ENDANGERED PLANTS IN NIGERIA: TIME FOR A NEW PARADIGM FOR VEGETATION CONSERVATION

Augustine O. Isichei
Department of Botany,
Obafemi Awolowo University, Ile-Ife

The global problem of biodiversity loss, especially vegetation loss has been of concern since humans realized the implications of habitat destruction in the course of economic development. Plants form the bedrock of life and human material culture depends on them. Our human world has been so closely tied to plants that it is difficult to imagine human existence without them. Being the only primary producers, all other consumers in the food chain are dependent on plants for food, fibre and energy. Knowledge of plants, their habitats, structure, metabolism and inheritance is thus the basic foundation for human survival and the way a people incorporate plants into their cultural traditions, religions and

Table 1: Categories of Biodiversity Values (adapted from Okali 2004)

Use values			**Non-use values**	
Consumptive	**Non-consumptive**	**Indirect**	**Option value**	**Existence value**
Generic: goods for home consumption, manufacture or trade		Ecological functions for maintaining sustainability & productivity	Possible future of serendipity	Satisfaction from knowledge of existence and ability to bequeath
Examples from diversity: mixed crop varieties; mixed food combinations	Aesthetic value of diverse landscapes; bird watching	Diversity of species assists ecosystem resilience and stability	Gene pool: potential medicines and drugs	Special concern for rare and threatened species and ecosystems
Examples from abundance: food, fuel, fodder, raw materials	Bird watching and recreation	Carbon storage, nutrient cycling, photosynthesis, waste assimilation, flood protection	Future availability of resources	Wilderness, cultural and spiritual assets
Example beneficiaries:				
Poor rural people, especially women	Visitors and tourists	Downstream users of land, water and energy; the world community	The young and future generations	Environmental lobbies and concerned people

even cosmologies reveals much about the people themselves. People rely on plants for much more than food and shelter and there are a few areas of human endeavour in which plants do not play an important role. For example, America was discovered during the course of the search for spices, pointing to one important way plants have determined the course of human civilization! Few societies can ignore the pivotal role of agriculture and forestry, both based essentially on plants. Several environmental crises such as global warming and biodiversity loss at their core, involve plants. It could indeed be that we are so closely linked that humans often take plants for granted, something to be left to the background and not worthy of serious economic consideration. Evolutionarily, plants have defined our 'life zones' and through them we continue to have life and it now looks as if we still have to dig deeper than ever before into them to seek solutions to our environmental problems. All the issues that are pertinent in biodiversity conservation find their full expression when plants are considered (Table 1).

Environment and Vegetation in Nigeria

Table 2: The two major classifications of the vegetation of Nigeria

UNESCO/AETFAT/UNSO (White 1983)		Nigeria (Keay 1959)	
Unit #	**Vegetation type**	**Unit #**	**Vegetation type**
77	Azonal	-	Mangrove and Coastal vegetation
8	Swamp forest	-	Freshwater swamp communities
1a	Lowland rainforest - wetter type	-	Lowland rainforest
2	Guinea-Congolian forest: drier type	-	-
11	Mosaic of lowland rainforest and secondary grassland	-	Derived (transition) savanna
12	Mosaic of lowland rainforest, *Isoberlinia* woodland and secondary grassland	-	Southern Guinea savanna
15	West African coastal mosaic	-	Coastal savanna
27	Sudanian woodland with abundant *Isoberlinia*	-	Northern Guinea savanna
29	Sudanian undifferentiated woodland	-	Sudan savanna
30	Sudanian undifferentiated woodland with islands of *Isoberlinia*		Sudan savanna
32	Jos Plateau mosaic		Jos Plateau
43	Sahel Acacia wooded grassland and deciduous bushland	-	Sahel zone

Jones and Wild (1975) had observed that zonation of major soil types in West Africa is closely linked with amount of rainfall such that the approximate soil-type boundaries coincide with the isohyets. Concordantly, vegetation biomass and luxuriance follow this

zonation and decrease northwards; from the Atlantic that has a major influence on rainfall amounts and distribution. Lawson (1986) has observed that West Africa is generally low-lying so that the vegetation falls into natural latitudinal zones determined by climate. A lot has been written on the species richness and high biodiversity of the tropical rainforest, amply represented in Nigeria, in the south. The two major vegetation classifications used in Nigeria: that of Keay (1959, see also Figure 1 in this paper) and White (1983, Figure 2 in this paper) show this relationship between vegetation and environment. 'Ecological Zones of Nigeria' by Charter (1969) is not widely used. The classification by Keay lists the indicator species for each zone, that is, those species one encounters most frequently in the natural vegetation of the zones. The classifications by Charter and White give detailed lists of plant species that are found in the zones. Table 2 shows the relationship between the Keay and White classifications (see Isichei 1995). White divided Africa into 20 regional centres of plant endemism. Four of these regions occur in Nigeria/West Africa. The southernmost centre of endemism is the Guinea-Congolian which is broken at the Dahomey gap, the point where there is incursion of savanna to the coast. Nigeria's tropical rainforest is contiguous with forests of the Congo basin. The Guinea-Congolian/Sudanian regional transition zone is north of the forest zone and would include the Derived and Southern Guinea savanna zones of Keay (1959). The Sudanian centre of endemism is a broad stretch from western Africa to Sudan and roughly occupies the Northern Guinea and Sudan savanna zones of Keay. The Sahel regional transition zone is next to the Sahara.

