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The Allure of Flora Species Diversity in the Tropical Rainforest Ecosystem: The Need for Concern in a Global Context

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Abstract- There is no doubt that the tropical rainforest and its floristic richness is being faced with enormous challenges. The rainforest is being destroyed by man for various purposes – agriculture, urbanization, fuelwood gathering and logging among others. Also, the increasing trend in the population structure of the people inhabiting the rainforest area has contributed significantly to its destruction. Thus, considering the inestimable value of the rich flora diversity of the rainforest, this paper therefore using relevant secondary sources of data tried to examine the rate of loss of the rainforest ecosystem and its rich flora diversity as well as examining the various forms of utilization of the flora species by the local people inhabiting the rainforest. So that their destruction becomes a very serious concern as there seem to be little or no effort to conserve these flora species for future generation.

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I. Introduction

Tropical rainforest is a term coined by Schimper (1903) in his great classic work 'Plant Geography'. His definition of rainforest was green hygrophilous in character at least 30m high rich in thick-stemmed lianes, and in woody as well as herbaceous epiphytes. Since then, this term has become so common that it can not easily be replaced. Myers (1988) defined tropical rainforest as evergreen or partly evergreen in areas receiving not less than 100mm of precipitation in any one month for two out of three years with mean annual temperature of more than 4^0c and frost free. The difficulty of drawing up worldwide definitions led Myers (1988) to consider the absence of seasonality as more critical than overall precipitation.

Despite the multifarious views of what constitute rainforest, a number of salient issues stand out that are quite acceptable in any given situation. That rainforest is conceptualized with the framework of high rainfall and characteristically evergreen vegetation and that it lies between the two tropics cancer in the north and Capricon in the southern hemisphere.

In the eighteen century, hundreds of scientists and natural philosophers set off from Europe to explore the tropical unknown. Distinct from earlier adventures, conquerors, and pirates, they had as their primary goals the discovery, documentation and the understanding of the diversity and abundance of tropical nature. The figure who best united these scientific concerns with artistic world was Baron Alexander Von Humboldt (1796-1859). In essence, factual accounts of tremendous diversity of life forms piqued the curiosity of biologists living in temperature land where nature had long seemed somewhat subdued. Nearly every ship returning from equatorial lands brought proof of the existence of previously unanticipated biological diversity (Putz and Holbrook, 1988). Naturalists accounts and illustrations like that of Goose, gave the public the impression of the tropics as a land teeming with life. In essence, biological diversity is one of the true riches of the tropics that have long attracted scientists. Many major developments in anthropology, ecology and systematics are based on the discoveries of the diversity of life forms made in the tropics. A common vision of tropical forest is that they are lands of biological marvels, sources of sociological insights and places where scientific reputations can be held for a song and some sweat (Putz and Holbrook, 1988).

Based on this curiosity to explore the area, many scientific studies have been undertaken in the tropical rainforest with the view to assessing the floristic richness of the area. For example, Richards (1952) study in Cameroon revealed a total of 109 species of 30m girth in Cameroon. Pore (1968) discovered 375 tree species belonging to upper canopy in 23ha of forest in Malaya, Granbrok (1988) estimated about 7900 plants in 1400 forest (28 endemic) in Malaya peninsula, Gentry (1987) noted 365 vascular plants in Riopulanque, Ecuador; Mabberley (1992) reported 6100 plant species in Madagascar and Okpiliya (2004) identified 91 flora species in 18 plots measuring 100m by 100m in six forest enclaves in Boki, Nigeria. Also, in Brunei Sastrapradja (1988) noted a total of 760 plant species in a plot measuring 45 hectares and 60 plants species in a plot of 2.5 acres in Sumatra.

It is not surprising therefore that considering the large numbers of flora species in the tropics, in the same manner, they are threatened as the tropical rainforest habitats are altered or destroyed for various purposes. We are made to understand that between 1990 and 2015, about ten percent of the flora of the tropical rainforest will become extinct, Briggs (1985). If this condition persists, then the basis for human existence will ultimately be questionable. It is this

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background that has necessitated this paper so that arising from here; human being can begin to appreciate the need to think on how to do little harm to the rich diversity of the tropical rainforest because of their relative importance in life sustenance.

