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Ecological and Phytosocio-Economic Assessment of Undergrowth in a Community-Owned Rainforest Reserve in Akwa Ibom State, Nigeria

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ABSTRACT
Sustainable natural forest management for multiple production of forest goods cannot be realized without quantitative and qualitative ecological data on the constituent plant species, particularly, those producing socio-economically valuable products. Accordingly, ecological survey of sundergrowth species producing edible and medicinal items in a community-owned rainforest reserve was carried out using transect and quadrat sampling system. Data collected were analysed to determine the population density per/ha for each undergrowth species, and dominance concentration index (cover over space) of each plant life-form was also determined. Thirty-eight (38) species were encountered with the distribution as follows: tree seedlings – 11, shrubs – 11, herbs – 12 and climbers – 4. The highest sum total population density of 1039 per/ha was obtained by the herbs, while the least of 39 per/ha was recorded for the climbers. Similarly, herb life-form had the highest dominance concentration of 0.5906, while climber life-form had the least of 0.0008. The edible and medicinal products from the undergrowth species vary from fruits, seeds, leaves, barks, tubers, roots and rhizomes. Drawing on the results, it is concluded that the forest should be managed for the production of multiple forest goods as against the wood or timber alone management objective.
Keywords: *Rainforest, Undergrowth, Non-timber products, Edible, Medicinal, Sustainable management.*

INTRODUCTION
A tract of forest is, indeed, a composite of natural resource of diverse benefits to man. However, more often than not, the value of a tract of forest is only estimated from the population density or standing volume of timber trees present, while much more valuable non-timber forest produce, like edible and medicinal fruits, seeds, nuts, leaves, flower, barks, twigs and livestock-fodder are ignored (Udo *et al.*, 2009, Olajide and Etigale, 2017). This is absolutely erroneous. The predominant natural forest type in Nigeria is rainforest. Other natural forest formations are fresh-water swamp forest and mangrove forest. The Nigerian rainforest is an integral part of the world's tropical rainforest, which has been adjudged the most biologically diverse ecosystem on earth (Gullespie *et al.*, 2004 and ITTO, 2011). The rainforest covers approximately 95,372 km^2 of Nigerian landmass of 983,213 km^2 (FAO, 2010 and 2011). Not until recently, the Nigerian rainforest has been exclusively managed for timber production. Consequently, vast areas of rainforest poorly stocked with desirable timber tree species, but richly stocked with other plant life-forms, which produce valuable non-timber products had been converted to monoculture forests of mostly fast-growing exotic tree species, like *Gmelina arborea*, *Tectona grandis* and *Eucalyptus* spp. That have caused a great diminution of drastically biodiversity richness of the rainforest area (CTA, 2009).

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The rainforest is now commonly occurred in patches, consequence of widespread deforestation (Akpan-Ebe, 2015). In contrast to timber exploitation, exploitation of non-timber products causes imperceptible perturbation to the rainforest ecosystem. Non-timber forest products are particularly important part of multiple-use strategies, because they increase the range of income generating options of forest-dependent communities and traders in forest goods while avoiding some of the ecologically costs of timber cutting (Ford Foundation, 1998; Ella and Domingo, 2014, Udo, 2016). Incomes generated from most of the non-timber forest products do not get entered into the national economic ledger to calculate the actual total contribution of forestry of the gross domestic products (GDP). The Nigerian rainforest has been widely degraded, denuded and destroyed consequences of indiscriminate logging, which paved way for other agents of forest destruction. A great number of constituent undergrowth flora of rainforest ecosystem, which are cornucopia sources of food, medicine and fodder for livestock extinction. This paper, therefore, is a report of a study on ecological assessment of undergrowth species of food, medicine and fodder in a community managed rainforest estate in Akwa Ibom State, Nigeria. It is hoped that the information obtained would help sustainable multiple value management of the remaining tracts of Nigerian rainforest.

MATERIALS AND METHOD

Study Area

The study was carried out in Ikot Efre-Itak Community Forest in Ikono Local Government Area of Akwa Ibom State, Nigeria. The forest is a secondary rainforest that covers an area of 29.6 ha. The area lies between latitudes 5°00' and 5°23'N, and longitudes 7°40' and 7°56'E (Fig. 1 and 2). The mean annual rainfall of the area is 2400mm, while the mean minimum and maximum temperatures are 25°C and 30°C respectively. The mean relative humidity of the area is 83%. The soil is predominantly silt-loam.