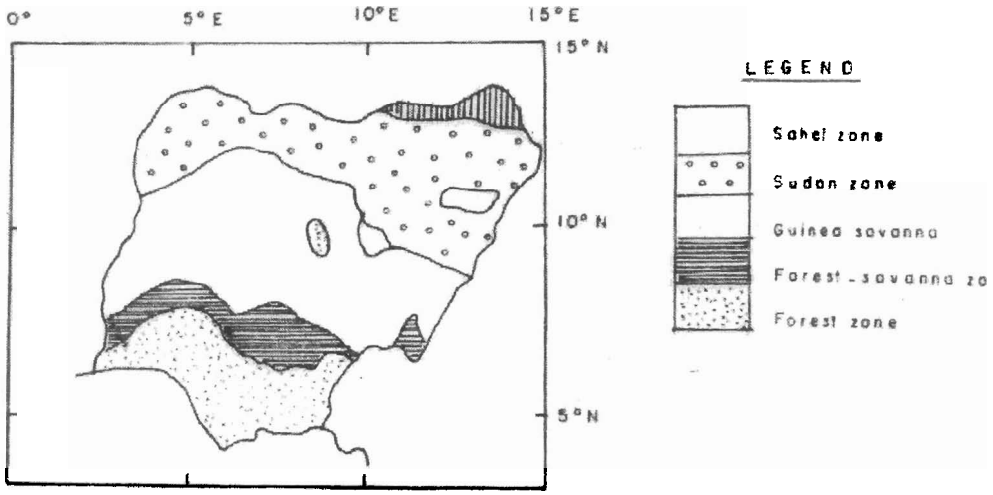

Figure 1: Vegetation Zones of Nigeria based on Keay (1959)

3.0 Nigerian Plants, Their Diversity and Utilization

Nigeria has over 800 species of algae, about 200 lower plants (bryophytes etc.), 150 ferns and over 5000 higher plants, about 205 of them endemic (Table 3, Federal Environmental

Protection Agency, *FEPA*, 1992, Okali 2010). Plants are the primary sources of food and are central to national food security. In addition to this, plants serve as sources of new crops when wild ones are domesticated, help to improve crop varieties through cross-breeding and play roles in crop protection when their chemicals are used in pest control. The contribution of plants in drug making is well known and their importance is on the rise with the continued search to tackle diseases where microorganisms have developed resistance to existing drugs. Ethnobotany is fast becoming a very popular engagement in Nigeria. Almost 300 plants are listed as being of medicinal value in western Nigeria alone (Adjanahoun et al. 1993) and publishing on the use of plants for medicines is one of the most active in the life sciences today (Sofowora 1993, Olapade 2003, Adeniji 2003, Aliyu 2006a, b; and Odugbemi 2008). Okafor and Ham (1999) identified 55 plants as being of medicinal value in southeastern Nigeria while Anwana and Obot (2003) reported that 67 plant species in 38 families are used for treating 18 categories of ailments by people living inside and within the support zone of the Cross River National Park, Okwango Division, in Cross River State.

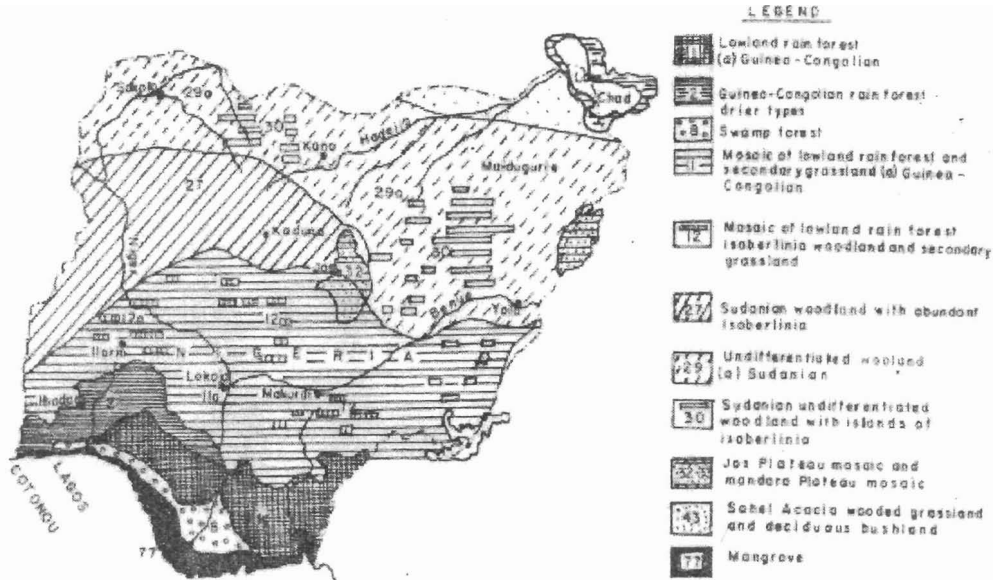

Figure 2: Vegetation zones of Nigeria drawn from 'Vegetation of Africa' by White (1983)

3.1 Plant Utilization as Timber and Other Forest Products

It was observed in the report by Ola-Adams and Iyamabo (1977) that whereas in 1950 only 17 species were commercially acceptable timber trees, by 1975 the number so regarded had increased to 47. For example, *Daniellia oliveri* can be considered one of the most intensely utilized timber species today. With just any tree being felled for timber these days, all trees

can be regarded as economic. The situation is so acute that timber has overtaken usually imported items such as roofing sheets as the most expensive component in housing construction. There are virtually no hardwoods left in the wild in most parts of Nigeria.

Morakinyo (1994) observed that the Ekuri Community in the support zone of the Cross River National park in southeastern Nigeria identified five principal non-timber forest products that are of great commercial importance and they are *Gnetum africana,* chewing sticks *(Garcinia mannii, Massularia acuminata),* rattan *(Calamus spp., Laccosperma spp, Oncocalamus spp., and Eremospatha spp.)* and bush mango (*Irvingia gabonensis)*. Many species that were not known to be of commercial value some twenty years ago are now exploited as sources of oils, condiments and other pharmaceutical products. Examples include *Allablanckia floribunda* and *Parkia biglobosa.*

Table 3: Biodiversity statistics for Nigeria: Plants
(*Source*: National Biodiversity Strategy & Action Plan, 2003)

Category	No. of Species
Fungi	>3423
Algae	>848
Lower Plants	<200
Higher Plants	5103
Trees (up to 5 m tall) 935 (from Keay, 1989; includes naturalized exotics)	
Other higher plants, 4168 (by subtraction)	

