwa Ibom State.

Parameters	Unit	Mean
pH		6.19 ± 0.04
EC	dms^{-1}	0.04 ± 0.003
Organic Carbon	%	6.55 ± 0.34
Total Nitrogen	%	0.57 ± 0.04
Available Phosphorus	$mgkg^{-1}$	65.64 ± 4.02
Ca	cmol/kg	6.12 ± 0.26
Mg	cmol/kg	2.41 ± 0.12
Na	cmol/kg	0.09 ± 0.002
K	cmol/kg	0.22 ± 0.03
EA	cmol/kg	1.54 ± 0.02
ECEC	cmol/kg	10.33 ± 0.40
B. Sat	%	85.05 ± 0.92
Cu	mg/kg	4.45 ± 0.24
Zn	mg/kg	6.27 ± 1.19
Mn	mg/kg	12.25 ± 0.35
Pb	mg/kg	4.94 ± 0.30
Fe	mg/kg	32.75 ± 2.37
Sand	%	85.15 ± 0.85
Silt	%	6.58 ± 0.27
Clay	%	8.28 ± 0.73
Soil Texture	Loamy sand	Loamy sand

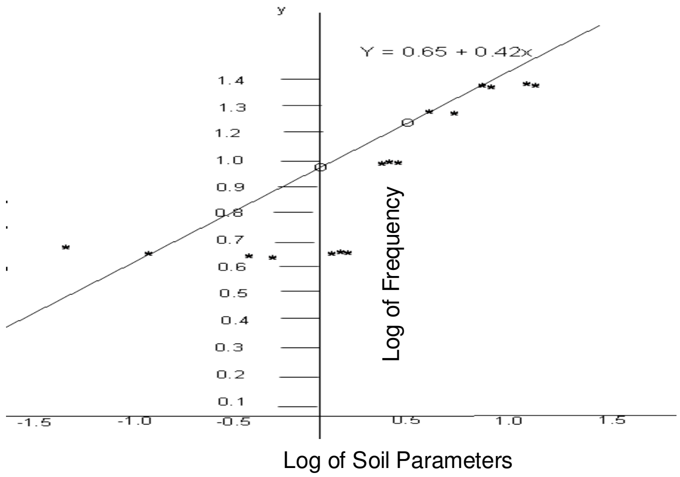

Figure 1: Relationship between plants frequency and soil parameters

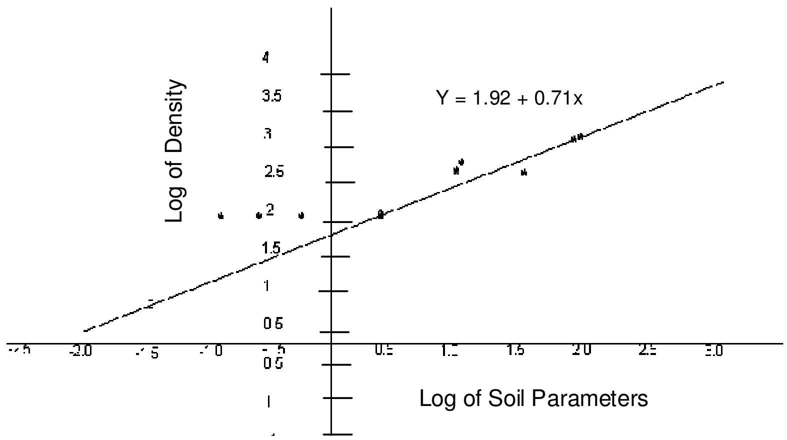

Figure 2: Relationship between plants density and soil parameters

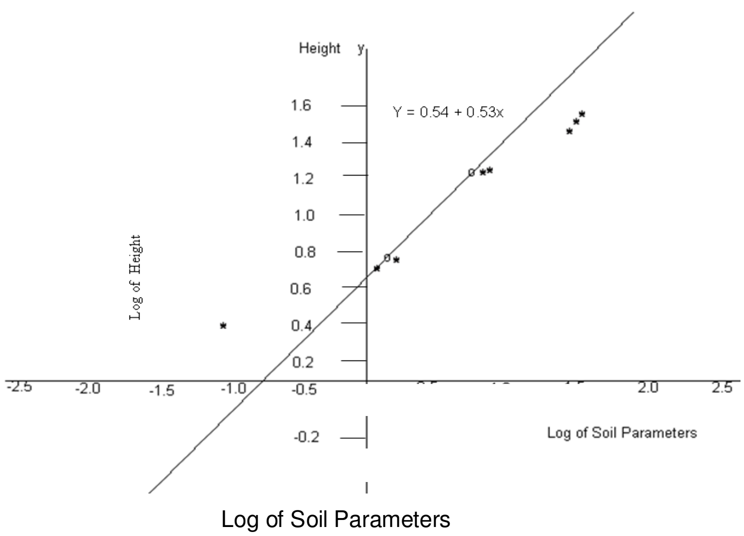

Figure 3: Relationship between plants height and soil parameter

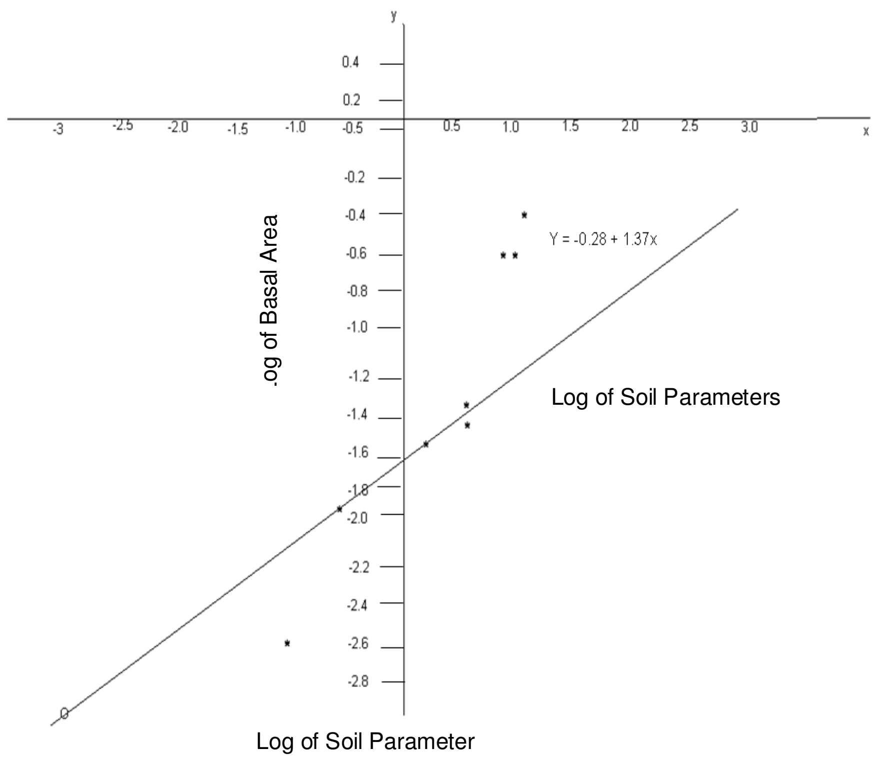

Figure 4: Relationship between plant basal area and soil parameters

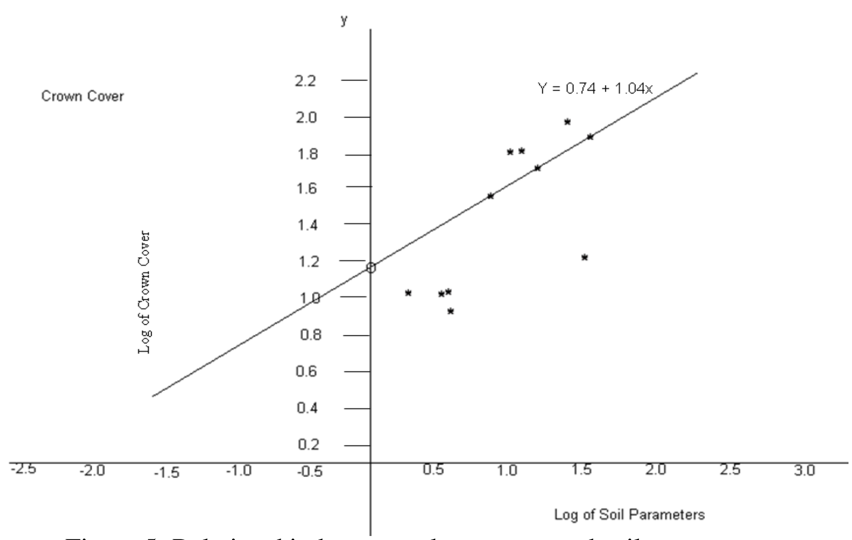

Figure 5: Relationship between plant crown and soil parameters

DISCUSSION

The results of the soil analysis showed that the nutrient status of the homestead gardens of Ikot Umiang Ede was low. However, there was much diversity in plant species composition in the homestead gardens. Thus, the high level of plant species present in the garden could have led to the reduction of the nutrients in the garden soil due to the high level of competition for nutrients. The low nutrient status in the homestead gardens could also be attributed to leaching in the soil of the gardens, even though the nutrient status was supposed to be high due to the various anthropogenic activities around the homestead gardens.

The structural characteristics of the homestead gardens are presented in Table 1. It shows that the vegetation variables varied considerably. Altogether, the variability in the values of height, basal area, frequency and crown cover of the homestead gardens portray the developmental stages of the gardens.