II. Location of Tropical Rainforest

The tropical rainforest is found in all the three tropical land areas – America, African and Indo-Malaya. Most extensive are the American or neo tropical rainforest, about half the global total $4x10^6km^2$ in area and 1/6 of the total broad-leaf forest of the world. These occur in the parts of which the largest lies in the Amazon and Orinoco Basins. Second is a block, which lies across the Andes on the pacific Coasts of Equador and Colombia, extending northwards through Middle America as far as Venecruz in Southern Mexico (19^0N). The Atlantic Coast of Brazil has a third block extending to the west towards Rio de Janeiro (23^05).

The second largest block of tropical rainforest is found in the Eastern tropics and is estimated to cover $2.5x10^6km$. It is concentrated in the Malay Archipelago, the region known to Botarists as Malesia. Indonesia occupies most of the Archipelajo and is second to Brazil in the amount of rainforest it possesses. The Malesia forest extends northwards up the Malay Peninsula into Continental South East Asia, Burma, Thailand and Indo-China. There are further outliners in South West Srilanka.

Africa has the smallest block of tropical rainforest, $1.8x10^6km^2$. This is centered on the Congo Basin with outliners in East Africa. It extends as a central strip into West Africa. There are isolated pockets of rainforest on the east coast of Madagascar.

III. Rates of Disappearance of Tropical Rainforest

The tropical rainforest has been disappearing at an alarming rate for centuries now. As they disappear, so does the rich diversity of floral species found in them. Table 1 below shows the rate of tropical rainforest between 1981-1990.

Table 1 : Annual loss of tropical moist forest from 1981-90 as percentage (and million ha).

	Tropical Moist Forest				
	Lowland Rain	Lowland Seasonal	Hills and mountains	Total	All natural tropical rainforest
America	0.4 (1.9)	0.96 (3.18)	1.2 (1.66)	0.72 (6.74)	0.75% (7.4)
Asia	1.2 (2.23)	1.4 (0.68)	0.95 (0.49)	1.1 (3.4)	1.1% (3.9)
Africa	0.51 (0.47)	0.82 (2.25)	0..75 (0.29)	0.75 (3.0)	0.72% (4.1)
Global total	0.64 (4.6)	0.94 (6.1)	0.93 (2.4)	0.9 (13.1)	0.81% (15.4)

Source: FAN data analyzed in Whitemore (1997)

The overall global loss of all tropical moist forest during 1981-90 was estimated to be $13.1x10^6ha$ year or 0.9 percent. At the continental scale loss of lowland rain, lowland seasonal, and hill and mountain forests was at a rate of about 1 percent year or less and no where over 1.5 percent. This situation has continued drastically up to date.

IV. Why Concern for Flora Species Diversity

The relative significance of flora diversity cannot be overemphasized. To be able to appreciate the importance of flora diversity and hence showing much concern for its integrity, one needs to evaluate the products that can be used (both species and genes) and the ecosystem services that tend to support human development. A comprehensive evaluation of flora diversity should take into account the values of the direct use (products) and indirect use (services) and combine both consumption and non consumption use (Ogbe, 2012).

According to biodiversity support program (BSP) Report (1993), concern for diversity or any biological resource rests essentially on the individual value systems. The concept of values here rests on the constellation of social norms and individual attitudes all which may play a role in the utilization of resources. In the view of Walker (1989), people value biological resources like flora species in different ways: spiritually, economically and culturally.

Given this background, it becomes evident in recent times that there has been a serious call for concern about flora diversity because of the rate at which this valuable resource is being destroyed (Sawyer, 1992). It has been estimated that one species of plant become extinct every minute because of the destruction of the tropical rainforest. Flora species extinction has escalated with increasing human populations and domestication of natural ecosystems by intensive agriculture, forest management and urbanization. Maintaining the local, regional and global diversity of flora species has become an increasing focus of ecologists, managers and the public. An entire science of conservation management and planning has arisen in response to a desire to maintain species richness.