Forest Decline/Deforestation in Nigeria

Contreras-Hermosilla (2000) has described forest decline to loosely include deforestation, understood as the reduction of tree crown cover to less than 10% of the total area for rather large areas and for long periods. He views degradation as loss of the main attributes of forests, be these the capacity to produce timber, wood, non-wood products, environmental services or a combination of all these. Loggers are the agents of forest decline in Central and West Africa but peasants as well as fuelwood collectors are also important in the sub-humid areas. Pastoralists are particularly active in the Sudano-Sahelian regions where the few remaining trees and woodlands are under the most severe pressure for browse and fodder. Some estimates have put the percentage energy supplied by fuelwood in Nigeria at about 80% making fuelwood gathering an important agent of deforestation. Loggers, however selectively exploit mature forests, thereby setting the stage for deforestation by other agents. These direct causes are in turn influenced or even determined by more fundamental forces, some of which originate in spheres that may be quite distant from, and apparently unrelated to, decisions by the main agents. These distant origins, sometimes far removed in the causation chain, Contreras-Hermosilla concludes, are the underlying causes

of deforestation.

The direct causes, all too well known, have always been blamed for deforestation but a look at the indirect/underlying causes would reveal they merit more serious consideration. All the four main underlying causes have played significant roles in forest decline in Nigeria. But 'governance weaknesses' is the most outstanding cause of deforestation. It is indeed not difficult to relate deforestation and general biodiversity loss in Nigeria to the issues listed under 'Broader socioeconomic and political causes'. 'Market failures' may be difficult for non-social scientist to comprehend but the problem of communal management of forest lands gives room for unregulated access and free-for-all exploitation. Forest goods and services are usually unpriced under such circumstances and forests end up as 'tragedy of the commons'. Developing countries are often characterized by poor regulation and weak markets.

Table 4: Summary of the extent of and changes in selected vegetation and land use classes for 1976/78 and 1993/95 in Nigeria (From Beak/Unilag Consult/Geomatics 1996)

Land Use Category	1976/78		1993/95		% Change
	% of Country	Km^2	% of Country	Km^2	
Intensive (crop) agriculture	35.5	322 794	40.2	365 491	13.2
Sudan savanna	12.5	113 880	9.0	81 694	-28.26
Guinea savanna	16.6	151 293	9.0	81 386	-46.21
Disturbed forest	1.6	14 573	2.1	18 990	30.31
Freshwater swamp	2.0	18 316	1.8	16 499	-9.92
Undisturbed forest	2.9	25 951	1.3	12 114	-53.32
Mangrove forest	1.1	9 994	1.1	9 977	-0.17
Gully erosion	0.0	122	2.0	18 517	15 077
Teak Plantation	0.1	628	0.1	1 156	84.06
Urban (major + minor)	0.2	2 083	0.6	5 444	161.35
Agriculture/Denuded	0.4	3 518	1.0	9 206	161.68
Grass marsh	0.5	4882	0.1	871	-82.16

With a very large human population and an economy based primarily on extensive, land-based agriculture and extraction of natural resources, it is no surprise that that Nigeria has one of the highest deforestation rates in the world. Rain forest Action Network (RAN) (2005) reports that Nigeria originally had 72,000 km^2 of forest which has now dwindled to 10,000 km^2. In fact, at the rate of 14.3% Nigeria has one of the highest deforestation rates in the world. One major cause of forest decline is agricultural expansion, a consequence of population increase and agricultural intensification (Table 4). In the 18-year period between

1976/78 and 1993/95 when spatial data were gathered, agriculture grew by 84,073 km^2, a growth of 9% of the total area of the country (Beak/Unilag Consult/Geomatics 1996). Undisturbed forest decreased by over 50% from what it was in 1976/78. Agricultural expansion most likely contributed to decreases in the areas of Guinea savanna, Sudan savanna, freshwater swamp forest and grass marsh (Table 4).

Table 5: Consequences of continuing forest decline from the perspectives of different segments of society. (FromContreras-Hermosilla (2000)

Societal Group	Implications of Continuing Forest Loss and Degradation
Forest-dwelling indigenous communities	• Loss of spiritual values. Social disruption of traditional structures and communities. Breakdown of family values. Distress and social hardship. • Loss of traditional knowledge of how to use and protect forests in sustainable ways. • Reduced prospects for preservation of forest environmental and aesthetic functions of interest and potential benefit to society as a whole
Forest farmers and shifting cultivators	• For shifted cultivators, an immediate opportunity to survive. • Forest degradation and declining soil fertility. • Loss of access to forest land and the possibility of food crop production and reduced possibilities for harvesting forest products, both for subsistence and income generation. • Prospects of malnutrition or starvation. • Disruption of family structures and considerable social hardship.
Local communities, the poor and landless living outside forests Urban dwellers	• Decreased availability of essential fruits, fuelwood, fodder and other forest products. • Reduced agricultural productivity. (Through loss of the soil and water protection potential of remnant woodlands and on-farm trees: loss of shelterbelt influence leading to reduced crop yield.) Reduced income generation and possibilities to escape from the poverty trap
Urban dwellers	• In developing-country situations reduced availability (and/or overpriced) essential forest products such as fuelwood, charcoal, fruits, building materials and medicinal products. • In developed countries, loss of the amenity and recreational values of urban forests and parks. Reduced prospects for assured supplies of clean drinking water and clean air. Loss of the recreational opportunities and amenity values afforded by national forest parks and wilderness areas.
Commercial forest industrial	• Immediate large profits. • In the longer term, loss of company business and forced closure

