UNIVERSITY OF PORT HARCOURT

"BIOLOGICAL DIVERSITY: INCREDIBLE GENEROSITY, INCREDIBLE RESPONSIBILITY"

An Inaugural Lecture

By

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DEDICATION

This inaugural lecture is fondly dedicated to my lovely grandmother; late Mrs. Elizabeth Omatu Ndukwu (nee Onwuamaeze) whose tenderly care and admonitions taught me early that human beings can love if they chose to do so. May her very kind soul rest in perfect peace. Amen.

ACKNOWLEDGEMENT

Mr. Vice Chancellor, permit me a few minutes to acknowledge some persons who played key roles in shaping my life and future.

I will like to thank the Almighty God who has a hand in the affairs of men. His unseen hand has indeed guided my affairs, and has produced something out of an ordinarily obscure and insignificant fellow. To Him be glory and honour. Amen.

Let me specially thank my parents, Ichie Hycainth and Ezinne Virgina Ndukwu. They laboured, pursued and pushed until I attained a satisfactory level of education. Together with my many siblings we all shared in pains and gains. Our togetherness and shared responsibilities kept me going even when it seemed very tough.

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My academic mentor, Professor 'Bosa Ebenezer Okoli contributed so much in shaping my future research focus. His interest in me eventually translated into a relationship that was beyond Teacher-Student status to a more intimate and robust one in many other

affairs. I thank him so much and feel glad that he is alive to see me become something.

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ourselves. These organizations and their staff gave me the opportunity to contribute and further deepen my understanding of Biological Diversity especially for the Niger Delta area.

Mr. Vice Chancellor, to reach this academic height, you will agree that so many actors and actresses must have played one role or the other such that time and space may not allow me to mention all of them. But please permit me to mention some spiritual leaders like Dr. Cosmas Ilechukwu and Pst Gerry Ukah. These men had tremendous influence on my life. Their zeal and quest for excellence was a great spur to me. I am happy to have been associated with them early in my life.

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Let me conclude this acknowledgement by thanking my BABY- Dr. (Mrs.) Geraldine Ugochinyerem Ndukwu and the children - Nonso, Edozie, Ud, Chuka and Chubby. They gave me joy and support that was unimaginable. You can't have such wonderful

people and will not strive to excel. I plead with God to keep them long by my side.

BIOLOGICAL DIVERSITY: INCREDIBLE GENEROSITY, INCREDIBLE RESPONSIBILITY

Background and Preamble

It was during a holiday extra-mural biology lesson in August 1981.The teacher made a statement that was to have profound influence on my inquisitive mind. He said then '*all the similarities and variations of the plants and animals we see around us are due to genes carried by chromosomes*'. Based on that perhaps unintended statement, I decided to study genetics to learn more about these genes and chromosomes. It was against this backdrop that I entered for Biological Sciences (Botany) in the Joint Admission and Matriculation Board (JAMB) examination of 1982 with University of Port Harcourt as first choice. I had a total score of 248 and topmost of all candidates for Botany that year. I therefore studied Botany by choice and not because I could not secure admission into any other course.

Then again something startling happened in a 100 level practical Phycology (Algology) class handled by Dr (Mrs.) B.H.R. Wilcox. She led us to prepare slides of certain blue green algae (*Nostoc* spp.) and *Anabeaena azollae* usually found within the intercellular cavities of tiny leaves of duckweed (*Lemna* species) and fronds of the smallest angiosperm plant – *Azolla* Species. I could not believe that those tiny leaves could harbour thousands of the algal organisms. I again resolved to seek for more knowledge of this profound 'mysteries' represented as diversity of organisms.

The Genetics and Systematics courses we were to take as part of the undergraduate training prepared appropriate background for

my inquiry into knowledge. I had to carry out my undergraduate thesis on Cytological (Chromosome) karyotyping and manipulations using two plant species (*Allium cepa* and *Crassocephalum biafrae*) under supervision of Prof. B.E. Okoli (a foremost Geneticist). He was later to supervise my Masters and Doctoral thesis in related fields also. The outcome of these initial research efforts was that biological diversity is profound and deeper than I had thought.

It was in this state that I came across the publications of Professors Inga and Oslo Herdberg of University of Sweden. I contacted the couple who promptly responded and to my astonishment literally emptied their library for me. In 1998, they sent cartons of different books including their publications and those of others related to Biodiversity. One of the books contained the essays of Edward O. Wilson of Harvard University who is known today as the Father of Biodiversity.

I suppose all these prepared me adequately for the various roles I was going to play towards a better understanding and response to Biodiversity whether it was in Shell Petroleum Development Company (SPDC) where I pioneered Biodiversity integration into business or Nigerian Natural Medicine Development Agency (NNMDA) where I work with other stakeholders to deepen our collective response to natural medicines from Biodiversity.

Another event happened in 2010 when I was invited by the Rivers State Ministry of Environment, to prepare a lecture on the theme of that year's World Environment Day (WED) Celebration – '***Many Species, One Planet, One Future***'.

Two other related events also happened in 2011. First I was mandated to conduct key activities to raise awareness among NDDC staff as part of the May 22nd International Biodiversity Day (IDB) Celebration with the theme 'Forest Biodiversity'. The second was an invitation to deliver a keynote address to mark African Traditional Medicine Day Celebration at the Federal University of Technology, Minna, Niger State on 15th September, 2011. The theme for that celebration was 'Conservation of Medicinal Plants: Africa's Heritage'.

I suppose these varied historical events, roles and perspectives culminated in preparing the background and foundation for today's lecture on ***Biological Diversity – Incredible Generosity, Incredible Responsibility.***

1.0 Introduction

Mr. Vice Chancellor, distinguished Ladies and Gentlemen, let me begin this lecture with the statement from the foremost Harvard Sociobiologist and indeed one of the known progenitors of the word Biodiversity – Professor Edward O. Wilson.

> *'The worst thing that can happen during the 1980s (and beyond) is not energy depletion, economic collapse, limited nuclear war, or conquest by a totalitarian government. As terrible as these catastrophes would be for us, they can be repaired within a few generations. The one process ongoing since the 1980s that will take millions of years to correct is the loss of genetic and species diversity by the destruction of natural habitats. This is the folly that our descendents are least likely to forgive us'.*
>
> *- E.O. Wilson, 1985*

Someone may then ask a very simple and honest question. What is biological diversity? To this question, I will like to address in a very short while to lay appropriate foundation for our discourse today.

The term biological diversity was used first by wildlife scientist and conservationist Raymond F. Dasmann in a lay book, *"A Different Kind of Country,"* advocating conservation (Dasmann, 1968). The term was widely adopted only after more than a decade, when in the 1980s it came into common usage in science and environmental policy. Thomas Lovejoy, in the foreword to the book *Conservation Biology*, (Soulé and Wilcox. 1980) introduced the term to the scientific community. Until then the commonest term was "natural diversity" introduced by The Science Division of

The Nature Conservancy (TNC) in an important 1975 study, "The Preservation of Natural Diversity." By the early 1980s TNC's Science programme and its head, Robert E. Jenkins, Lovejoy and other leading conservation scientists at the time in America advocated the use of "biological diversity".

The term's contracted form *biodiversity* may have been coined by W.G. Rosen in 1985 while planning the 1986 *National Forum on Biological Diversity* organized by the National Research Council (NRC). It however first appeared in a publication in 1988 when Harvard sociobiologist E. O. Wilson used it as the title of the proceedings of that forum (Wilson, 1988). Since that period the term has achieved widespread use among biologists, environmentalists, political leaders, and concerned citizens.

Biological Diversity or simply **Biodiversity** is a critical component of our overall natural resources. It is the totality of all species of plants, animals and microorganisms and the ecosystems and ecological processes which drives all natural systems. Biodiversity is a term that conveys the degree of nature's variety and variability including the number and frequency of genes, species and ecosystems in their totality (Soule and Wilcox, 1980). It is used to describe the variety of life forms in nature (the HUGE variety of animals and plants on our planet, together with the places where they are found).

However, the most current and widely accepted definition of Biodiversity was as adopted at the Convention on Biological Diversity (CBD) endorsed during the United Nations Conference on Environment and Development (UNCED) otherwise known as Earth's Summit at Rio de Janeiro 1992. It states that Biodiversity is '*the variety and variability among the living organisms (plants,*

animals and microorganism) from all the terrestrial ecosystems, and the ecological complexes of which they are part, and this includes the diversity within the species between the species and of the ecosystem'. The ecological complexes in which variety of life forms exist are the intricate and interdependent relationships that often occur among co-existing organisms including the various processes that are going on continuously in the ecosystem whether terrestrial or aquatic. The diverse interconnected food chains and food webs create an ecological balance in nature. The loss of any one or more species may threaten the existing ecological balance of nature leading to a great direct or potential loss to humans.

Diverse genes constitute individual species, and diverse species inhabit diverse habitats (ecological systems or places) of the earth. All these sum up to biodiversity.

Genes ⟶ ***Species*** ⟶ ***Ecosystems***

The total number of biological species present on earth is very uncertain and no centralized catalogue of named and documented species exists. It is also possible that some species are recorded under different names by different researchers. However, the actual documented number of organisms is much smaller than what occurs in nature. Until recently only about 1.8 millions species have been named and recorded (Santosh *et al*, 2006). This includes about 0.5 million plant species, 1.3 million of animal species, out of which 75% are insects. The uncertainty about the total number of biological species, and great variation in their estimation says a lot about how little we know about our world's biodiversity (Plate 1).

Plate 1: Sections of Tropical Rainforests with Rich Biodiversity: Ughelli River (A); Uniport Conservation Area (B); Uniport Botanic Garden (C & D).

1.1 Origin of Biological Species

There are various facts, myths, hypothesis and theories about the origin of species on earth. Different tribes, religion and science have different views on the origin and causes of diversity among the different species of organisms on earth. Two widely accepted and contradicting theories are - religious and evolution theories.

The Religious (Biblical) Theory: Popularly believed among the Judeo-Christian sects, this theory is as contained in the Biblical account of creation. It is purely a religious theory and does not rely on any scientific evidence. According to the theory, the earth and its biodiversity were created by a superior and intelligent being called God. He designed and executed the master plan of how the earth and its content would look like. According to the story, "In the beginning the earth was without form and void. God created the heaven and earth and everything in it in just six days and rested on the seventh day. He then gave every living thing He has created the command of procreation. *'let each organism reproduce their kind and fill the earth'* (Genesis 1:1-2). Thus a goat should reproduce a goat; yam to reproduce yam, melon to reproduce melon, man to reproduce man, bacterium to reproduce bacterium etc. God gave man the authority to lord and rule over the earth and its creation. From this theory, it means that all the varying organisms - biodiversity on earth were designed and created by God.

The Evolution Theory: This is also regarded as the scientific theory and often seems to contradict the biblical theory. The theory was popularized by Charles Darwin in his classical book, "*the origin of species by means of natural selection "* written in 1859, in which he postulated that natural selection acting through environmental pressures is the driving force behind the accumulation and success of species with favourable variations and exclusion of those with unfavourable abilities. He believed that present day organisms evolved from earlier unrelated species. The modern view of evolution (***Neo-Darwinism***) however combines Darwin's theory with our present knowledge of genetics and molecular biology. Current understanding of the evolution theory states that natural selection is not the only driving force

that regularly produced adaptive evolutionary changes. Several forces such as recombination, hybridization, mutation, genetic drift and other isolating mechanisms also play significant roles in the evolution of organism.