Data Collection

Four 200m line transects were laid randomly, at 5m away from the main access route, into the forest. Fifty quadrats of 5m x 5m were laid alternatively at randomly selected points along each transect. The plants deemed undergrowth were tree seedlings, herbs, shrubs and climbers. Accordingly, the undergrowth species producing non-timber products were identified and enumerated in all the quadrats with the aid of two forest taxonomists and four resident natives of the community with ages ranged between 55 and 62 years. The sum of the areas of all the quadrats enumerated was 5000m^2 (0.5ha). The data were collected during the rainy season of year 2017.

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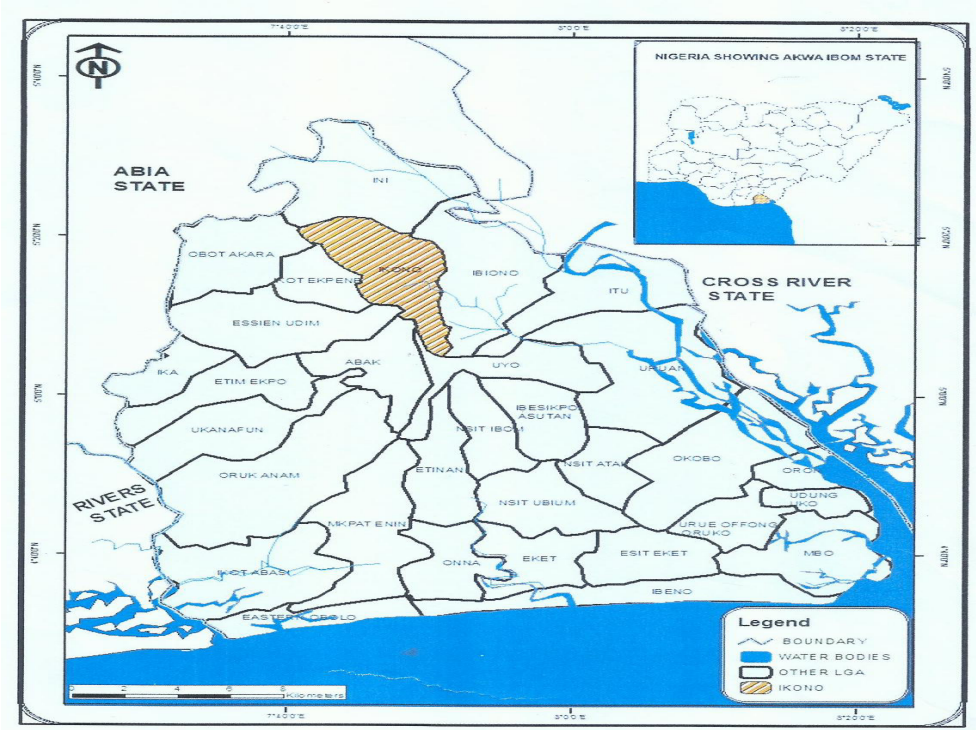