The summary of soil analysis had revealed that the soil was dominated by sand followed by clay while silt ranked last. Texturally, the soil was loamy sand. These combined to influence other soil properties in the soil of the garden. The soil of the homestead gardens was slightly acidic, affecting the nutrient status of the soil with low concentrations of plant nutrient. Sandy soil holds less organic matter than clay. The clay fraction is a source of plant nutrient. Clay plays a cementing role between mineral particles and enhances soil nutrient holding capacity. Thus, the low content of clay in the soil must have contributed to low cation contents. Webster and Wilson (1980) agreed with this fact and stated that soil texture influences the nutrient status and water holding capacity of the soil pointing out that soil texture also affects the presence of the soil nitrogen contents. The acidic nature of the soil results in low values of the macro-elements. Loamy soil being less fine soil contains fewer nutrients as observed in this study. The percentage of organic carbon present reflected the level of humus contents in the soils, this could be attributed to decomposition of dead roots, trunks, branches and leaves under the action of various types of soil bacteria and fungi. Available phosphorus was high and could have been due to human activities. There was also high concentration of iron mainly due to anthropogenic activities i.e. dumping of refuse, kitchen ash etc due to the close proximity of the homestead gardens to homes. The low ECEC of the soil supported that the homestead gardens of Ikot Umiang Ede has a potential low sink for cations particularly sodium, potassium and other soil nutrients. Trace elements (Mn and Cu) were low.

Regression is a biometric method that obtains an indication as the whether there is any interrelationship or association between variables. The soil characteristics and the homestead gardens vegetation are interrelated as shown by the scattered diagrams of soil properties and vegetation parameters, (Figure 1-5). It discovers the nature of the association between there variables. Soil