According to the evolution theory, new species arise through modification of existing species which can happen in two ways:

(i) One species becomes transformed into another. Here the ancestral species becomes extinct and is replaced by a new species.

(ii) New species evolve as branches from existing species. This is called speciation. This process increases the number of species and is responsible for the diversity of organism.

In my view, the hard-line pro-Darwinists seem to have pressed their assumptions on the evolution theory too far. As a matter of fact, it will be difficult for any scientist irrespective of his or her standing to insist that the living species we have today arose from some non living materials of a sort. If so, we can then challenge such eminent scientists to assemble and formulate these non living materials and create new set of living organisms. I suggest that the best approach to our resolving the conflicts about evolution is not for the scientists to be seeking ways to disprove the theory of Divine Creation. We should be humble to accept that we cannot fully understand and explain everything on the basis of 'material' existence. If we are asked to explain how and where the original materials came from? Then all our arguments will suddenly flatten and hang. For as many will unequivocally assert, ever since we have been born, and as our father's told us, every species had continued to give birth to its kind. Or did evolution, as propounded stop immediately after Darwin and his co-travelers? Let's leave that for another day.

The best that science can do is to seek to understand how nature works, and thereafter learn how we can profit from the incalculable wisdom embedded in nature itself.

What we have come to know based on our investigations and observations over the years is that there is nature-facilitated innate and inherent propensity to diversify. It is nature that is at the background of mutation, hybridization, cross fertilization, habitat and environmental heterogeneity. These are the known factors that trigger adaptation, speciation, evolution and diversity of organisms. And we can strongly suppose that nature in its wisdom must have established this in-built diversity process as an essential insurance that would prevent the sudden wiping away of any particular species group by natural or man-made assaults. There are always '*individuals that can survive and thrive no matter the adversity*' is a universal policy of nature. Thus given any set of challenges certain individuals can always emerge to surmount these by some acquired capacity and natural resilience.

1.2 Types and Levels of Biodiversity

On the basis of whether the variability occurs within a species or among different species or between ecosystems, three types or levels of biodiversity are known (Campbell, 2003; Ndukwu, *et al*, 2012). These are: genetic diversity, species diversity and ecosystem diversity.

Genetic diversity: This is the diversity or variation that occurs among the same species due to the differences in their constituent genes. The genes are the basic unit of heredity transmitted from one generation to another. Though the genes of the same species are identical, variability often occur in the different individual organisms. For instance although pumpkin (*Cucurbita moschata*)

is a single species, several varieties occur in nature due to differences in the genetic composition (Plate 2).

Plate 2: Genetic Variants of Species of *Cucurbita moschata*
(Agbagwa & Ndukwu, 2004)

Species diversity: This is also known as organismal diversity. It is the variation among species of organisms of a community. It is made up of species richness and species evenness. It occurs whenever the forces of speciation and isolating mechanisms have sufficiently separated related organisms to an extent that they can no longer interbreed effectively.

Ecosystem or ecological diversity: This is the variation that occurs among ecosystems in terms of their structure and functions. There are wide variations among the various ecosystems due to differences in their physical conditions like climate (rainfall, temperature etc.), topography and edaphic, etc factors. There may also be variations within a particular ecosystem. For instance there are different forest types such as rainforest, boreal forest or swamp forest. Ecosystem diversity gives rise to tremendous diversity in biological life because varying species prefer and occur in different habitats and ecosyems.

1.3 Diversity Range among Living Organisms - Plants

One of the most important pre-occupation of man in his environment is the ordering or the classification of living organisms. Grouping of organisms may be done on the basis of various criteria such as their uses to man, their habitat or their biological attributes (Ndukwu, 2001). In classification very few or combination of criteria may be used in classifying organisms.

As evolution develops, classification of organisms supposedly based on their evolutionary relationships (i.e. relationship by decent) were popularized. All forms of classifications are however the result of accurate identification and systematic arrangement of the organisms.

Taxonomy – the science of classification and identification and its related field Systematics involves the naming (nomenclature), gathering and assessment of classification of data. Scientific names were given to organisms based on binomial nomenclature developed by **Carolus Linnaeus**. The names consist of two words (genus and species) and the name (s) of the persons that first named or classified the organisms (authority). Let us show this using the plant kingdom as example.

There are many different organisms belonging to diverse species, genera, families, orders, classes, divisions and kingdoms. These are grouped into categories in a systematic format for ease of identification by scientists based on their similarities and differences.

1.3.1 Classification of Plants

Kingdom	Divisions	Class
Planta	Thallophyta	phycotina (Algae)
		Mycotina (Fungi)
	Bryothyta	
		Hepaticae (Liverworts)
		Musci (Moses)
	Pteridophyta	Psilotinae (*Psilotum*)
		Lycopodinae (*Lycopodium*)'
		Equesetinae (Horsetales).
		Filecinae (Ferns)
	Spermatophyte	Gymnospermae (Gymnosperm)
		Angiospermae (Angiosperm)

Thallophyta
These are in thalloid forms – without distinct body division such as root, stem and leaves. They are largely small plants which are rarely visible to the unaided eye. However species that are fairly large exist among them. They include the bacteria, algae and fungi.

Bryophyta
The bryophytes are small with leaflike, stemlike and rootlike structures that propagate by spores – mosses, liverworts and

hornworts were grouped together because of various similarities in reproduction, form and habitat.

Pteridiophyta
These are plants with featherlike leaves. They are cryptogams with well developed vascular system. They are known as vascular cryptogams. Most pterdiophytes especially ferns are terrestrial growing in moist and shady place.

These three divisions indicated above are often grouped into a sub-kingdom Cryptogamae (non flowering plants)

Spermatophyta.
These are the most advanced in plant kingdom. Some botanists treat them as a single division in the subkingdom Phanerogamae (flowering plants). Spermatophytes are also known as seed plants. The seed plants are divided into 2 groups those that have naked seed (**gymnosperms**) and those with enclosed seed (**angiosperms**). The angiosperms consist of monocotyledons and dicotyledons.

1.4 Global Distribution and Status of Biodiversity
The highest degree of biodiversity in the world is found in the humid tropics (WWF, 1989). In general, however, the degree of biodiversity in different organisms varies among regions and within each major geographical region (Groombridge, 1992; Hillebrand, 2004). There are many more species of fresh water fish in the tropics than in temperate countries (Benton, 2001). It has also been reported that there are more species of breeding birds in Nigeria than in the whole Europe which is ten times the area of Nigeria (Myers, 1990). Within the continent of Africa, the highest species diversity occurs in the equatorial areas because species diversity, just as with primary production, is highly correlated with

annual rainfall (Okigbo, 1994). Of course, within each area there are other modifying factors such as the landscape, drainage, vegetation and soil type (Stuart *et al*., 1990, Ndukwu, 2011). Environmental heterogeneity, in space and time, usually increase biodiversity. Consequently, within the continent of Africa for instance, even among countries close to the equator, differences in biodiversity may be accounted for by variations in topography and other environmental factors which are responsible for habitat and ecosystem differences. Thus in Africa, as a result of high rainfall, the highest species diversity occurs in the equatorial areas. In these areas, other factors such as landscape, drainage, vegetation and soil types further affect the distribution of biodiversity. An estimate of the recorded number of species of plants in 12 countries with highest levels of diversity in African continent confirms this observation (**Table 1**).

Table 1: Estimated Number of Plant Species in some Countries of Africa

S/N	**COUNTRY**	**NUMBER OF PLANT SPECIES**
1	South Africa	21, 988
2.	Zaire	13, 243
3.	Tanzania	12, 633
4.	Madagascar	11, 771
5.	Cameroun	10, 184
6.	Kenya	9, 370
7.	Gabon	8, 032
8.	Ethiopia	6, 986
9.	Uganda	6, 631
10.	Angola	6, 442
11.	Zambia	5, 974
12.	Nigeria	5, 949

Source: Okigbo, 1994

It must be noted that topography is the single most important factor that influence species diversity in Africa. For instance, Zaire and Cameroun possess higher diversity than the countries of West Africa ((Okigbo, 1994) and in Nigeria, diversity of plants occurs more in the areas around Cross River State than western parts due mainly to geomorphologic variability.

2.0 The Value of Biodiversity – Nature's Generosity

Let's Make a New Planet…The Case of Biosphere 2

There was recorded this story where Scientists tried to make a materially closed system the same as the earth to support 8 adults completely for 2 years. The system was provided with plants, animals, soil, water, air and climate at the cost of over 200 million USA dollars and hundreds of man hours. Unfortunately it completely failed. Surprise changes in the environment, a dramatic fall in oxygen levels and rise in carbon dioxide, a rise in nitrous oxide concentrations, overloading of water systems with nutrients and the extinction of all pollinators (e.g. bees etc.). In short, all our technology, ingenuity, financial resources and technical skills cannot build a system to provide for 8 humans - let alone a life support mechanism that natural ecosystems provide for free.

Almost all cultures have in some way or form recognized the importance that nature, and its biological diversity has had upon them and the need to maintain it. Yet, power, greed, materialism and politics have affected the precarious balance necessary for prolonged life on earth. As clearly documented by the CBD, at least 40 per cent of the world's economy and 80 per cent of the needs of the poor are derived from biological resources. In addition, the richer the diversity of life, the greater the

opportunity for medical discoveries, economic development, and adaptive responses to such new challenges as climate change.

We have said that the exact number of species of all groups of organisms on our earth is unknown. Currently, science has listed about 1.75 million species (Normile, 2010), but since most have not been discovered yet, we can realistically estimate that the actual number is closer to 40 million with insects alone approximately 75% of all species. Every one of these species possesses a combination of genes that defines their characteristic morphology and capacity to interact with the world.

The total amount of genes differ; bacteria count 1000, mammals 100 000 and flowering plants possess the highest amount with more then 400 000 (Campbell, 2003). This genetic baggage is passed through to each generation and causes a species to evolve in a certain way when confronted with natural selection or environmental challenges. Nature's constant pressure: predators, extreme temperature or the challenge to consume energy, explains their different shapes.

Genetic diversity plays a crucial role in the stability of our ecological system, and what we retrieve from it is priceless. Every species fulfills a role in the earth's biosphere and assures ecological survival. By self-regulation, biodiversity keeps the soil fertile, recycles all nutrients and cleans the air and water. Moreover, the richer the genetic base, the higher the capacity to fight different viruses or bacteria, which are also species that evolve. For every virus, there is a gene capable to neutralize it. It is this diversity of the genetic baggage that makes natural extinction so rare.

Many products, whether industrial or medicinal exist because we have biodiversity. Because of its rich diversity, the tropical forest

provides us with special medicines that can help us overcome diseases. But most importantly, biodiversity provides food for humans. Different kinds of plants and animals mean different kinds of food as well. Food diversification assures us the possibility to have provisions when contamination or extinction happens to a certain type of food. This is a crucial advantage for our survival (Okigbo, 1994; Normile, 2010 and Ndukwu, 2011).

Basically therefore, biodiversity provides everything humans need to survive: food, fresh air, clean water, clothing, medicine and material for shelter (different types of wood for example). It is considered for some people to be the most precious thing we have on earth. A rich ecological environment is indeed very complex, and is impossible for human to recreate (Plate 3).