companies and forest worker communities	of forest operations. • Loss of jobs for forest-dependent communities, social disruption and hardship. • Loss of income and possible negative social implications of reduced income of shareholders with significant savings invested in forest industrial company stocks.
Mining, oil exploration and other industrial interests	• Improved access to potentially profitable mineral, oil or other commercially valuable products located under forests. • Increased profitability of company operations and returns to company shareholders. Politically negative impact on company operations of criticism by environmentally concerned groups.
Environmental advocacy groups and conservation agencies	• Loss of the essential environmental functions of forests including biodiversity, climate regulation, preservation of water catchments and fishery values. • Loss of cultural values and social hardship for the underprivileged communities whose welfare these groups are committed to protect. • Increased problems of environmental pollution. • Loss of those forest values that could be of vital importance and/or interest to the survival and welfare of future generations.
The global scientific community	• Prospects that continued forest destruction will accelerate global warming with potentially negative consequences for human welfare and survival. • Continuing biotic impoverishment of the planet, loss of genetic resources, and all that implies for sustainable food production, and loss of potentially valuable medicinal and other products. Increasing pollution and toxification of forest soils, contributing to declining forest health.
National government planners and decision makers	• Immediate escape from political pressures when impoverished populations migrate to frontier forest areas. 1. Loss of a potential source of development revenues with consequences of reduced employment and opportunities, sustainable trade and economic development. 2. Loss of the wide range of environmental functions that forests provide in contributing to societal needs and a habitable earth. 3. Loss of political support in situations where forestry loss and degradation adversely affect the welfare of many citizens.

No segment of society actually benefits from deforestation as can be observed from Table 5. Where there are apparent, immediate benefits, these benefits disappear soon afterwards. But poorer segments of society, especially subsistence farmers and local communities suffer the greatest losses. Globally, the consequences of deforestation are frightening: 3 billion

tonnes of CO_2 added to the atmosphere each year, widespread changes in water flows, scenery, microclimates, pests and pollinators (Chomitz 2007). Isichei (2005) observes that the Guinea and transition savanna zones that cover 417,630 km^2 or approximately 45% of Nigeria's land area is subjected to intense annual fires. Deforestation in the forest zone results in the invasion of degraded forests by *Chomolaena odorata* a semi-annual shrub that dries up in the dry season and burns easily. Approximately half of the Guinea and transition zones is burned annually and from this is emitted 27,369 gigagram, Gg (= 10^9 g; cf. 1 kg = 10^3g) carbon, 145 x 10^9 g CH_4, 3,831 x 10^9 g CO, 2 x 10^9 g N_2O and 49 x 10^9 g oxides of nitrogen, NO_x (Isichei *et al.* 1995). An estimated 125,561 Gg CO_2 is released from burning of cleared forest, delayed emission from decay of unburned wood, and long-term emissions from soil in Nigerian forests and woodlands. 300 Gg CH_4, 4375 Gg CO, 2.4 Gg N_2O and 24 Gg NO_x are estimated to be released from the burning of cleared forest and woodland. Burning of over 80 million cubic metres of wood as fuel is included in these estimates. Carbon dioxide is a commonly known global warming gas and if it's global warming potential is taken as 1, that of methane, CH_4 is 22 while nitrous oxide, N_2O has a warming potential of 270. There is also addition of particulates and other global warming gases such as volatile organic compounds to the atmosphere during burning. These have implications for climate.

As with most crises situations, finger-pointing has come into the deforestation arguments with the global north, much battered for being responsible for global-warming gas emissions now claiming that deforestation is to blame. "The accelerating destruction of the rainforests that form a precious cooling band around the Earth's equator is now being recognized as one of the main causes of climate change. **Carbon emissions from deforestation far outstrip damage caused by planes and automobiles and factories** ...deforestation accounts for up to 25 per cent of global emissions of heat-trapping gases, while transport and industry account for 14 per cent each; and aviation makes up only 3 per cent of the total".
[http://environment.independent.co.uk/climate_change/article2539349.ece]

Combating deforestation: Forest Management and Conservation

International commitments to the development of networks of protected areas date from 1972, when the Stockholm Declaration from the United Nations Conference on the Human Environment endorsed the protection of representative examples of all major ecosystem types as a fundamental requirement of national conservation programs. Since then, the protection of representative ecosystems has become a core principle of conservation biology, supported by key United Nations resolutions - including the World Charter for Nature 1982, the Rio Declaration 1992, and the Johannesburg Declaration 2002 (Wikipedia).

In Nigeria, efforts at forest conservation dates back to the early years of the 20th century (Aminu-Kano and Marguba 2002, Oyebo 2006). It is acknowledged that private land ownership was not the norm when the colonialists came but that low population densities facilitated demarcation of forests for conservation. These initial steps went so well that forest reservation went up from 970 km^2 in 1907 to 93 420 km^2 in 1970 (Oyebo 2006). Then the target was to have 25% of Nigeria's land area under reserves. There were management plans for the reserves. Large plantations of exotics were also established from 1960 and by 1988 there were 270 000 ha of such plantations. But problems had started creeping in by the 1930's when tracts of forest were given as concessions to timber companies. The government department of forestry was mainly concerned with inspection of exploitation activities and the collection of fees and revenue. The Land Use Act of 1977 vested ownership of lands in state governments who saw forests as good sources of revenue. The working plans of forest reserves were not reviewed, except those of Cross River State which were carried out with the assistance of the Department for International Development (DFID), United Kingdom.

- **Forest Conservation Status**

The colonial objectives of forest management in Nigeria were to maximize the annual production of wood, mostly timber and generate revenue on a sustainable basis (Oyebo 2006). Strategies to achieve these objectives were the conversion of the natural forest to even-aged exotic and indigenous tree plantations with a management based on felling cycles. The *Taungya* system initiated in aid of this still survives to date. Oyebo states that there are 1,160 forest reserves covering 10,752,702 ha. Aminu-Kano and Marguba gives the proportions of each of the six geopolitical zones covered by reserves and when summed up, gives a total of 99,991.92 km^2, a figure that converts to 10.99% of our land area. There are 8 National Parks and 8 Strict Nature Reserves, six of which according to Oyebo, are very badly degraded. Wood demands far outstrip supply and Ojo (1994) projected an 80 – 100 million m^3 deficit by 2020.