parameters showed direct influence on frequency as it related positively with it, this showed that as soil parameters increased the frequency of occurrence of plant species also increased. The soil parameters also showed a direct influence on height, crown cover and density indicating that the soil parameter plays a major role in their distribution. However, for plant basal area the relationship was inversely positive. Regression plays a role by providing estimation technique for determining the form of relationship best suited for the patterns exhibited by the measured data. Nevertheless, regression analysis of the homestead gardens revealed strong relationships between the soil nutrient and vegetation components. Thus, the relationship found to exist between vegetation components and soil parameters in this study is an indication that the vegetation components are dependent on the soil parameters.

CONCLUSION AND RECOMMENDATION

The nutrient status and soil characteristics, (pH, nutrients and soil texture (sand, salt and clay) of the soil have been observed to have a major impact on vegetation nutrition, growth and distribution. The positive interactions of the vegetation parameters with the soil properties indicated the importance of soil properties in the ecosystem. The high composition of plants species observed in the homestead gardens has revealed that, nutrient loss in the soil could have resulted from leaching and high competition for nutrients amongst the plants species.

The information obtained from this research has shown that there could be nutrient loss in gardens even when the anthropogenic activities around the homestead garden are supposed to augment the nutrient status of the soil. Thus, it is recommended that measures should be taken to prevent leaching in homestead garden soil, and to increase and conserve organic matter since it is an important component that enhances soil fertility by natural regeneration, because homestead gardens provide rich medium for food production.

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