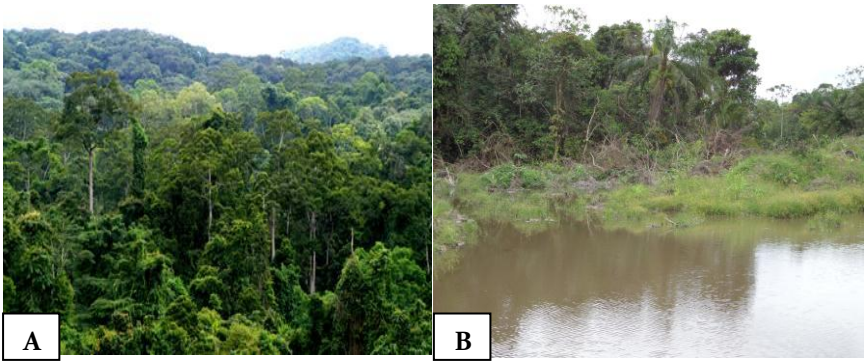

Plate 3: Tropical Rainforest: Centre of Incredible Diversity Peru (A); Uniport (B)

Biodiversity however means different thing to different people depending on their culture, economic status and environmental consciousness (Ndukwu, 2000; Ndukwu and Obute, 2005). This was aptly captured by a Jordanian herder and gatherer:

"*When I am hungry, a date palm gives me food. When my belly is full, behold, the tree is beautiful*." -

In general, the economic value attached to any biodiversity component depends on its utility to humans and the environment. In many cases, the economic value of a bioresource is taken as the only worthwhile value arrived at by often biased monetary valuation systems. This is very unfortunate as we are yet to fully understand several components of biodiversity.
In most instances biodiversity is valuable because:

- The well-being of humans depends on robust economies and a healthy natural environment.
- Biodiversity is a natural capital on which societies depend for economic growth and development.
- Biodiversity has inherent values of beauty and tranquility and thus valuable for just being existent.

In all, there are biodiversity **direct, indirect** and **option** values; as well as **non-use** values which must be aggregated in order to capture the total economic value (TEV) of biodiversity (Jeffrey, 2004).

This total economic value (TEV) of biodiversity therefore comprises both Use and Non-Use Values of its particular components. The use values include the goods or direct uses (both consumptive and non consumptive), or indirect uses and option values, while the non-use values embrace such futuristic aspects like spiritual, cultural, aesthetics and existence values. The indirect uses or services (functions) of biodiversity are the life-sustaining functions derivable by humans and the ecosystems. The overall TEV of Biodiversity thus includes:

- The goods or direct uses of biodiversity including food, clothing, medicines, shelter, clean air, fresh water, energy (fuel wood) and industrial raw materials.
- Services and life sustaining functions provided by biodiversity like photosynthesis (food production) and pollination (producing fruits, seeds),
- Cycling of nutrients, climate regulation, drought and flood control, land purification, provision of habitats for species
- Income generation for peoples and countries world-wide
- Cultural, spiritual and aesthetic values
- Recreational, psychological and emotional fulfillment
- Enhanced human capacity to adapt to future environmental changes, risks and uncertainties.

The various components that add up to biodiversity total economic value are shown in Fig. 1.

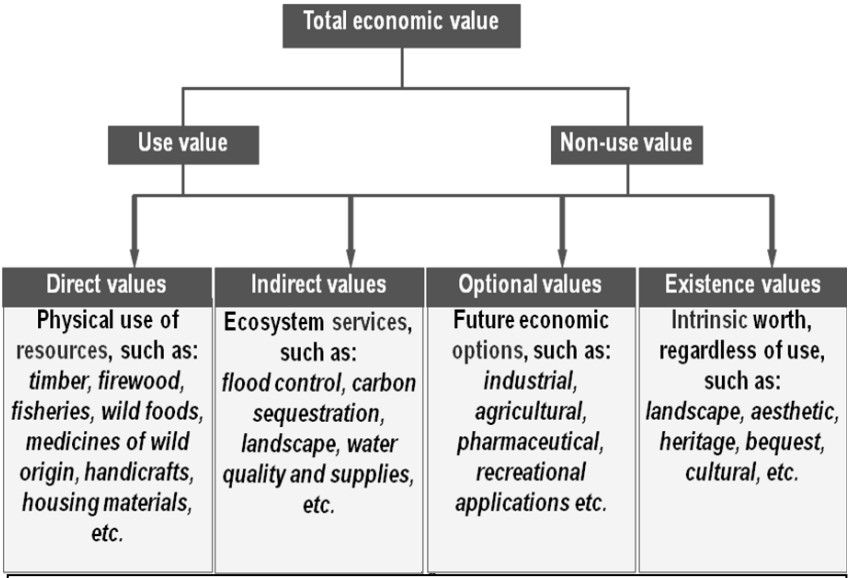

Fig 1: Total economic value (TEV) of ecosystems – a level of biodiversity

2.5.1 Direct or Consumptive Biodiversity Uses

- **Food (from wild and domesticated sources)**

The most fundamental benefit we derive from other species with whom we share the planet is in our food. We use other species to obtain food somewhere between two extremes. At one end farming where land is completely re-engineered for the growth of food species, be it maize or cattle; and at the other collecting wild foodstuffs, where the land is relatively intact and food is taken from where it grows in nature. For example hunting wild antelopes or collecting fungi (mushrooms), bush mangoes, bread fruits, star apples, oil bean seeds, bush pears or snails (Plates 4 – 11) remains the means of obtaining various kinds of foodstuffs for mankind in all cultures. In many instances, obtaining foodstuffs from the wild collections seems preferable. A number of reasons may account for this; the ecosystem is relatively intact, most species are preserved, genetic diversity is not reduced, food is local, fresh, little transport costs, meaningful interaction with nature etc. Recall that many of us as children enjoyed going to our local vegetable farms with our mummies.

Currently after several years of farming, less than 3000 out of the nearly 250,000 species of flowering plants are regarded as food source, and about 200 domesticated for food while 90% of the per capita plant food supply of 146 countries is supplied by 103 plant species (Campbell, 2003). In the animal world, the number of species used is even more restricted. This is demonstrably bad for biodiversity, as globally one-third to one-half of the earth's land surface has been transformed by humans, the biggest contribution by farming.

The World Conservation Strategy 1980 reported that biodiversity provides the bulk of human food needs:

- Fish and aquatic animals contribute 17% of animal protein in human diet.
- 65% protein comes from plant cereals, beans, peas, nuts and oilseeds.
- 4 varieties of wheat produce 75% of that crop in Canada.
- 4 varieties of potato produce 72% of this crop in USA.
- Every coffee plant in Brazil descends from a single plant.
- Entire soya bean industry is derived from 6 plants.

Plate 4: Fruits and Seeds of *Irvingia gabonensis* (African Bush Mango)

Plate 5: Fruits and Seeds of *Treculia africana* (African Bread fruit)

Plate 6: Fruits and Seeds of *Chrysophyllum albidum*
(African Star apple)

Plate 7: Fruits and Seeds of*Dacryodes edulis* (African bush butter)

Plate 8: Seeds and Sliced Seeds of *Pentaclethra macrophylla* *(*African Oil Bean Seed)

Plate 9: Fruit/Seeds of *Canarium odontophyllum* (Dabai or Ube Mgba)

Plate 10: Delicious edible mushroom (Fungus) on a decaying tree log

Plate 11: African Giant Snail (*Achantina* spp) mostly collected from our forests

- **Medicines (both for traditional and orthodox health care)**

Another major use-value of biodiversity is medicine. Most of the world's drugs are of wild origin either as direct biodiversity products or goods or extracts from these. Over time, critical medications including aspirin, tamoxifen, quinine and digitalis have largely been discovered by accident because plants or animals produce biochemicals for defense or attraction. The pharmaceutical industry today relies heavily on such discoveries to develop new drugs or improve existing ones (Chivian and Bernstein, 2008).

Consequently, in the field of human health, robust biodiversity has led to the development of drugs that come from plants or microbes. About half of all drugs on the market across the globe are derived from plants, animals, or microbial organisms. Although in recent decades more research has been spent on developing synthetic drugs, many believe that the energy and money would be better spent on exploring new treatment options

based on natural sources. In this case, maintaining biodiversity has an obvious benefit: the more plants, animals, and microbes that exist, the better the chances of finding treatments for a wide range of diseases.

The medicinal importance of biodiversity is particularly impressive considering that only a tiny fraction of earth's species have been thoroughly investigated for medicinal properties. Who knows the medicinal potentials of the thousands of yet-to-be discovered plethora of species? The enormous medicinal potentials of many tropical species such as *Garcinia kola*, *Moringa oleifera* and *Annona muricata* (Plates 12 -14) are only being appreciated most recently.

Plate 12: Fruits and Seeds of *Garcinia kola* (Bitter kola)

Plate 13: Shoot, Fruit Pods and Seeds of *Moringa oleifera* (Tree of Life)

Plate 14: Fruit head of *Annona muricata* (Soursop Fruit)

- **Energy needs (rudimentary and hi-tech)**

Fuel wood (Plate 15) is one major sources of energy in developing countries. It is acually the indiscriminate felling of live trees in these developing countries to meet the energy needs of the rural populace that has put a stress on biodiversity. One worrisome fact about this is that trees are not replanted when felled despite the campaigns and efforts of environmental advocacy groups. The

current interest in biogas and biodiesel as alternatives to fossil fuel also depends on biodiversity. Moreover, fossillized biodiversity has sustained the oil and gas industry that puts our boats out to sea, our cars on the road and our planes in the skies.

Plate 15: Fuel wood gathering is common in many traditional communities

- **Clothing (from animal and plant materials)**

Clothing for humans ranging from fibre, cotton, linen, hides and skins, jewelry from elephant tusks, fur and wool are products of biodiversity. Even the synthetic textile materials used in making clothing (Plate 16) are copies of natural raw materials adapted from biodiversity. Animal skin shoes, bags and belts serve some exotic tastes that some of the source animals have either become highly threatened or at the verge of extinction.

Plate 16: Clothing materils from biodiversity components

- **Habitats Construction Materials (for humans and animals)**

Much of the construction for human and animal habitation (Plate 17), bridges, fences, hedges derive materials from biodiversity. Timber is a significant biodiversity contribution to the housing needs of humans. All the global timber needs are supplied by forest trees for different purposes. It is the overexploitation of timber in most cases that has had the most devastating effects on forest resources. Timber may be treated and transformed into various refined products used in the wood industry. Such wooden panels found in cars, planes, trains, hand rails, floors, boats, ships, beds, sofas, mortars and pestles, dugout canoes and paddles etc are derived from timber.

Apart from humans, animals depend on materials from ecosystems to contruct their nests, roosting grounds, holes in trees, termitaria, ant hills etc.

Plate 17: Materials and forms of habitats by humans and other animals using biodiversity. A). Tailor ants weave their nest with leaves from living plants. B). Forest wood used to construct pens for domesticated animals. C). Straw for construction of huts on a camel. D). Bird nest attached to a plant.