- **Threatened Plant Species of Nigeria**

A taxon is considered endangered if there is a reduction in population size in time (>80% in the last 10 years or projected reduction in the future), in numbers ((estimated to be less than 2500 mature individuals) and if projected extinction of at least 20% within 20 years (IUCN 2004). The general aim of the *IUCN Red List Categories and Criteria* is to provide an explicit, objective framework for the classification of the broadest range of species according to their extinction risk (IUCN 2004). It is not the sole means of setting priorities for conservation measures for the protection of the species. The specific aims of the 'Red List' are to:

- provide a system that can be applied consistently by different people;

- improve objectivity by providing users with clear guidance on how to evaluate different factors which affect the risk of extinction;
- provide a system which will facilitate comparisons across widely different taxa;
- give people using threatened species list a better understanding of how individual species were classified.

Ezealor (2002) presents a simplified Status Categories of Species as follows (see Figure 2):

- **Extinct (Ex)**; species has not been seen in the wild or in captivity during the past 50 years
- **Extinct in the Wild (ExW)**; as above, but the species is still held in zoological gardens or other live collections
- **Critically Endangered (CR)**; species is very threatened and at risk of becoming extinct
- **Endangered (EN)**; species is unlikely to survive if the factor that is posing threat persists
- **Vulnerable (Vu)**; likely to become endangered in the future if factor that is posing threat persists
- **Near Threatened (NT)**; species is approaching the threshold of vulnerability
- **Data Deficient (DD)**; strongly suspected or thought to belong to one of the above categories, but data is insufficient to substantiate
- **Rare (R)**; species has small global population that is not threatened, but is at risk Low Risk - conservation-dependent(LR/cd); species is in no immediate danger, but survival will depend on implementation of effective conservation measures in its range
- **Low Risk, not threatened (LR/nt)**; species is in no immediate danger, but needs to be consistently monitored.

The Nigerian 'Red List' has 189 plants: 138 fall into the Vulnerable category, 16 are Critically Endangered, 16 are at Low Risk; 18 are endangered and 1 belongs to the Data Deficient category. Twenty Nigerian Plants are known to have gone extinct since 1950. The numbers of plants in the other categories are shown in Table 6. The Federal Environmental Protection Agency (1997) has compiled a list of 18 Nigerian plants requiring urgent conservation attention (Table 7). Table 8 shows how Nigeria is faring in terms of conservation, when compared with some other Sub-Saharan African countries.

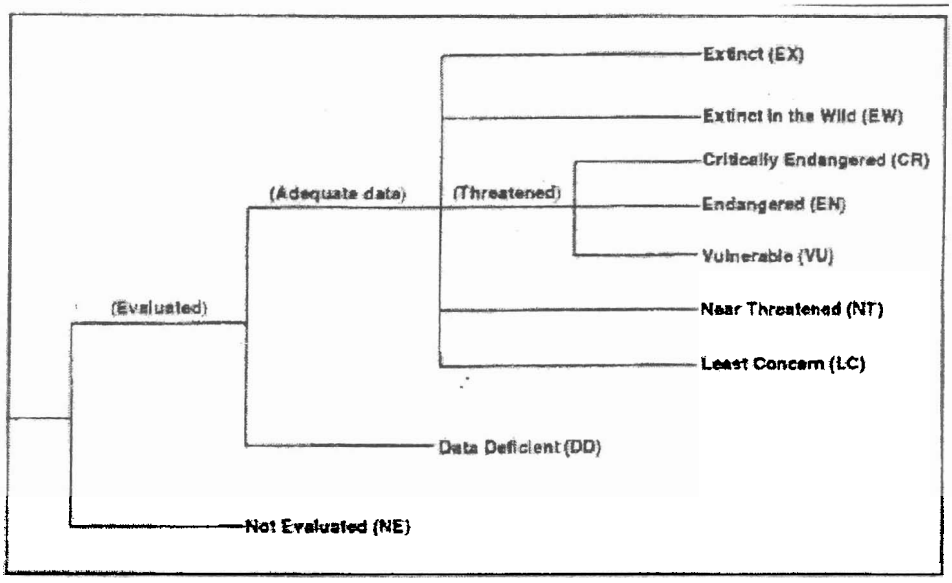

Figure 3: Categories of conservation status for evaluated species (IUCN 2004)

Table 7: Plant Species Requiring Urgent Conservation Attention In Nigeria (FEPA 1997)

No.	Names	Family	Status
1	*Crateranthus talbotti*	Lecythidaceae	E, M*
2	*Didelotia africana*	Caesalpinioideae	E, M
3	*Loesenera talbotti*	„	E, M
4	*Cryptosepalum diphyllum*	„	E
5	*Piptostigma pilosum*	Annonaceae	E
6	*Okoubaka aubrevillei*	Ocktoknemataceae	M*
7	*Dichostema glaucescens*	Euphorbiaceae	M*
8	*Cyrtogomone argenta*	„	M*
9	*Marcyopsis longifolia*	„	M*
10	*Acalypha manniana*	„	M*
11	*Pseudagrostistiachys africana*	„	M*
12	*Plagiostyles africana*	„	M
13	*Ophiobostrys zenkeri*	Flacourtiaceae	M
14	*Phyllobotryum soyauxianum*	„	M
15	*Arialopsis tabouensis*	Rutaceae	M
16	*Scytopelalus tieghemii*	Scytopelaceae	M
17	*Salvadora persica*	Salvadoraceae	M
18	*Radlkofera calodendron*	Sapindaceae	M

KEYS: E: endemic to Nigeria; **M**: Monospecific genera in Nigeria; *: Genus represented by only one species in the world flora