A greater concern about flora diversity arises around species that are considered rare, in danger of extinction, or endemic-limited in size and restricted to an

ecological region. Also, some flora species are keystone. These are species whose impact on its community or ecosystem is large and disproportionately large relative to its abundance (Power *et al,* 1996). If the destruction of this caliber of species and others continue unabated in the tropical rainforest ecosystem, then man kind is at the risk of survival. This has led some rainforest ecologists to attest to the fact that if this scenario persists, it could ultimately lead to the collapse of the entire earth's ecosystem. Others simply pointed out that 'we are destroying the rainforest and its rich diversity before we even know its potential to provide sustenance to man'.

According to Flint (1991), the recognition that human kind is part of nature; that all flora species have an inherent right to exist regardless of their natural value to humans; that human culture must be based on a respect for nature; and that present generations have a social responsibility to conserve nature for the welfare of future generations all provide a justification for concern about the status of flora diversity. Also, on ethical ground, Goudie (1989) asserted that flora species have a right to co-exist with us on our planet, and that we have no right to exterminate them the way we are currently doing.

Myers (1980) has argued that a great variety of flora species if not all contribute to the workings of climate through their impact on rainfall regimes not only at the local or regional levels, but also globally. He asserted that this situation therefore has an important effect not only on the agriculture of the millions of people inhabiting the wet tropics but that the rate at which they are degrading may also lead to disruption of climate patterns beyond the tropics. Despite popular views on impending disasters, meteorologists have been less unequivocal in that they continuously point to certain linkages, but the most significant interaction seems to be that flora species of all kinds exchange moisture and energy more intensely than they do to other types of land cover. The source of concern in this scenario is that the degradation of flora diversity would not only lead to self promotion of albedo enhancement but would also result in decrease in rainfall, evaporation and cloud. The consequence of which may be drought, desertification, hunger and death.

In recent times, it has been discovered that flora species is highly valued economically. In pharmaceutical sciences for example, plant products can be used directly or as raw materials to refine therapeutic derivatives or as the inspirations for synthesis of artificial analogues. For example in the USA, plant products were used in the manufacture of 255 drugs prescribed between 1953 and 1973. Also, 40 plant taxa estimated at over $200 million was used during this period (Jeffries, 1977). The returns to pharmaceutical prospectors from new drugs found in the Costa Rican forests have been cited at $4.5m per drug. In Cross River State, Nigeria, Obot and Anwana (1997) have identified several flora species used for pharmaceutical purposes such as *Garcinia manii, Piper guinensis, Afromomum daniella, the Afromomum melegueta, Lasianthera Africana, ocimun gratissimun* and *Ageratum cozyzoides.* Also, Obot (1997) identified certain medicinal plants such as *fumtumia elastica, Garcinia cola*, and *Erythrophlem ivorensis* used for curing cough, *piptadenastrium africanum* for chest and tooth ache, *parkia biglobosa* and *Arapiopsis soyauxii* for stomach ache and *fagas xanthrooxyloides* for sickle cell. In Amazon Basin, '*Curare' (chonodendon tomento-sum, stryhnos toxifera* are used as muscle relaxant employed in cardiac surgery. Amazonian Indians also use this species as arrow poison, while the insecticide plant, '*barbosco*' is used as fish poison. In Boki, Nigeria, plants used as fish poisoning include *cassia alata, erythrophloem ivorensis, strychnos aculeate, Albizia ferruginea, piptadenastrum africanum and tetrapleura tetraptera* (Obot, 1997). Also in Amazon Basin, '*leche caspi'* or '*chicle'* is used for stomach aches. (Caneiro, 1988).

In central Brazil, the Kuikuru used the root of *'netu'* plant to poison dogs. They also use Resin for medicine (Carneiro, 1988). It is this absolute utility of these flora species for this purpose that one begins to wonder that given the present state of degradation of these flora species, the pharmaceutical industry will suffer a great deal with the overall consequence on man since there seems to be little or no effort geared towards conserving any of these species in the tropical areas.