- **Non timber or Non-wood forest products (NTFP's or NWFP's)**

There are several products of forests, besides wood or timber that are directly consumed by humans. These include snails, spices, wrapping leaves (Plate 18), ropes, bush meat, fruits, nuts, sea food, mushrooms and all are important livelihood supports. As a matter of facts, these are some of the resources that are most cherished in many rural cultures around the world. Other products including extractable secondary metabolites from plants yield products such as dyes, inks, tannins, gums, phenols, resins and several rare biochemicals that drives major industrial concerns. Some of these products and services obtained from biodiversity are listed in Table 2.

Source: Shell and Biodiversity 2008

Plate 17: Spices from forests drive major economic activities. A. Guinea pepper (*Piper guineense*). B. Alligator pepper (*Aframommum melegueta*). C. *Xylopia aethiopica*. D. African nutmeg (*Monodora myristica*). Insert: Protein sweetener (*Thaumatococcus danielli*) leaves valued as wrappers for food items.

Product	Use	Biological origin
Drugs	Medicine	Micro-organisms, e.g. Antibiotics; Plants, e.g. steroids; Animals, e.g. heparin; Enzymes from micro-organisms, plants and animals.
Enzymes	Industrial	Micro-organisms, e.g. proteinase; Plants, e.g. papain; Animals, e.g. rennin
Flavours	Food	Plants, e.g. vanilla
Colouring agents	Food and cosmetics	Plants, e.g. red colour of Byadgi chillies
Fragrances	Perfumes	Plants, e.g. jasmine; Animals, e.g. musk
Cosmetics	Cosmetics	Plants, e.g. lanolin; Animals, e.g. triglyceride esters
Emulsifiers	Cosmetics, soaps, food	Plants, e.g. laurate
Dyestuffs	Tannins	Plants, e.g. myrobolam
	Textile dyes	Plants, e.g. indigo
Plant growth regulators	Agriculture	Plants, e.g. auxins
Biological agents	Agriculture	Plants, e.g. azadirachtin
		Micro-organisms
		e.g. *Bacillus thuringiensis*
Processes		
Bioremediation	Removal of metal ions from waste water	Micro-organisms
Biobeneficiation	Removal of calcium from alumina	Micro-organisms
Biotransformation	Hydrocarbon degradation Steroid transformation Leaching of metals	Micro-organisms
Oleoresins and oleo chemicals	Flavours Adhesives Lubricants Plastics Cosmetics	Plants; Animals; Micro-organisms
Gene products from cloned genes	For industrial and medical products	Micro-organisms, e.g. pectinase; Plants, e.g. endo-1,3-β-glucosidase; Animals, e.g. insulin
Improving crops and animals through breeding and genetic interaction	Salt tolerance in rice	Plants
	New colours in ornamental plants	
	Increasing growth hormone production for larger size in fish (Salmon, Tilapia)	Animals
	Increasing milk production in dairy animals	
	Production of desired proteins (e.g. tissue plasminogen activating factor) in milk of dairy animals	

2.5.2 Indirect or Non-Consumptive Uses

These are services provided by biodiversity that makes life on planet earth possible. They include ecological functions that stabilize the hydrogeological regimes, nutrient cycling (biogeochemical cycles), soil formation and fertilization, and shoreline protection.

Other ecosystem services include air purification (sequestration of carbon), water purification, climate regulation, generation of moisture and oxygen.

- **Shoreline Stabilization**

The shorelines of many coastal areas especially around tropical estuaries are protected by mangrove species (Plate 19). Such places could have been washed away by ravaging sea waves and coastal erosion were they not protected by these mangrove plants and other associated species.

Plate 19: Shoreline protection by mangrove forest defends coastlines from typhoons, tsunamis and coastal erosions

- **Soil fertility and Nutrient Cycling**

The activities of microbial and invertebrate animal species such as bacteria, algae, fungi, mites, ants, termites, millipedes and worms condition soils by breaking down organic matter to release essential nutrients for enhanced soil fertility and plant growth. These processes cycle such crucial elements as nitrogen (Fig. 2), carbon and phosphorous between the living and non-living parts of the biosphere.

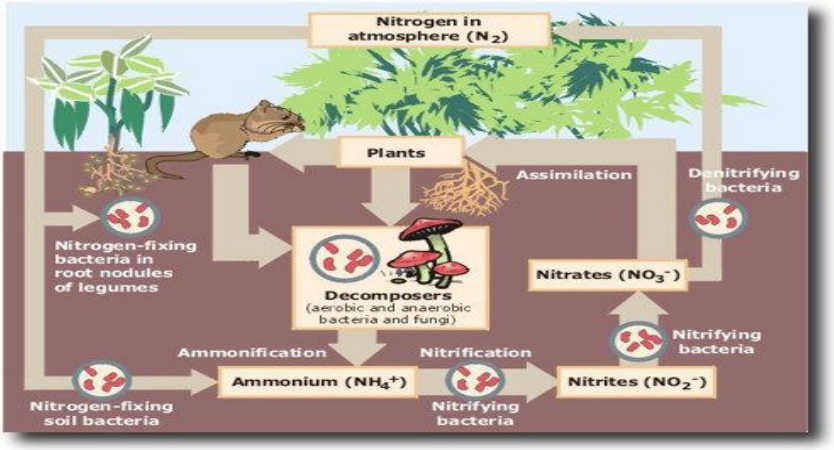

Fig. 2: Diagrammatic Representation of Nitrogen Cycle.
(**Source**: Wikipedia, 2012)

- **Air quality**

Green plants purify the air and regulate the composition of the atmosphere, recycling vital oxygen and filtering off harmful particles resulting from industrial pollution. This is because the process of photosynthesis removes carbon dioxide from the

atmosphere while releasing oxygen in the presence of sunlight. Only green plants are equipped with the facility that can trap sunlight to drive photosynthesis (Fig. 3). In this wise, green plants form a sink to sequester carbon dioxide and thus ensure that the air all humans and other animals breathe is not contaminated.

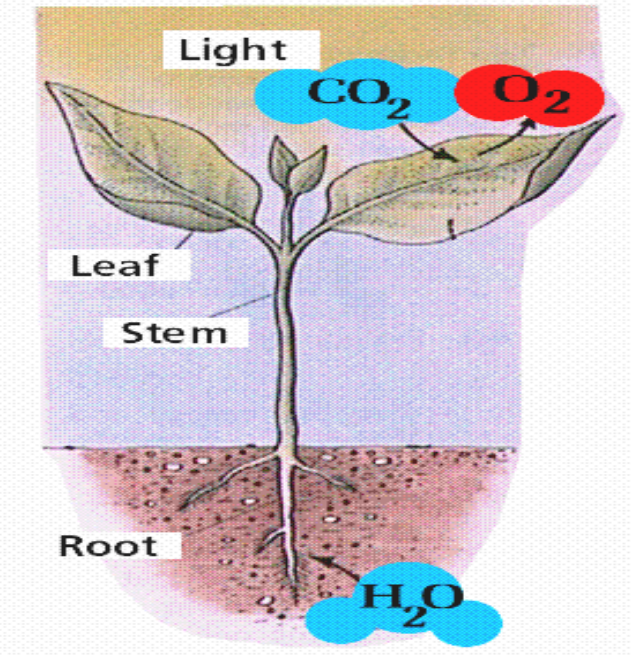

Fig. 3: Basic Diagram of Photosynthetic Process
(**Source**: Wikipedia, 2012)

- **Pest and Weed control**

A variety of organisms, including insects, birds and fungi helps to control weeds and pests of crops and animals. This army of natural enemies or biopesticides provide superior and more

environmentally friendly pest and weed control services since their chemical counterparts often leave problematic residues. More so, pests can easily develop resistance to control by chemicals, which is not the case with biological agents. These natural enemies are the best option in controlling certain obnoxious weeds (Plate 20).

Plate 20: Use as Bioagents for weed control: A. Weevils (*Neochetina bruchi*); B. Insects (*Megamelus scutellaris*) attacking water hyacinth. (Source: Wilkipedia, 2012)

- **Water Quality and Detoxification of Wastes**

Wetland or aquatic ecosystems (swamps, marshes, etc.) absorb and recycle essential nutrients, treat sewage, and cleanse wastes. In estuaries, molluscs prevent eutrophication by removing nutrients from water bodies. In combination with trees, forest soils purify water flowing through forest ecosystems while the network of plant rhizospheres through their binding effects, prevent damages due to erosion and landslides.

Many industrial and municipal wastes, including detergents, oils, acids, plastics and paper are either detoxified and/or decomposed by the activities of biotic agents or biodiversity component of the

ecosystem. In so doing, simple inorganic chemicals locked up in these materials are returned to the soil and plants as nutrients.

For instance, water hyacinth is being used to aid the process of water purification either for drinking or for liquid effluent from sewage systems. For drinking water treatment clean, healthy plants have been incorporated into water clarifiers to remove small flocs that remain after initial coagulation and floc removal or settling (Benton, 2001). The result is a significant decrease in turbidity due to the removal of flocs and also slight reduction in organic matter in the water.

In sewage systems, the root structures of water hyacinth (and other aquatic plants) provide a suitable environment for aerobic bacteria to function. Aerobic bacteria feed on nutrients and produce inorganic compounds which in turn provide food for the plants. The plants grow quickly and can be harvested to provide rich and valuable compost. Water hyacinth has also been used for the removal or reduction of nutrients, heavy metals, organic compounds and pathogens from water (Julien, 2001). At the Songhai Centre in Republic of Benin, this process is used in the open treatment of the sewage from the toilets (Plate 21).

Plate 21: Luxuriant Water hyacinth growing on open sewage.

- **Pollination and crop production**

The dependence of several flowering plants on the activities of various animal species – bees, butterflies, bats, birds, snails etc. (Plate 22) to effect pollination is well known. This service is invaluable considering that the survival of life on earth is consequent upon that of plants. Pollination is fundamental for fruits and seeds to form. Many food sources therefore can only happen if pollination has occurred.

Also, this process provides rare delicacies including honey from honey bee. Ordinarily there would have been no possibility of eating honey by humans without the extraction from the plant's nectar of the raw materials by the bee.

Plate 22: Pollination is an essential biodiversity service not by any other means possible. A. Honey bee foraging for nectar and effecting pollination. B. Snail pollination, a rare but necessary type of biodiversity service. Source: Wilkipedia, 2012

- **Climate stabilization**

Generally, green plant tissues and other organic materials within terrestrial, marine and other aquatic ecosystems serve as storehouse for carbon - the so called carbon sink. Thus by utilizing carbon dioxide these plants aid in slowing down the adverse consequences of atmospheric carbon dioxide build-up (Jeffrey, 2004). In essence, the process directly contributes to climate stabilization. Ecosystems exert direct influences on local, regional, continental and global weather patterns. Rainforests are known to release moisture into the atmosphere which circles as regular rainstorms and thus limits water loss from the tropical regions. Conversely, forests act as insulators to mitigate the impacts of freezing temperatures in temperate regions of the world.