Figure 1: Map of Akwa Ibom State showing Ikono Local Government Area

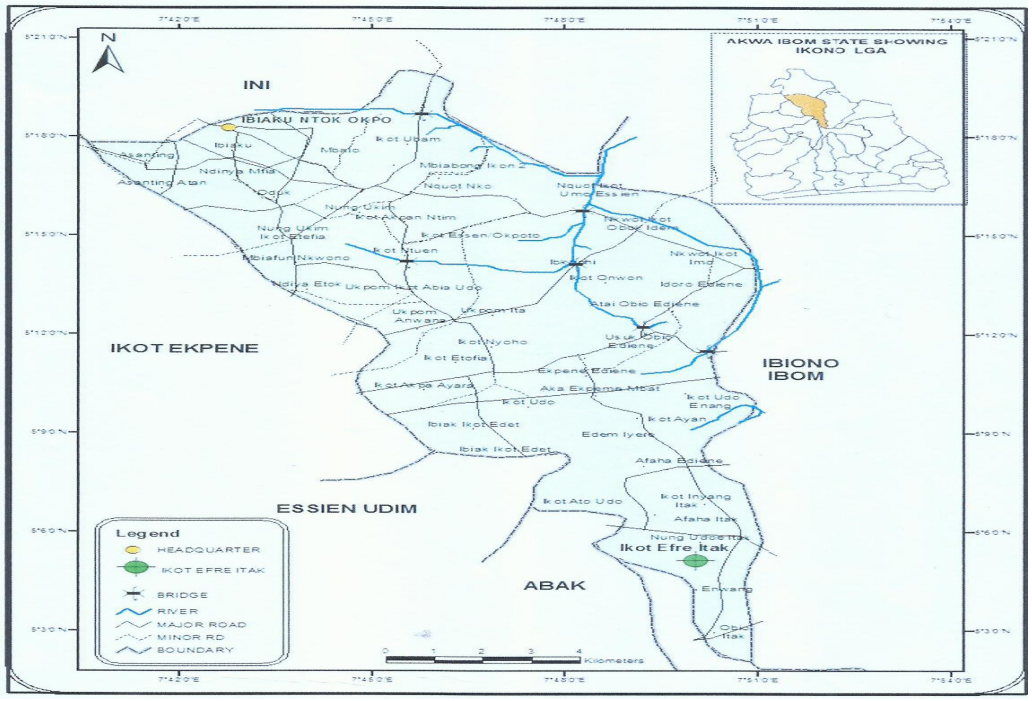

Figure 2: Map of Ikono Local Government Area indicating Ikot Efre Itak Village.

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Data Analysis

The enumerated undergrowth species were classified into four life-forms of tree seedling, shrub, herb and climber. The population density of each plant species per hectare was determined from its population in the total area of all the quadrats enumerated, which was 0.5 ha. Moreover, the sum total of population density (per/ha) of individual species in each life-form was computed. Also, dominance concentration, which expresses plants' cover over space in the forest, was determined for each life-form using the function of Pielou (1969) as applied by Knight (1975), Bhandar (2003) and Udo *et al* (2012). The function is expressed as:

$$C = -\sum_{i=1}^{x}\left(\frac{N_i}{N}\right)^2$$

Where,

C = Dominance concentration
N_i = Population density of the life-form i
N = Population density of all the life-forms.

RESULTS

Thirty-eight (38) undergrowth species producing various edible and medicinal items were encountered. The distribution of the number of species among the life-forms is as follows: tree-seedlings: 11; shrubs: 11; herbs: 12 and climbers: 4 (Table 1). Under tree-seedling's life-form, *Cola millenii* had the highest population density of 25 per/ha, while *Canarium schweinfurthii, Dacryodes edulis, Garcinia kola, Pycnanthus angolensis* and *Spondia mombin* had the least of 1 per/ha apiece (Table 1). The highest population density of 47 per/ha was recorded by *Sysepalum dulcificum*, while *Araliopsis soyauxii* had the least of 2 per/ha under shrubs (Table 1). *Nephytytis constrita* had the highest population of 323 per/ha while *Melastomastrus capitatum* had the least of 4 per/ha under the herb life-form (Table 1). Under the climber life-form, *Icacina trichanta* had the highest population density of 24 per/ha, while *Abrus precatorius* had the least of 1 per/ha (Table 1). The highest sum total population density of 1039 per/ha was computed for the herb life-form, while the least of 39 per/ha was for the climber life-form (Table 1). Herbs have the highest dominance concentration of 0.5906, while climbers have the least of 0.0008 (Table 2). The edible and medicinal products from the species vary from fruits, seeds, leaves, barks, tubers, roots and rhizomes (Table 3).

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Table 1: Population density of undergrowth species of edible and medicinal products in Ikot Efre Itak Community Forest, Akwa Ibom State, Nigeria

S/N	Species	Population density (ha^{-1})
	Canarium schwinfurthii	1
	Cola argenta	2
	Cola millenii	25
	Dacryodes edulis	1
	Garcinia kola	1
	Pentaclethra macrophylla	14
	Petersia africanum	15
	Pycnanthus angolensis	1
	Spondia mombin	1
	Sterculia tragacentha	3
	Vetex doniana	5
	Total	**69**
	Shrub	
	Aralopsis soyauxii	2
	Genestis ferruginea	22
	Lasienthera africanum	21
	Maesobotrya dusenii	7
	Mallotus oppositifolius	3
	Microdermis puberula	33
	Rauvolfia vomitoria	6
	Rothmania hispida	29
	Sorindeia mildbrieadii	16
	Sysepalum dulcificum	47
	Uvaria chamae	19
	Total	**205**
	Herbs	
	Acanthus montanus	33
	Afromomum melegueta	44
	Afromomum sceptrum	16
	Anchomanes difformis	56
	Costus afer	15
	Laportea aestuans	31
	Marantochloa cuspidata	30
	Melastomastrus capitatum	4
	Nephytytis constrita	323
	Palisota hirsota	162
	Physalis angulata	241
	Piper umbellacum	84
	Total	**1039**
	Climber	
	Abrus precatorius	1
	Icacina trichanta	24
	Lonchocarpus cyanescens	3
	Smilax anceps	11
	Total	**39**