Table 8: Plants Red List Category Summary, Sub-Saharan Africa

Country	EX	EW	Sub-total	CR	EN	VU	Sub-total	LR/cd	NT	DD	LC	Total
Angola	0	0	**0**	0	2	24	**26**	0	6	1	6	**39**
Benin	0	0	**0**	0	0	14	**14**	0	2	0	2	**18**
Chad	0	0	**0**	0	0	2	**2**	0	1	0	0	**3**
Congo	0	0	**0**	1	7	27	**35**	1	4	0	3	**43**
Côte d'Ivoire	2	0	**2**	2	18	85	**105**	1	10	1	5	**124**
Equatorial Guinea	0	0	**0**	3	12	46	**61**	0	12	0	3	**76**
Gabon	0	0	**0**	3	14	90	**107**	1	16	3	4	**131**
Ghana	0	0	**0**	3	19	95	**117**	1	10	0	5	**133**
Guinea	0	0	**0**	0	0	22	**22**	1	3	0	3	**29**
Kenya	0	0	**0**	5	14	84	**103**	1	26	1	15	**146**
Liberia	0	0	**0**	0	4	42	**46**	0	2	0	4	**52**
Madagascar	0	0	**0**	61	98	117	**276**	0	31	16	39	**362**
Nigeria	0	0	**0**	16	18	136	**170**	2	14	1	6	**193**

The IUCN Red List is designed for global taxon assessment. Guidelines for regional applications are prepared by the Species Survival Commission of IUCN. A global category may not be the same as a national or regional category for a particular taxon. The nearest attempt at categorization of plants in Nigeria is the work of the Federal Ministry of Agriculture, Water Resources and Rural Development (FMAWR&RD) (1986) shown in Appendix 1..

The Way Forward: Recommendations

- **Need for Paradigm Shift in Conservation**

It is important to realize that conservation objectives change with time. The main objective of the early colonists was to exploit timber. With more knowledge, we have to know that vegetation serves various other purposes such as environmental services. Catchment area protection, aesthetics, and ethnobotany have become important issues.

- **Industries based on Ethnobotany**

a) Okafor (1993) has observed that there are prospects for commercial development of cottage industries based on edible forest species. In addition to enhancing the improved

and efficient utilization of the species, such industries could also promote the conservation of the species and aid in rural poverty alleviation (Okali 2004). Products expected include:

b) Jams and Jellies from *Irvingia gabonensis var gabonensis*, *Chrysophyllum albidum* and *Dialium guineense*;

c) Fruit Juice: With the exception of *C. albidum*, all the species listed above for jam and jelly are also suitable for fruit juice. Other suitable species include *Tamarindus indica* and *Parkia biglobosa;*

d) Confectioneries: Breadfruit flour, processed from *Treculia africana*, can be used to produce a variety of sweetened baked goods including cookies, buns, cakes, biscuits and snacks;

e) Soup mixes: The flour of *T. africana* is suitable for the preparation of a product that tastes much like mushroom soup;

f) Non-alcoholic beverage from *T. africana* seeds;

g) Composite seasoning from *Xylopia spp.*, *Piper guineense*, *Monodora myristica*, and the leaves of *Ocimum gratissimum*;

h) Oils from the fruits of *Dacryodes edulis*, *Elaeis guineensis*, *Irvingia gabonensis* and *Vitellaria paradoxa*;

Address underlying causes of deforestation

Since the adoption of the structural adjustment programme in Nigeria there has been a series of retrenchments of workers, especially public servants. There have been factory closures occasioned by reduction in power generation and general global economic decline. Job losses mean more pressure on land and forests. There is the need to address economic policies in such a manner that pressure on land is reduced. There is also the need for innovations that will increase food production but not necessarily increase the area of land under cultivation. Industrialization and economic diversification will reduce the population pressure on the land.

Based on he assumption that there is a better chance of natural resources enjoying better protection when people who live in their proximity participate in their management, the trend in the 1980's was to advise decentralization of conservation (see Poffenberger 1996). Management of forest reserves were decentralized in Nigeria in the 1970's. Unfortunately, this was the period powerful military centralized governance was the vogue. Lack of democracy meant that local people had no input into the management of conserved areas. It was during this period, up to the late 1990's that de-reservation of forest reserves was most rampant. Apart from forest degradation, land within reserves was unconscionably allocated to other interests such as housing and private farms. In addition exotic trees in

plantations were massively felled and the logs exported for quick cash. Decentralization of conservation under a centralized governance regime is regarded as one of the pitfalls of decentralized biodiversity conservation (Wyckoff-Baird *et al* 2000).

- **Policy and legislative reform**

Publicize carbon trading and informal conservation. Economists have urged the use of "market-based" instruments such as emissions trading to address environmental problems instead of prescriptive "command and control" regulation. Command and control regulation is criticized for being excessively rigid, insensitive to geographical and technological differences among nations, and for being inefficient.

Emissions trading is a market-based approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants. Emissions trading requires a limit (cap) to effectively reduce emissions, and the cap is a government regulatory mechanism. A governmental body sets the limit or *cap* on the amount of a pollutant that can be emitted. After the limit/cap has been set by a government political process, individual companies are free to choose how or if they will reduce their emissions. Failure to reduce emissions is often punishable by a fine that increases costs of production. The limit or cap is allocated or sold to firms in the form of emissions permits which represent the right to emit or discharge a specific volume of the specified pollutant. Firms (or globally, nations) are required to hold a number of permits (or *credits*) equivalent to their emissions. The total amount of permits cannot exceed the cap, limiting total emissions to that level. Firms/nations that need to increase their emission permits must buy permits from those who require fewer permits. The transfer of permits is referred to as a trade. In effect, the buyer is paying a charge for polluting, while the seller is being rewarded for having reduced emissions by more than was needed.

Emission trading has the convenience of allowing small holdings that may either be individually or company-owned to benefit directly from forestation projects. This will indeed allow conservation to be practiced by the so-called informal sector of the economy and ensure private sector and citizen involvement.

- **Aggressive Reforestation**

Aggressive reforestation should be revived in the sub-humid and arid zones. Indigenous trees should be preferred but where there are constraints species whose environmental impacts are known – for example, they should not have a history of uncontrolled invasion or constituting a menace. The lessons learned from the earlier Arid Zone Reforestation Project should be put to use.