2.5.3 Existence Values of Biodiversity (Non Use Values)

- **Spiritual values and Cultural values**

People's religions, traditions and culture are tied most often with biodiversity components and they spend enormous time and energy to safeguard this cultural heritage. In many communities around the world, cultural affinities have been developed in connection with several components of biodiversity. Think about new yam festivals, kola nut breaking ceremonies, fishing festivals, etc. Biodiversity inspires musicians, painters, sculptors, writers and other artists. Many cultures view themselves as an integral part of the natural world which requires them to respect other

living organisms. Moreover, mankind over the years have developed deep cultural regards and in the process established sacred customs and taboos for certain plants and animals. We are aware of such cultural regards for the iroko tree, pythons, monkeys, etc. I am sure each of us in the audience can recall and mention some of the sacred species and taboos in our own community. We all certainly appreciate that desecration of any such species is usually viewed as onslaught to the community with dire consequences.

- **Aesthetic value**

The beautiful landscapes and seascapes scattered around the globe have some intrinsic recreational qualities that enhance the well being of humans. This value is immeasurable in economic terms. A bird's eye view of the meandering water bodies through the different ecological zones of the Niger Delta is a worthwhile experience. The serene feeling from botanic gardens and the unmatched beautiful flower garden (Plate 23) can often induce healing of the mind for troubled souls

Plate 23: Sections of Beautiful Landscape and Flowers at IPS, Delta Park, Uniport

2.5.4 Option Value of Biodiversity.

This is captured in the futuristic existence and economic importance of biodiversity to be able to provide its essential services and goods to generation yet unborn (WWF, 1989; Okigbo, 1994). Other option values derive from the yet undiscovered possibilities for future uses of wild flora and fauna. In other words some biodiversity of apparent non economic value may in the future become the bedrock for pharmaceutical and agricultural breakthrough, development of new drugs from plants; or in providing genes usable in breeding new characteristics into crops and domestic animals.

Biodiversity's intrinsic educational and research values are of great worth. If not for being there no one would have discovered that *Azadiracta indica* could possess potent active ingredients to deal with the dreaded malaria parasites. This vindicates the option value of biodiversity for the future because a thousand and one other equally important plants, animals and microorganisms are yet to be even described not to mention their hidden potentials for future adaptations of humans to changing scenarios of life.

Of recent there have been palpable concerns of impending energy crises due to dwindling fortunes of fossil fuels and the environmental issues. The search of renewable energy and alternative cleaner fuels is driving rapidly the move towards biofuel. We have pointers to the effect that there are some bioresources that can bridge the gap. Those of us in the tropics and indeed Nigeria can benefit immensely from such energy hopeful since we are endowed with extensive biodiversity as against Middle East or other European nations.

3.0 The Biodiversity Crises and Concerns

People may then wonder why all the fuss and concern for Biodiversity? To that innocent question, I intend to respond briefly.

We are afraid and concerned because biodiversity is shrinking and disappearing rapidly across the globe (Jeffrey, 2004; Ndukwu, 2011). We do know that even without human action, few species will naturally become extinct over time. However, the current rate of extinction is exceptionally too high and mostly stems from human activities. The unusual explosion of human population continues to add pressure on natural resources. The combined factors of overexploitation, urban expansion, habitat loss, pollution and environmental degradation, global climate change as a result of increase in green house gases and ozone widening, invasive alien species etc. are all threatening biodiversity globally. The older generations are already telling stories of the disappearance of previously cherished local fruits, vegetables, spices, condiments, sweeteners and bush meats etc.

Of greater concern however is the abysmal poor knowledge of the intrinsic value of the disappearing species. For instance it was only recently that discoveries were made about a West African plant - Katemfe (*Thaumatococcus daniellii*) known to possess a protein sweetener that was 1,600 times sweeter than sucrose. Another species, serendipity berry (*Dioscoreophyllum cumminisii*), was also discovered with another substance 3, 000 times sweeter than sucrose

Currently, approximately half of the world's species are found in tropical forests. These are the areas of megadiversity mostly around the equator. These areas are often victims of human expansion and deforestation resulting in the loss of critical gene pool. This phenomenon is known as genetic erosion or decrease of genetic diversity. Since species often depend on a specific environment or another species to survive (food chain), genetic erosion is a real domino effect. The present earth's biodiversity is the heritage of a monumental evolution. However human actions are driving many species to extinction leading to the decline of our genetic reservoir. Genetic erosion is wiping out millions of years of evolution and this loss of biodiversity is irreversible.

Biological resources upon which the bulk of humans depend on is shrinking and depleting at alarming rate especially in the recent past. The rate of decrease of biodiversity however varies in the different countries and regions. Although we are yet to identify all available species in the universe to quantitatively assess the exact rate of decrease, some identified species have either become extinct or drastically decreased in number (Okigbo, 1994; Ndukwu, 2011).

4.0 Threats and Causes of Biodiversity Loss

There are several explanations for the loss of populations and species of organisms. There are however fundamental issues which promote the unacceptable loss of biodiversity. If one should ask, why is habitat destroyed or chemicals released into the environment? I do not have space to go into many details to provide possible answers to this question, however two are obvious: *the capitalist regime we live under and numbers of humans on Earth.*

Briefly, under capitalism, everything, from our own time to the food we eat is commodified, as is the natural world. Nature is only worth its exchange-value, without reference to biology. Habitats are not destroyed by magic. Someone pays for it to happen. Land is to be bought, sold and exchanged for profit. This is exceptionally grave for species with reproductive rates lower than the rate of return expected on capitalist investments. This explains why annual crops are preferred, as returns are yearly - the short-term - and rates of reproduction is high. This is why a 3-year rice-growing project is, for a capitalist, always more attractive than a 500 year sustainable timber extraction project.

The second ultimate cause of species loss is the extremely controversial subject of high human population levels. It is a fact that a little above seven (7) billion people now inhabit the Earth and these people need more space, land for growing crops, and material goods than three (3) billion years ago. It is an uncomfortable fact that we live on a finite planet and that the more humans there are the less space there is for the other life forms we share this planet with. We should take these simple truths onboard, while making every effort to attack those who use population arguments as cover for racism and coercion.

In all about ten factors are known to cause biodiversity decline or loss across the globe (Myers, 1988; Okigbo, 1994; Ndukwu, 2011). These are:

1. **Population Pressure** – The rising population of many countries of the world have put concomitant pressure on the use of resources for several development activities – roads, railways, airports, mass housing, large markets, large scale farming etc. With each of these developments go large ecosystems, innumerable species and their genes.

2. **Poor Agricultural Practices** – Agricultural methods and practices involving technologies and slash-and-burn fallow systems (Plate 24) that depend on expansion of the areas under cultivation for increasing productivity, overgrazing in savanna areas have resulted in loss of many plant species due to land degradation and accelerated reduction of forest stands in many areas.

Plate 24: Slatch-and –Burn Shifting Cultivation destroys Biodiversity

3. **Commercial Landuse Metho**ds – Forest destruction and ecosystem conversions for monoculture cultivation in timber and cash crop production, (Plate 25) mining, oil and gas extraction and other related activities have irreversibly destroyed the resource base of strategic ecosystems such as wetlands and coral reefs which harbour unique species;

Plate 25: Oil Palm (Cash Crop) Monoculture Plantation (Depresses Biodiversity)

4. **Poverty and Foreign Debt Burden** – especially in Africa, Asia and South America drastically affects available fund for development purposes and thereby leading to unsustainable exploitation of natural resources with its concomitant deleterious consequences on the resources renewal capabilities and availability;

5. **Over-harvesting and overgrazing** - is heightening environmental degradation, desertification, erosion in the arid and semi-arid areas while uncontrolled harvesting of economic species including for herbal remedies and timber

(Plate 26) is depleting the genetic base of the affected species;

Plate 26: Timber Trade is common source of Biodiversity loss

6. **Inviable Population of Species** – many species need certain critical numbers to promote reproduction. Unfortunately, the number of such species have been drastically reduced to such an extent that genetic diversity and long term survival due to reproduction process have weakened. Such small populations can easily disappear if affected by forces of fires, diseases or natural disasters.

7. **Climatic Change and Global Warming** – Recent incidence of climate change and global warming is accelerating the occurrence of prolonged droughts, widespread flooding, desertification and affecting the capacity of several species to reproduce. The combined effect is the possible loss of many species especially in the Sahel regions (Plate 27).

Plate 27: Drought-Devastated Ecological Systems due to Climate Change (Most fauna and flora found dead)

8. **Introduction of Alien Species** - The introduction of alien invasive species, sometimes deliberately, have adversely affected many indigenous species (Mooney and Cleland, 2001). This is particularly severe in islands where the introduced species often permanently alter ecological balance and sometimes displace the local species as in the case of Nipa palm (*Nypa fruticans*), which is currently displacing the mangroves of the Niger Delta and water hyacinth that has overtaken other aquatic macrophytes (Plate 28).

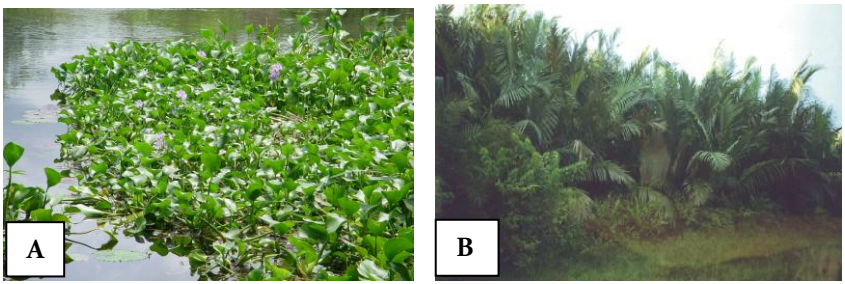

Plate 28: Alien Invasive Species (A. Water hyacinth; B. *Nypa* Palms)

9. **Wild Fires** – Reckless and inadequate fire management is a major threat to biodiversity in many parts of Africa. Such fires usually lead to soil degradation and permanent alteration of species composition in such habitats and ecosystems
(Plate 29). Sometimes such fires are deliberately ignited for a mere hunt for squirrels.

Plate 29: Incessant Wildfires destroy species and alter habitats.

10. **Environmental Degradation and Pollution** - Widespread degradation of environment and pollution occasioned by heightened developmental and industrial activities are contributing to habitat fragmentation,

displacements and outright destruction of many species. The case of the Niger Delta is more pronounced due to the multiplied influence of the petroleum industry, wetland conversion and urban refuse dumping (Plate 30).

Plate 30: Massive Construction Projects and Urban Refuse Destroy habitats and Biodiversity. A. Pipe laying at Obirikom (A); CBN Facility Site, Uniport (B & C); Refuse Dump Site, Rukpokwu (D).

5.0 Why do we have to Conserve Biodiversity?

"*...When you lay a siege to a city for a long time, fighting against it to capture it, do not destroy its trees by putting an axe to them, for*

*the tree of the field is man's life…" Deuteronomy 20:19 (**The Holy Bible**)*

The above Biblical command agrees with the concluding remarks made by Professor A.E. Arinze, the University of Port Harcourt 43rd Inaugural Lecturer (Arinze, 2005). He observed thus '*the basis of any agriculture is the healthy productive green plant. We should be concerned about the health of these plants. If we are not, it is to our peril; indeed our extinction as human beings. All life depends on the photosynthetic factory of green plants. It behoves on man to do everything possible to keep these plants healthy'*. This point and in particular the incalculable value of diverse plants to humanity had been earlier elaborated by Professor Francis Onofeghara in his own inaugural lecture – 'Botany and Human Affairs' (Onofeghara, 1986).