Also, the numbers of edible fruits is legion. Onyeagoche (1977) apines that in the rural areas of the tropics where the popular food eaten is mainly carbohydrates, indigenous fruit trees fulfill a very useful role in improving food quality by providing proteins, minerals, vitamins and fats especially during "hungry" periods when most of the storage foods are out of season. Okpei (1997), have identified certain flora species in Cross River State, Nigeria, used for food to include *Elaeis guinensis, irvinga gabonnensis, Raphio hookeri, Dacrodes eludes, Gnetum africanum, Mucuna sloaneil, Lasianthera hanburyi, Ocúmun gratissimum, Maranteceae, Heinsia Crinata Afronomum melegueta* among others. Okpiliya (2004) also identified in Boki, Nigeria certain flora species used for food to include *Garcinia kola, poge oleosa, Ceiba pentandra and cola acunimata.* The kuikuru in Brazil used the plant known as '*Piqui' (Caryocar brasiliese)* and '*Cocona' (Solamum sessiliflorum)* for eating. The Efe people inhabiting the Ituri forest in Congo Republic use some local plants known as '*ato*' (*aynometra alexandri)* and '*rofo' tree (Brachystesia laurentii)* to produce honey. They flower between February and March and May to August. In Orinoco Basin, 'Moriche palm' (*Mauritia Flexuosa)* is used to make palm wine, and beverage, (Carneiro, 1988). Okpiliya's (2004) study in Boki, Nigeria revealed

that the use of flora species for food ranks the highest among other forms of utilization. Given this situation, the value of flora species generally in any area can not be overemphasized so that any form of their destruction will imply hunger, starvation and subsequent death. Hence the need to accord concern to their state of being.

The relative importance of shelter to man cannot be overstressed. The corner stone of most housing construction in rural areas of the tropical rainforest are the varieties of flora species found here. They are used in various forms of building purposes. In the Congo-Zaire Basin for example, the Ngodingodi women in the Ituri forest used the local 'tilipi' leaf (*Meagaphrynuim Macrostataclyum)* to shingle the roof of their '*Mafika'* (kitchen shelter). In central Brazil, the Kuikuru living in the rainforest area use the native 'tafakin' *(Xylopia sp)* for lashings and wall posts. In San Alejandro in Brazil, the caboclos or Riberenos collect the leaves of 'Irapai' (*Lepidocaryum tesmanii)* to reroof house. The Matrytahuam also in Alejandro, Brazil use the trunk of 'huacrapona' palm (*Iriantea deltoids)* and 'Cashopoma' (*Sratea exharize)* for walls and floor. Other roofing wood species used here include: *Minquartia guianensis, Gualteria spp, G.microcarpa, Gnerium sagittatum* and *Heteropsis jenmanii* to tie the structure because nails are expensive. In Eastern Amazonia, Voucapoma Americana, the local 'huacarpin' is used for house post. In Cross River State, Nigeria, almost all the merchantable flora species are used for building construction. But the most commonly used ones are *Millethia excels, Khaya ivorensis celtis, Daniella orgea, fagara spp and Poga oleosa.* The destruction of these species have been so great in the area that most of them are beginning to go extinct. Okpiliya's (2004) study on the degradation of flora diversity in Boki revealed that there is high level of reduction in flora species richness owing to destruction by man. According to him, some of the flora species in low diversity owing principally to the utilization for construction purposes include *Afzelia spp, Dianiella ogea, Irvinga gabonensis, Pericopsis alata, Celtis, pterocarpus osun* etc. the source of worry in this case therefore is that the cost of having alternative for wood which may be rod is too high in the developing tropical rainforest region and the wood are not readily available due to destruction. This has made the building industry to suffer drastically in the face of extinction of these valuable flora species.

The end result is the call for conservation of these endemic flora species in order to guarantee continuous supply of wood from them. Most flora species are used as an aid to travelling. In Brazil, the 'Barnigud' (*Peltogyre paniculata*) and 'Jatoba' (*Hymenacea carbanil*) are used for making canoe. The mangrove is used in Cross River State and other riverine areas of Nigeria to make canoes and oars.