- **Review Endangered Species Act to include endangered plant species and special habitats**

The Endangered Species Act should be broadened to include many more plant species, especially those now listed as threatened. Species protection without habitat protection is, however, futile. The realization that protecting megafauna without the plants and vegetation habitats on which they depend led to some re-thinking of conservation strategies. Such new strategies are needed to conserve threatened habitats such as riparian systems. Steentoft (1988) has, for example, listed families of flowering plants that are dispersed by elephants and baboons and also plants that have ant domatia, illustrating mutualisms that should be considered in conservation. When habitats get labeled as 'special', Nigeria might then move to considering Habitats of Special Scientific Interest as is done several parts of Europe. Sites of special interest will localize conservation and lead to more intense studies of the Nigerian flora.

- **Promote alternative energy sources, solar in particular**

While governance and related issues have been identified in this paper as the factors that must be looked into for sustainable conservation, it is immediately obvious that alternative rural energy sources have to be central in deforestation reduction. Perhaps there is need to take a deeper look into 'market forces' such that the long term benefits of providing cheaper fossil fuel energy can be compared, on the basis of environmental economics, to the ultimate cost of vegetation degradation. But the ultimate environment-friendly energy is solar power, a resource that can be maximally harnessed through research.

REFERENCES

Adeniji, M.O 2003. *Herbal Treatment of Human Diseases*. ISBN 978-36716-7-7

Adjanahoun, E., Ahiyi, M.R.A., Ake Assi, L., Dramane, K., Elewude, J.A., Fadoju, S.O., Gbile, Z.O., Goudote, E., Johnson, C.L.A., Keita, A., Morakinyo, O., Ojewole, J.A.O., Olatunji, O.A. and Sofowora, E.A. 1993. *Traditional Medicine and Pharmacopoeia: Contribution to Ethnobotanical and Floristic Studies in Western Nigeria*. O.A.U. Scientific, Technical and Research Commission, Lagos

Aliyu, B.S. 2006a. *Common Ethnomedicinal Plants of the Semi-arid Regions of West Africa,. Volume I. Their Description and Phytochemicals.* Triumph Publishing Company, Kano.

Aliyu, B.S. 2006b. *Some Ethnomedicinal Plants of the Savanna Regions of West Africa,. Volume II. Description and Phytochemicals*. Triumph Publishing Company, Kano.

Amnu-Kano, M. and Marguba, L.B. 2002. History of Conservation in Nigeria. Pp 3 – 11 in: *Critical Sites for Biodiversity Conservation in Nigeria*, A.U. Ezealor, editor.

Nigerian Conservation Foundation, Lagos.

Anwana, E.D. and Obot, E.A. 2003. Ethnobotany of human settlements in Cross river National Park, Okwango Division: useful and Medicinal Plants. *Roan* 1 (1 & 2), 34 – 45.

Beak/Unilag Consult/Geomatics 1996. *Preliminary Report on The Assessment of Landuse and Vegetation Changes in Nigeria Between 1978-1993/95.* FORMECU ENVIRONMENTAL MANAGEMENT PROJECT, Ibadan.

Butler, R. A. 2005. *Nigeria has worst deforestation rate, FAO revises figures. mongabay.com. November 17, 2005. Available at: http://news.mongabay.com/2005/1117-forests.html downloaded on April 5, 2010.*

Charter, J.R. 1969. *National Atlas of Nigeria: Vegetation Ecological Zones*. Federal Department of Forestry, Lagos.

Chomitz, K.M. 2007. *At Loggerheads? Agricultural Expansion, Poverty Reduction and Environment in the Tropical Forests*. A World Bank Policy Research Report. The World Bank, Washington

Contreras-Hermosilla, A. 2000. *The underlying causes of forest decline*. Occasional paper No. 30. Center for International Forestry Research, Bogor, Indonesia.

Ezealor, A.U. 2002. *Critical Sites for Biodiversity Conservation in Nigeria.* Nigerian Conservation Foundation, Lagos.

Federal Environmental Protection Agency (FEPA) 1992. *Biological Diversity in Nigeria: A Country Study.* The Federal Environmental Protection Agency, The Presidency, Abuja

Federal Environmental Protection Agency (FEPA) 1997. *Nigeria Biodiversity Strategy and Action Plan.* The Federal Environmental Protection Agency, The Presidency, Abuja

Federal Ministry of Agriculture, Water Resources and Rural Development (FMAWR & RD). 1986. *A National Conservation Strategy for Nigeria*. Federal Department of Forestry, Lagos

Hopkins, B. 1974. *Forest and Savanna*. 2nd Edition. Heinemann Educational Books, London.

Isichei, A.O. 1995. *Omo Biosphere Reserve, Nigeria. Current Status, Utilization of Biological Resources and Sustainable Management.* Working Papers No. 11, South-South Cooperation Programme, UNESCO, Paris.

Isichei, A. O. 2005. The role of plant resources in Nigeria's economic recovery agenda. *Nigerian Journal of Botany* 18, 1 -22.

Isichei, A.O., Muoghalu, J.I, Akeredolu, F.A. and Afolabi O.A. 1996. Fuel characteristics and emissions from biomass burning and land-use change in Nigeria. *Environmental Monitoring and Assessment* 38, 279 - 289.

IUCN (The World Conservation Union) 2004. *IUCN Red List Categories and Criteria*

IUCN, Gland, Switzerland

Jones, M.J. and Wild, A. 1975. *Soils of the West African Savanna.* Technical Communication No. 55, Commonwealth Bureau of Soils, Harpenden

Keay, R.W.J. 1959. *An Outline of Nigerian Vegetation.* 3rd Edition. Government Printer, Lagos

Keay, R.W.J. 1989. *Trees of Nigeria.* Clarendon Press, Oxford

Lawson, G.W. 1986. Vegetation and environment in West Africa. Pp. 1 – 12 in: *Plant Ecology in West Africa – Systems and Processes*, G.W, Lawson, editor. John Wiley & Sons, Chichester.

Morakinyo, A.B. 1994. Community forestry in the support zone of the cross River National Park. *Nigerian Field* 59, 95-104

Nigeria National Biodiversity Strategy and Action Plan, 2003. Federal Ministry of Environment, Abuja

Odugbemi, T. 2008 (ed.). *A Textbook of Medicinal Plants from Nigeria.* University of Lagos Press, Lagos.