Biodiversity therefore needs to be protected in order to preserve the quality of life on Earth (Bowen, 1999; Jeffrey, 2004). Many plants and animals have already become extinct through human actions and it is estimated that if the trends do not change, 34,000 plant species will become extinct. Shrinking biodiversity means ecosystems are going to be unable to operate effectively; with the loss of effective ecosystems, medicine, food, shelter and other valuable resources are lost.

Other species are used, utilized and valued in many ways, but why those ways and not others? Different people ascribe different values to the same thing; a tree is many things to many people, beauty, profit, a home for wildlife, furniture, a source of food. Also people's values change over time, and depending on their current condition, for example being hungry or full; or due to the culture they happen to live in, or over longer time-scales. It's a case of 'one

man's meat is another man's poison'. What is cherished in one place at one time may be disdained in some other place and some other time.

Despite this cultural diversity, three basic sets of attitudes and ethics are usually considered in biodiversity preservation across the globe. These are:

- **The Romantic-Transcendental Preservation Ethic**

This ethic sees nature as a temple that should not be soiled by the activities of humans. We are to commune with nature when we visit it as if a god. Thus nature reserves and parks should be established to keep nature relatively intact for this very purpose.

The romantic ethic is behind many environmental non-governmental organizations (NGOs). This confirms why their brochures is full of requisite photos of the natural world and campaigns to save virgin rainforest, or save whales in their habitats untouched by the hand of man. It encourages fairly pristine areas to be preserved for tourist purposes. It therefore appeals to the wealthy who can afford trips to pristine nature places. That also accounts for their huge donations to the NGOs that campaign for wildness of nature.

This deification of pristine nature mainly leads to voyeurism and not the true interaction with nature because we only visit nature but do not live in it. Nature is kept in a separate box from both humans and society. This perhaps explains why some NGOs can afford to support the expulsion of indigenous people from their dwelling just for the purpose of creating new reserves. People and nature, despite the worship, are separate. Thus nature is merely there to feed an anthropocentric need for voyeurism. This

viewpoint creates some real challenges because all efforts go into saving the most beautiful areas and species for a booming tourist business. Consequently biodiversity is preserved because it is hoped to pay for itself much like any other commodity - anyone fancy seeing the lions on a private game reserve in Africa? That was the slogan used by a celebrated US naturalist and politician John Muir to raise funds for his huge NGO - The Sierra Club. That NGO was recently embroiled in controversy about whether to join other US environmental NGOs and back racist US policy to 'protect' the US environment from immigration by Latinos.

- **Resource Conservation Ethic**

The resource conservation ethic considers nature as consisting solely of natural resources and should be used to provide the greatest good to the greatest number of people for the longest time. The idea is not to plunder the land, but to use it in a way that distributes benefits fairly and efficiently among many people. It advocates wise, judicious use so that future generations will not be shortchanged. Also by recognizing aesthetics as a resource some preservation of relatively intact nature is possible as with the romantic's viewpoint. This is the dominant ethic put forward today by the government, business, the media and most scientists. It however appears to still serve the interest of the elite. Indeed both the resource conservation and romantic ethic both place nature in anthropocentric (people-centred) terms - nature offers only utility to humans, nothing more.

- **Evolutionary-Ecological Land Ethic.**

The Evolutionary-Ecological Land Ethic view is based on Darwin and other scientific works. They argue that humans are but one species of many created through evolution by natural selection. If humans evolved as other creatures and have intrinsic value then

surely the other creatures also should have intrinsic values, regardless of their usefulness to us. This is effectively expressing equality in ecological terms. It implies we are part of ecosystems, not separate from them, and that we can and should interact with other species, as all species interact with others in a web of life. However, we should do this with responsibility, in a manner which recognizes the intrinsic value of other species and whole ecosystems.

For those who want a free, equal and ecological society this is clearly the attitude to take. This is a radical departure from the other views. It is based more on co-existence and not about what nature can do for us. It drives us to seek more on how we can relate with our partners (nature) in life. This forces us to ask many honest and relevant questions in relation to the use of resources rather than concentrating primarily on utilitarian values to humans.

6.0 Biodiversity Conservation Efforts and Strategies

Mankind has always appreciated the absolute necessity to conserve the earth's abundant biological diversity. At the global and national levels, a number of efforts and strategies have been developed towards tackling the problems of biodiversity loss. A summary of all such efforts are hereby highlighted:

A. International Conventions and Treaties

There are five main conventions guiding the management of biodiversity in the world aimed at protecting flora and fauna to which member nations agree and ratify for policy framework and integration at their individual levels.

- **Convention on Wetlands of International Importance especially as Waterfowl Habitat**, (Ramsar Wetlands

Convention) of 1971. It makes available a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

- **The Convention Concerning the Protection of World Cultural and Natural Heritage** (World Heritage Convention) of 1972 – aims at identifying and conserving the world's cultural and natural heritage.
- **The Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES)** of 1975 - is an international agreement between governments aimed at ensuring that trade in wild fauna and flora does not affect their chances of survival.
- **The Convention on the Conservation of Migratory Species of Wild Animals** (The Bonn Convention) of 1979 - aims to "conserve terrestrial, marine and avian migratory species throughout their range."
- **United Nations Convention on Biological Diversity** (1992). The three main goals of the Convention on Biological Diversity (CBD) are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from utilization of genetic resources. In a marked paradigm shift from previous agreements, the CBD is aimed at a more holistic approach to biodiversity management by recognizing its ecosystem, species and genetic levels. The CBD was one of the major outcomes of the 1992 United Nations Conference on Environment and Development – termed the "Earth Summit" – in Rio de Janeiro, Brazil.

B. Awareness and Education

The United Nations proclaimed May 22 - The International Day for Biological Diversity (IDB) to increase understanding and awareness on biodiversity issues. When first created by the Second Committee of the UN General Assembly in late 1993, 29 December (the date of entry into force of the Convention of Biological Diversity), was designated The International Day for Biological Diversity. In December 2000, the UN General Assembly adopted 22 May as IDB, to commemorate the adoption of the text of the Convention on 22 May 1992 by the Nairobi Final Act of the Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity. This was partly done because it was difficult for many countries to plan and carry out suitable celebrations for the date of 29 December, given the number of holidays that coincide around that time of year.

Usually, each year's celebration is marked with clear objectives aptly captured by an internationally agreed theme. All nations that are parties to the CBD are expected to carry various activities to create awareness and educate their citizenry about the issues of biodiversity. They are to also highlight the contributions and steps towards the development and conservation of biodiversity.
The different years and their IDB themes are listed below:

Years and Themes

- 2012 - Marine Biodiversity
- 2011 - Forest Biodiversity
- 2010 - Biodiversity, Development and Poverty Alleviation
- 2009 - Invasive Alien Species
- 2008 - Biodiversity and Agriculture
- 2007 - Biodiversity and Climate Change
- 2006 - Protect Biodiversity in Drylands

- 2005 - Biodiversity: Life Insurance for our Changing World
- 2004 - Biodiversity: Food, Water and Health for All
- 2003 - Biodiversity and poverty alleviation - challenges for sustainable development
- 2002 - Dedicated to forest biodiversity

C. Strategies and Methods of conservation

Two main methods of biodiversity conservation are in practice. These are: *ex situ* and *in situ* conservation methods. These methods are currently practiced and expanded in many countries including Nigeria.

***In situ* conservation**

This simply means on-site conservation or protection of plant or animal species in their natural habitat. It is considered the most appropriate way of conserving biodiversity. Thus protected areas form a central element of any national strategy to conserve biodiversity. Approaches to in situ conservation are either by specially protecting the habitat, or by defending the species from predators and competitors. Furthermore, in situ conservation is progressively being applied in agro-ecosystems or on-farm protection often referred to as agro biodiversity.

In-situ conservation is usually done by declaring a natural habitat as a legally protected area. In Nigeria the following types of natural habitats are being maintained in this way:

- National parks

- Wildlife sanctuaries or Forest Reserves
- Biosphere reserves

Another form of *in situ* conservation is sacred groves (shrines or sacred forests) scattered in many communities of Africa. The potentials of such groves are increasingly being advocated in conservation (Okigbo, 1994; Ndukwu, 1999).

***Ex-situ* conservation**

Ex-situ conservation is the preservation of components of biological diversity outside their natural habitats. This involves conservation of genetic resources, as well as wild and cultivated species, and involves techniques such as:

- Gene banks, e.g. seed banks, sperm and ova banks, field banks;
- In vitro biotechnological techniques are now available to preserve cultures of plant organs, embryos, anthers, callus, tissues, cells and even microbial cells;
- Captive breeding of animals and artificial propagation of plants, with possible reintroduction into the wild; and
- Collecting living organisms for zoos, aquaria, and botanic gardens for research and public awareness.

Ex-situ conservation measures can be complementary to in-situ methods as they provide an "insurance policy" against extinction. In agriculture, ex-situ conservation measures maintain domesticated plants which cannot survive in nature unaided. *Ex-situ* conservation provides excellent research opportunities on the components of biological diversity. It also promotes public education and awareness by bringing members of the public into contact with plants and animals they may not normally come in contact with. It is estimated that worldwide, over 600 million people visit zoos and botanic gardens every year.

7.0 Nature's Expectations – Our Incredible Responsibility
"And the Lord God took the man, and put him into the Garden of Eden ..... to DRESS IT and to KEEP IT ....." Gen. 2:15.

Mr. Vice Chancellor, from the foregoing attempt to highlight the value and incalculable magnanimity of Mother Nature in Biodiversity towards man and other living creatures, you and all listening to me this evening can unanimously attest that it is indeed an INCREDIBLE GENEROSITY. It is a generosity so thrilling, exhilarating and bewildering. It not only provides physical, social and economic advantages, but promotes total spiritual and psychological tranquility. It is simply a wonder and a marvel. It is truly an EDEN indeed.
Permit me to inform us that we may not have an Eden in that original sense anymore. However, each of us has been handed over an Eden of a sort. Your own Eden could be University of Port Harcourt or your village, compound, estate or homestead garden, depending on your sphere of influence.

Mr. Vice Chancellor, distinguished Ladies and gentlemen, the magnanimity and incredible generosity of Mother Nature carries with it an equally incredible responsibility.

May I then inform all of us that those words 'DRESS IT' and 'KEEP IT' which were originally handed down to Adam and by extension all of us his descendants are heavy, onerous and widespread if we understand them. In those words, Nature inputs and requires our greatest RESONSIBILITY. We may sound religious about this. We may trivialize and gloss over it. But I assure us that we ignore their implications to our own peril. This is because our very lives, livelihood and continued existence in the beautiful EDEN – planet

earth is inextricably hinged on how we understand, apply and run with those sacred injunctions .... DRESS IT and KEEP IT.

I suppose that a few of us may be wondering if I am on a campaign to prevent us from utilizing our God-given biological resources for our good and welfare. But that is far from the issue because Nature's intention and generosity was for use to use these resources. What we are rather admonishing, based on empirical understanding is the wise and balanced utilization as the best rational option for man's continued survival on this bountiful Eden – earth. We are insisting on exploitation based on wisdom and not recklessness. We must understand the issues, the behavior of biodiversity and subsequently collaborate with Nature to ensure and insure our future survival. It is rather this dynamic and pragmatic approach that guided our research efforts and interests over the years.