In Eastern Amazonia, *Tecomaviotacea* and *Bactrics gasipaces* are used for making bow and *Gnerium sagittatum* for arrow. They are beautiful plants that have a very strong elasticity. They are highly durable and can be bent to any shape. Some flora species are being reverenced in different parts of the tropics. In Indonesia for example, Banyan tree is seen to be sacred. This tree is located at the forest of Sanggi, Bali. Worshipers troop in here always to pay obeisance to the tree. Also, Okpiliya (2004) identified a tree in Borum, Boki locally called 'Nzob owum'. This tree is seen to be the oldest in the area which eventually earned it the nickname "elephantiasis tree". It is seen to harbor some deities and as such highly reverenced. People with ailments go there to pray for their healing.

Closely related to the above use of flora species is the fact that majority of the flora species in the tropical rainforest are used for cultural purposes. In Boki, Okpiliya (2004) equally noted the use of *Pterocarpus osun* for dyes. The dyes are derived from the root, bark and leaves of this tree. Here, dyes are used for decorations (tattooing and cicatrisation) during circumcisions locally called "etien". Also Ebony tree is being used to make masquerade for display during festive occasions. In Brazil, *Gneipa americanna* for piercing and decorating ear lobe. It is locally called 'arga' by the Kuikuru people inhabiting the jungle.

Through the Paleolithic and Neolithic age, human muscle was the major source of energy, but this was later replaced by wood. Firewood derived from flora species is the first type of fuel used by man and this scenario has come to stay with him over the ages. Indications in the tropical rainforest are that there is high pressure in the use of wood as sources of energy compared to other sources. For example, Okpiliya (2004) noted that about 80% of the people in Boki prefer fuelwood to other sources. He also identified ten flora species with excellent heating characteristics in the area, the best being *pterocarpus osun.* Others are *lovoa trichiliodes, Albizia lebbek, Pterocarpus mildbreadii, irvingia gabunensis, Khaya spp* among others. It is suffice to note that the steady increase in the cost of natural gas, petroleum, kerosene and even coal re-established the importance of wood for fuel, particularly for farmers and those communities located in or near the forest (Okpiliya, 2004). Also observations revealed that the cultural habits of the people inhabiting the jungle will continue to prolong the use of fuelwood to other sources of energy. This is because a greater percentage of these people relish roasted yams, cassava, plantain, peer and maize as the tropical rainforest is an agriculturally rich area. Given this background, there is therefore a high demand and pressure on flora species so that as observed by Okpiliya (2004), women in Boki now trek for reasonable distances in search for fuelwood. This is a major concern because apart from the degradation of these

flora species that have good heating qualities, the time used for other domestic chores by the rural women are now used in search of fuelwood.

Finally, it has been argued that generally due to the pressure that man has been placing on flora species for different purposes, there has arisen the need to be worried or concerned about their state of existence as most of flora species are very alluring and so tend to enrich our lives and cultural heritage

V. Conclusions

The tropical rainforest ecosystem is viewed not to be the only abode for great variety of beautiful plants, but also a place for people with diverse socio-cultural background. Very many people are found inhabiting this tropical rainforest and there is the tendency for an increased population growth in the years to come. The growing human population has many resource needs, most of which are derived from he utilization of the land. Vast tracts of natural forest land have been converted into farms and other uses to earn a living.

From the foregoing therefore, it seems factual that the tropical forest ecosystem is now being faced with the dilemma of how to preserve the beauty and treasure of the rich diversity of flora species for future generations, while encouraging economic expansion and undergoing rapid population growth. Unlike animals, plants cannot flee from a piece of land earmarked for development and often that piece of land contains the remaining habitat that is suited for a particular plant species (endemic plants). Despite great advances over the last century in our understanding, management and appreciation of these irreplaceable resources, there seems to be no headway. In sum, tropical rainforest derive value and concern not only as stronghold of diversity but also as repositories of mystery and the romance of the unknown.

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