Ojo, L.O. 1994. *Update of Wood Supply and Demand Data.* Report submitted to FORMECU, Ibadan

Okafor, J.C. 1993. *Lost crops of Nigeria: an overview*. Pp. 2-32 in: *Lost Crops of Nigeria: Implications for Food Security.* J.A. Okojie and D.U.U. Okali, editors. University of Agriculture, Abeokuta

Okafor, J.C. and Ham, R. 1999. Identification, utilisation et conservation des plantes médicinales dans le sud-est du Nigeria. Themes de la biodiversité africaine, Numéro 3, Julliet 1999

Okali, D.U.U. 2004. *Biodiversity and Poverty Alleviation*, Chief S.L. Edu Memorial Lecture, NCF, Lagos, 8 Jan. 2004. NCF, Lagos

Okali, D.U. 2010. Many species, one planet, one future. Pp. 10 – 21 in: *Many Species One Planet One Future:* Proceedings of the 3rd Annual Conference of the Institute of Ecology and Environmental Studies, Obafemi Awolowo University, 15 – 17 June 2010, I.E. Ofoezie, O.O. Awotoye and M.B. Adewole, editors. Obafemi Awolowo Unversity, Ile-Ife.

Ola-Adams, B.A. and Iyamabo, D.E. 1977.Conservation of natural vegetation in Nigeria. *Environmental Conservation* 4, 217-226

Olapade, E.O. 2003. *The Herbs for Good Health.* The 50th Anniversary Lecture of the University of Ibadan. NARL Specialist Clinic, Ibadan.

Oyebo, M.A. 2006. History of Forest Management in Nigeria from 19th Century to Date. Paper Presented at the International Stakeholders Workshop on Geo-Information System-Based Forest Monitoring (GEOFORMIN) in Nigeria, Abuja, 27th – 30th March, 2006

Padham, J. 2006. Agricultural development under changing climate: Opportunities and challenges for adaptation. The World Bank Joint Discussion Paper, Agriculture and Rural Development and Environment Departments, The World Bank, Washington.

Poffenberger, M. (Editor) 1996. Communities and Forest management. IUCN Working Group on Community Involvement in Forest Management. IUCN, Gland, Switzerland

Sofowora, A. 1993. *Medicinal Plants and Traditional Medicine in Africa*, 2nd Edition. Spectrum Books, Ibadan

Steentoft, M. 1988. *Flowering Plants in West Africa*. Cambridge University Press, Cambridge.

White, F. 1983. *The Vegetation of Africa. A Descriptive Memoir to Accompany the Unesco/AETFAT/UNSO Vegetation Map of Africa*. Natural Resources Report XX, UNESCO, Paris.

Wikipedia. The Free On-line Encyclopedia. http://en.wikipedia.org/wiki/Emissions_trading (downloaded June 2010)

APPENDIX 1
Distribution of Endangered Plant Species within the Different Families (From FMAWR&RD 1986)

Family	No. of endangered species	Family	No. of endangered species
Acanthaceae	26	Loganaceae	4
Adiantaceae	5	Lomariopsidaceae	2
Agavaceae	2	Loranthaceae	1
Amarantaceae	1	Lycopodiaceae	1
Anacardiaceae	7	Malvaceae	1
Annonaceae	15	Marantaceae	1
Apocynaceae	19	Melastomataceae	8
Araceae	3	Melastomataceae	2
Araliaceae	1	Menispermaceae	2
Aristolochiaceae	3	Mimosaceae	3
Asclepiadaceae	2	Monimiaiaceae	2
Aspidiaceae	7	Moraceae	9
Aspleniaceae	6	Myristicaceae	2
Athyriaceae	2	Myrtaceae	1
Balsaminaceae	1	Najadaceae	1
Begoniaceae	2	Ochnaceae	1
Boraginacae	4	Octoknemataceae	1
Burseraceae	1	Olacaceae	1
Butamaceae	1	Oleaceae	1
Caesalpiniaceae	13	Onagraceae	1
Capparidaceae	2	Opiliaceae	2
Caryophyceae	2	Orchidaceae	23
Celastraceae	6	Orobanchaceae	1
Combretaceae	9	Oxalidaceae	2
Commelinaceae	3	Papilionaceae	8
Compositae	36	Pedaliaceae	1
Connaraceae	6	Pittosporaceae	2
Convolvulaceae	3	Plantaginaceae	1
Cruciferae	1	Podostemaceae	2
Cucurbitaceae	6	Protaceae	1

Cytheacea	1	Ranunculaceae	2
Cyperaceae	21	Rosaceae	3
Dennstaedtiaceae	1	Rubiaceae	16
Dichapetalaceae	11	Rutaceae	3
Ebenacaeae	7	Salvadoraceae	1
Ericaceae	2	Santalaceae	1
Eriocaulaceae	3	Sapindaceae	8
Euphorbiaceae	31	Sapotaceae	2
Flacourtiaceae	7	Scrophulariaceae	2
Gentianaceae	2	Scytoppelaceae	2
Geraniaceae	1	Selaginellaceae	1
Gnetaceae	1	Simaroubaceae	2
Goodeniaceae	1	Sloganaceae	1
Gramineae	19	Sterculiaceae	4
Guttiferae	4	Thelypteriodaceae	2
Hypmenophylaceae	4	Thymelaeaceae	3
Hypericeae	3	Tiliaceae	2
Icacinaceae	2	Ulmaceae	1
Guttiferae	4	Umbelliferae	3
Iridaceae	1	Urticaceae	2
Labiatae	6	Verbanaceae	2
Lauraceae	2	Violaceae	2
Lecythidiaceae	2	Vittariaceae	1
Lemnaceae	1	Vochysiaceae	1
Lentibuariaceae	1	Xyridaceae	1
Liliaceae	2	Zingiberaceae	2
Lobeliaceae	3		