8.0 What We Have Done

Mr. Vice Chancellor, eminent scholars, distinguished ladies and gentlemen, let me now attempt to highlight some of the modest efforts that we have knowingly but also unknowingly made in this regard.

8.1 Sound Science

I got convinced early in my career that prior to giving appropriate response to those powerful words; one must have sound understanding of what has been handed over to us. This understanding ladies and gentlemen, must be based on sound scientific knowledge. To this end, Mr. Vice Chancellor, I have for the past few years dedicated myself to sound scientific investigations to understand this intricate natural heritage – *Biological Diversity*.

This interest actually dates back to my secondary school during a genetic class. It was that interest that prompted me to seek admission into Botany option during the Joint Admission and Matriculation Board Examination. In the University and as I passed through the undergraduate training that interest of course expanded to include the various expressions of the genes – morphology, anatomy, histochemistry and phytochemistry.

Armed with the basic understanding of these gene expressions and associated diversities, I embarked on the onerous task of helping out in our challenging responsibilities to biodiversity.

A. **Knowing the Species by their Names**

> '*And out of the ground the LORD GOD formed every beast of the field …. And brought them unto Adam to SEE WHAT HE WOULD CALL THEM; and whatsoever Adam called every living creature, that was the name thereof …'* ***Genesis 2:19.***

One of the most profound responsibilities that the Almighty God gave to mankind was to provide acceptable names to all living creatures. He expected that they must be given names and subsequently classified to manageable groups that can easily be identified. We have attempted to respond to this responsibility in our own little ways. In this direction, we have used every conceivable difference in their general features including morphology, micromorphology, anatomy, cytology, pollen grains, chemistry, geography etc. to differentiate them from one another. In several of our own works, we have used these lines of information and variations to classify or improve the quality of earlier classifications (Plate 31). We have in the process learnt how to know and give the species internationally accepted names –

scientific or botanical names. We have done so with *Combretum* Species (Ndukwu, 1999), *Cucurbita* species (Ndukwu and Okoli, 1992; Agbagwa and Ndukwu, 2004), *Lagenaria* Species, (Ndukwu and Obute, 2002), *Euphorbia* Species (Ndukwu and Okoli, 2005, 2006), *Gnetum* Species (Agbagwa and Ndukwu, 2005); *Emilia* species (Ndukwu and Agbagwa, 2006); *Abrus* species (Agbagwa, et al, 2007) and *Anthocleista* species (Edwin-wosu *et al*, 2010; Edwin-wosu and Ndukwu, 2012).

Consequently, scientists, environmental consultants and other users of plants, including some persons in the audience continues to seek our assistance in providing accurate identification and nomenclature for the specimens they intend to use or experiment upon. We gladly render such services even by the wayside, fields and more recently through internet and phones.

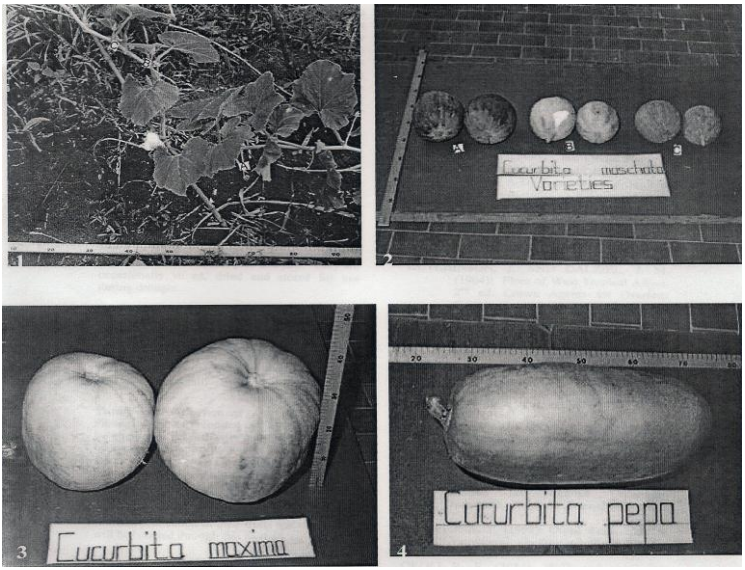

Plate 31: Different Species and Variants of Genus *Cucurbita* *(Agbagwa & Ndukwu, 2004)*

B. **Explore and Expose some of their hidden treasures**

, 'It is the glory of God to conceal a thing; but the honour of kings (men) is to search out a matter'..... ***Proverbs 25:2***.

Mr. Vice Chancellor, Mother Nature hides several of the benefits of Biodiversity in deep secrets. Part of our responsibilities and indeed honour is to discover these things and wisely exploit them for our advantages. If we humble ourselves and quietly approach Nature, we will be shown some of these deep secrets. That is the basis of all human ingenuity and inventions.

In this regards, we have also made modest efforts and contributions.

- **Chromosome karyotypying and number counting**: Accurate measurement and description of chromosome structure (karyotyping) is fundamental for any meaningful studies of any species. We have therefore established chromosome numbers and characterization (Figs. 4 & 5) in some species of plants including *Crassocephalum biafrae* (Ndukwu, 1986; Ndukwu and Okoli, 2000), *Curcubita moschata* (Ndukwu and Okoli, 1999) and several other cucurbits (Ndukwu, 1988). The work on *Cucurbita moschata* had reported for the first time the diploid chromosome number of 2n = 20 and also proved that the species is amenable to cytological studies in contrast to earlier reports. The observation indicated that the species may have originated from Nigeria since all previous records had chromosome numbers of 2n = 40 (Whitaker, 1974).

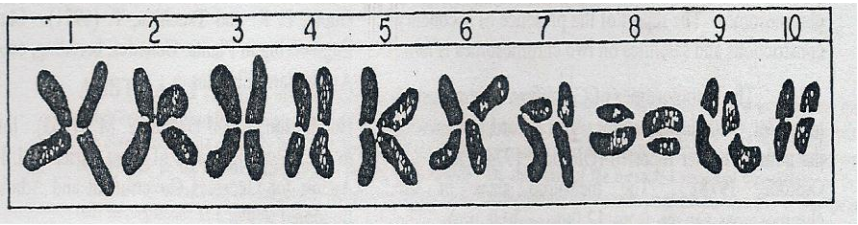

Fig. 4: Karyotype of *Crassocephalum biafrae* (Ndukwu & Okoli, 2000)

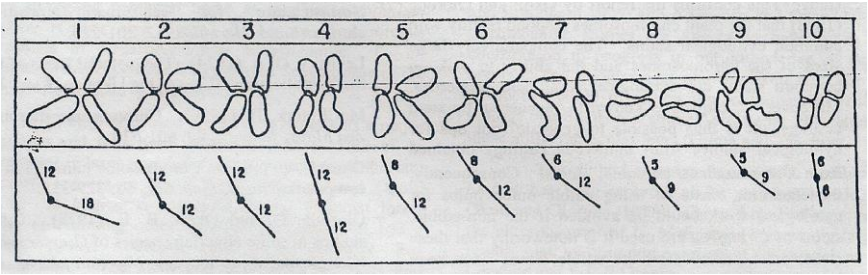

Fig. 5: Ideogram of *Crassocephalum biafrae* (Ndukwu & Okoli, 2000)

- **Chromosome manipulations**: We have applied strategies and subsequently developed some basic protocols for the manipulation of the chromosome structures, numbers, behaviours and manifestations in certain species such as *Crassocephalum biafrae* (Ndukwu, 2000); *Telfairia occidentalis* (Ndukwu *et al*, 2005); *Vigna unguiculata* and *Cucumeropsis mannii* (Obute *et al*, 2007). Some of the protocols developed from these research efforts are being harnessed by other scientists for chromosome analysis and genetic manipulation studies (Ndukwu and Okoli, 1997). Armed with such skills, we can today embark on any direction of chromosome and other

cytogenetic modifications with varied ramifications in agriculture, bioremediation and medicinal plants research.

- **Kranz anatomy and C_4-pathway** – Here we were able to establish the incidence of bundle sheath chloroplasts (kranz anatomy) and the associated phenomenon of C_4-pathway of photosynthesis in *Euphorbia* species (Ndukwu and Okoli, 1999). This particular finding is very strategic in our understanding of the photosynthetic process as performed in dicotyledons and monocotyledons. It also provides clues to the issue of evolutionary affinities between the two groups of plants. The bundle sheath chloroplasts and C_4-pathway of photosynthesis are thought to be restricted to monocotyledons. However, our work observed these structures and process in certain species of *Euphorbia* which are clearly dicotyledonous plants. This therefore has raised new issues on what was previously assumed by science. We intend to pursue the new frontiers further in the foreseeable future with better analytical instruments.

- **Tannins localizations** – Tannins are secondary metabolites with wide applications in medicine, leather, ink and paint industries. We have been able to localize these tannins in several plant species including those of *Combretum* Species (Ndukwu, 1999) – Plate 32; *Euphorbia* Species (Ndukwu and Okoli, 2005); *Anthocliesta* species (Edwin-Wosu and Ndukwu, 2012). The benefit of such works is that we can rapidly screen several species and establish the exact locations of these substances in the plant tissues investigated. Such information ensures that we can act with precision towards the phytochemical extraction of the substances when needed.

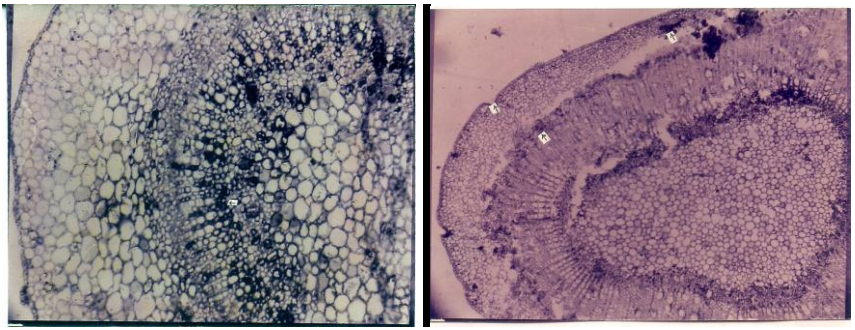

Plate 32: Transverse Sections of *Combretum* Spp. showing Tannins in Tissues *(Ndukwu, 1999)*

- **Calcium oxalate crystals** – These are another group of secondary metabolites that play roles in maintenance and mobilization of structural materials, defense mechanisms and plant protection. We have been able to establish their presence, distribution and exact locations in the tissues of some plants such as Cocoyams (Ndukwu, 2005) and *Musa* (Banana and Plantain) species (Osuji and Ndukwu, 2005).

- **Phytomedicine and medicinal value** – We appreciate the roles of many plant species as actual and potential sources of medicinal, pesticidal and aromatic substances. We have therefore attempted to identify those plants with these valuable resources especially within our region. We have in the process recorded and documented several plants (Ndukwu and Ben-Nwadibia, 2005; Idu and Ndukwu, 2006; Edwin-wosu and Ndukwu, 2008). We have also been part of the expert teams that collected, described and documented wide range of medicinal plants for several geopolitical zones of Nigeria as part of the efforts at embedding this sector in our health care

delivery systems. We are fully aware of the progress nations like China and India have made in this regard.