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Table 2: Dominance concentration of undergrowth life-forms in a community-owned rainforest reserve in Akwa Ibom State, Nigeria

Life-form	Dominance concentration
Tree seedlings	0.0026
Shrubs	0.0230
Herbs	0.5906
Climber	0.0008

Table 3: Undergrowth species producing edible and medicinal items in Ikot Efre-Itak Community Forest, Akwa Ibom State, Nigeria

S/N	Species	Products
	Tree-seedling	
	Canarium schweinfurthii	Edible fruit medicinal leaves, roots and bark
	Cola argentia	Medicinal leaves, edible fruit
	Cola millenii	Medicinal bark and roots
	Dacryodes edulis	Edible fruit
	Garcinia kola	Edible seed, medicinal leaves, bark and roots
	Pentaclethra macrophylla	Edible seeds
	Petersia africanum	Medicinal leaves
	Pycnanthus angolensis	Medicinal bark
	Spondia mombin	Edible fruit, livestock-fodder
	Sterculia tragacentha	Edible young leaves
	Vitex doniana	Edible fruit
	Shrubs	
	Araliopsis soyauxii	Livestock fodder
	Gnestis ferruginea	Edible fruit
	Lasienthera africanum	Edible and medical leaves
	Maesobotry adusenii	Edible and medicinal leaves
	Mallotus oppositifolius	Livestock fodder
	Microdermis puberula	Edible leaves and livestock fodder
	Rauvolfia vomitoria	Livestock fodder
	Rothmania hispida	Medicinal leaves
	Sorindeia mildbrieadii	Edible seeds
	Sysepalum dulcificum	Edible fruit
	Uvaria chamae	Edible fruit
	Herb	
	Acanthus montanus	Medicinal leaves
	Afromomum melegueta	Medicinal leaves
	Afromomum sceptrum	Edible fruit and pulp, medicinal rhizome
	Anchomanes difformis	Medicinal leaves
	Costus afar	Medicinal rhizome
	Laportea aestuans	Medical leaves and root
	Marantochloa cuspidata	Livestock fodder
	Melastomastrus capitatum	Edible fruit and medical leaves
	Nephytytis constrilla	Medicinal leaves
	Palisota hirsota	Medicinal leaves and livestock fodder
	Physalis angulata	Medicinal leaves
	Piper umbellacum	Medicinal leaves
	Climber	
	Abrus precatorus	Medicinal leaves and seeds
	Icacina trichanta	Edible fruit
	Lonchocarpus cyanescens	Medicinal leaves
	Smilax anceps	Edible tuber

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DISCUSSION AND CONCLUSION

The presence and preponderance of an undergrowth species in a rainforest ecosystem is a function of availability of its seeds or propagule, favourable micro-sites and micro-climate. Micro-sites of different sizes are created at the forest floor due to natural and artificial perturbations, like death of big old trees and felling of trees, which create canopy-gaps of different sizes. Different micro-sites provide niches for different undergrowth species. Accordingly, the variation in the population densities of the undergrowth species in this study can be ascribed to the availability of different niches that support their growth. The generally high population density of the herb life-form implies extreme disturbance of the forest occasioned by timber exploitation which created large canopy-gaps for their proliferation. Undergrowth population density is usually low in a typical pristine or slightly disturbed tropical rainforest. The results of this study agreed with Udo *et al.* (2009) which reported high population density of valuable herbs large canopy-gaps than in small canopy-gaps in a communal managed rainforest in Akwa Ibom State, Nigeria. Similarly, Oni (2010) recorded high population densities for many undergrowth species of socio-economic importance in an intensively logged area of a rainforest in Southwest Nigeria. The results of this study with respect to the sequence of the sum total population densities and dominance concentration of the life-forms, which indicated herb life-form having highest values and climbers the least, agreed with the findings of the earlier studies on a rainforest reserve in Cross River State and two community forests in Akwa Ibom State, Nigeria (Udo *et al.* 2012; Olajide and Udo, 2014). The highest dominance concentration of herbs implies that the forest is characterised by many wide canopy-gaps consequence of intense disturbance which favour the growth of the herbs. Sustainable management a tract of rainforest must be holistic in approach so that trees and other plant-forms producing socio-economically valuable non-timber products are managed in accordance to their required ecological requirements at any stage of ecological succession of the forest. With the very high population densities of most herb and shrub species, which are the permanent residents of undergrowth layer of rainforest, the community-owned rainforest should be sustainably managed for production of multiple produce or product as against timber alone management.

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