- **Phytoextraction and phytoremediation** – Components of biodiversity especially plants can become veritable tools in our efforts towards remediation of polluted sites. In fact certain plants (hyperaccumulators) are known to be particularly better for the rehabilitation of recalcitrant heavy metal pollutants in the soil. Such plants are able to extract through absorption such metal pollutants (phytoextraction) and thereafter bioaccumulate or evapotranspirate them for possible tie-down or sequestration respectively. We have established this usefulness with certain plant species (Ndukwu *et al*, 2008). We have also used the distribution of certain plant species as pollution indicators especially in altered habitats and microhabitats (Ndukwu and Edwin-wosu, 2007).

C. Wise Exploitation and Conservation

Mr. Vice Chancellor, distinguished audience, I suppose that here lies one of the greatest responsibilities we have been charged with. That is the wise exploitation, sustainable management and conservation of biodiversity. This is currently a global challenge and immense responsibility. In the last few years, particularly of recent and perhaps in the foreseeable future, I hope to spend more time in research and dissemination of information – you may call it awareness campaign or advocacy in this part of our collective responsibility, because in it lies the '**life of man**'.

Let me mention the little we have done so far in this regard:

– **Sacred forests:** The study examined the potentials and usefulness of sacred forests, groves and shrines preserved by traditions in the renewed efforts towards the conservation of

biological diversity (Ndukwu, 1999). Based on the observed declining fortunes of these customary sanctuaries and heritage arising from severe pressure from many forces especially acculturalization and demand for land resources, the study recommended urgent need to incorporate protected sacred forests into global bioconservation strategies.

– **Conservation of *Tranchosanthes*** L (Snake Gourds): The plant is popularly called 'snake tomato' (Plate 33). It was a major crop and supplier of tomato paste during the Nigerian civil war when the common tomato could not be brought down from Northern Nigeria. Through our works and publications on this vital vegetable crop with immense potentials that were largely unexploited, we were able to raise a new attention to its shrinking genetic base (Ndukwu, 2000). As a result, other scientists began to carry out studies in several aspects of the plant species. It is hoped that the new consciousness will be sustained until the plant is incorporated into the national programme of crop improvement.

Plate 33: Mature Fruits of *Trychosanthes cucumerina* (Snake Tomato).

- **Systematic Botany and Conservation**: This work identified the role of systematic botany in plant exploration, collection, identification and classification as critical prerequisite for effective biodiversity conservation efforts of any area. The study raised alarm on the dearth of trained manpower, poor funding and unacceptable low level of interest by government and students towards systematic botany in the Niger Delta area (Ndukwu, 2002). It finally warned that unless drastic measures were taken to redress the ugly trend, unpleasant consequences especially the loss of customary knowledge and several vital germplasms would happen.

- **Impact of dredge spoils**: Dredged spoils are heaps of excavated earth materials from dredging and canalization activities. They are common sites all over the creeks of Niger Delta. We investigated the likely impacts of these spoils on the ecosystems especially the mangrove forests of the region (Ndukwu and Edwin-wosu, 2007). It was generally observed that the spoils usually created new microhabitats with significant alteration to the biodiversity of the locality. In the mangrove swamps for example the spoils altered the hydrological regimes that led to displacement of traditional mangroves and establishment of mostly rainforest species. The studies therefore recommended better management of dredged spoils by spreading and leveling to minimize the impacts on local hydrology and biota.

- **Rehabilitation of Impacted Mangrove Species**: The strategic importance of the mangrove species and ecosystem of the Niger Delta have been studied and highlighted by our several studies. We have used the knowledge we obtained from such studies to assist in the sustainable management and conservation of the mangroves especially the rehabilitation of petroleum-related impacts (Okoli and Ndukwu, 1998; Osuji *et al*, 2006). In the process, we have been involved in the revegetation and remediation of thousands of hectares and kilometers of sites impacted by oil and gas exploration and exploitation in various locations across the entire Niger Delta. We have also trained many young people in the region on the essential steps for raising mangrove seedlings and transplanting them onto impacted sites for restoration (Plate 34).

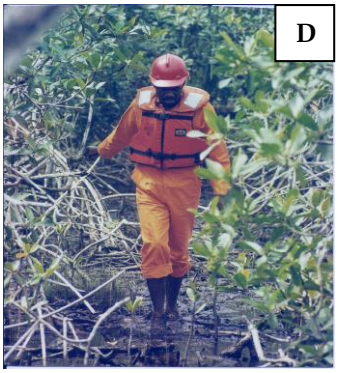

Plate 34: Mangrove Rehabilitation Process: (A) Nursery (B) Transplanting (C & D) Inspection and Monitoring. (***Source:*** Field Studies, 1998).

- **Awareness to Shell Staff and development of Shell Biodiversity Policy**: We had the opportunity to facilitate through our activities and enlightenment the development of Biodiversity Policy and subsequent integration of Biodiversity considerations into the business of Shell Petroleum Development Company of Nigeria Limited (SPDC). In fact as a result of this initiative, we were able to justify, in year 2004, the establishment of Biodiversity position in Shell Companies in Nigeria (SCiN). For nearly three years, I was engaged to educate Shell staff in various divisions and to seek for ways of embedding Biodiversity considerations in the Company's operations. I am glad that these modest efforts have reasonably expanded in the last few years and Biodiversity is now a major issue in Shell business considerations.

- **Education and Training of Traditional Medicine Practitioners:**

I am one of those that strongly believe that there is some good in our herbal remedies. We do know that traditional medicines and practices occupies very strategic importance in our health care system. Indeed over 85% of our people depend solely or partly on traditional medicines for therapy. Therefore, there is absolute need to educate, train and retrain the practitioners of traditional medicines for our common good. Consequently I have been part of the team that has assiduously worked in the past eight years or so to fill this gap (Ndukwu, 2006, 2008). In the process we have trained and worked with many Traditional Medicine Practitioners (Plate 33). We have even hosted hundreds of them here in the University of Port Harcourt in December, 2010 as part of this initiative with assistance and support from Nigeria Natural Medicine Development Agency (NNMDA), Lagos.

Plate 34: Training Sessions for TMPs

- **Ethnobotanical Surveys and Documentation:** There are global concerns on the loss of customary knowledge of plants and use of them considered critical to every conservation effort. As a response, there are international agreements and

concerted efforts to rapidly conduct surveys to document, in nearly all languages and cultures, this vital information. In our own little way we have carried out extensive surveys and prepared useful documentations in various communities especially in the Niger Delta areas (Ndukwu and Obute, 2002; Idu and Ndukwu, 2006; Idu *et al*, 2007; Edwin-Wosu and Ndukwu, 2008) – Plate 36.

- We have also worked with other key stakeholders, facilitated by the Nigerian Natural Medicine Development Agency (NNMDA) to prepare various Ethnobotanical Survey Reports and Books of great value for all the six geopolitical zones of Nigeria (Plate 37). These are invaluable documents that are in current high demand internationally.

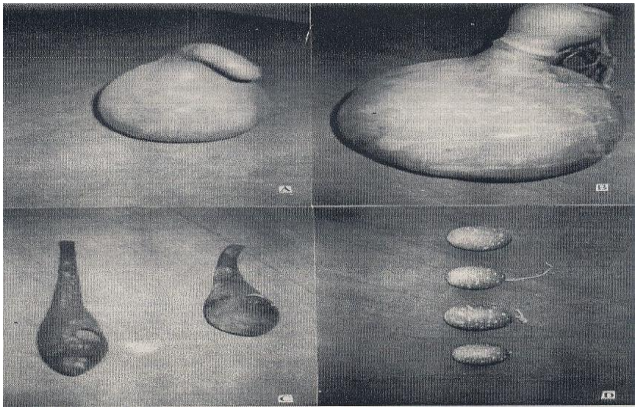

Plate 36: Types and products of *Lagenaria* species serve different uses *(Edwin-Wosu & Ndukwu, 2008)*

Plate 37: Volumes of Regional Reports on Ethnomedicinal Plants Documentations

9.0 Recommendations and Conclusion

Mr. Vice Chancellor, permit me to make some recommendations and thereafter conclude this lecture. Based on current realities and the absolute necessity to act fast, I wish to make the following recommendations to you Mr. Vice Chancellor, our governments and other concerned stakeholders:

1) Provide and plant our own '**Eden Garden**' here in the University of Port Harcourt, and charge our eminent scientists and scholars to DRESS IT and KEEP IT. To this end, the 'GREEN PARK' project which I proposed to the Vice Chancellor early in his administration should be pursued with greater vigour. This Green Park should house a standard Botanic and Zoological Gardens;

2) Provide and equip a laboratory where sound science can be properly practiced to build adequate database for both morphological and molecular markers of plants especially those endemic to the Niger Delta Region that is our catchment area;
3) Trigger the acquisition and documentation of customary/traditional knowledge of plant species in every language group of the Niger Delta Region before we permanently lose this vital natural database and asset;
4) Incorporate basic knowledge of Biodiversity and its conservation into the teaching curricula of the University. It may be taken solely or embedded into an appropriate existing GES course;
5) Identify suitable location within the University neighbourhood for the establishment of Biodiversity Monitoring Centre to track the forces that deplete biodiversity and rate of loss of species in the Niger Delta;
6) Establish and support a Centre for Mangrove and Coral Reef Studies in the University to coordinate and promote research and training on this vital natural asset. The Centre can become a key component of the Institute of Natural Resources, Environment and Sustainable Development (INRES) already existing in the University;
7) Commission the compilation of the Flora of University of Port Harcourt to document with appropriate identification, descriptions and photographs all plants that are found in and around the University. This could become one of the most valuable contributions of your administration and indeed the University to knowledge and the global scientific community.

Mr. Vice Chancellor, may I then conclude this lecture by paraphrasing the epoch speech made by General Winston Churchill when he took charge as Prime Minister of Britain during the most difficult history of his nation.. That was on May 10th 1940 in the full glare of the advancing and ravaging Hitler-led German Nazi war. He said:

> *"Upon this battle depends the survival of modern and future civilization. Upon it depends our own life on earth and the long continuity of our current and future developments. The forces that erode biodiversity understand this. If we can rise to the INCREDIBLE responsibilities we have, mankind will flourish and life will be prolonged on earth; but sadly if we fail, it will be to our greatest peril..."*

My greatest question then is shall we rise up to our incredible responsibility of saving the incredible generosity of Mother Nature in Biodiversity? If you leave me to answer on our behalf, I will say - based on our current understanding and abilities, a resounding 'YES WE CAN'.

Thank you for listening.

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CITATION ON

PROFESSOR BENJAMIN CHINYEM NDUKWU,
THE 96TH INAUGURAL LECTURER OF THE
UNIVERSITY OF PORT HARCOURT

Introduction

Mr. Vice Chancellor, Sir, distinguished Ladies and Gentlemen. I have this exceptional honour and privilege to give the citation of the 96th Inaugural Lecturer of the University in the person of Professor Benjamin Chinyem Ndukwu. He is a Professor of Plant Science and Biotechnology with multifaceted, widespread and immense academic and professional exposure that spans over 25 years at the tertiary education level.

Early Life and Education

Born on the 4th of April, 1963 at Uli, Ihiala Local Government Area in present Anambra state, Professor Benjamin Chinyem Ndukwu had his early education – Primary and secondary all at Uli

finishing in 1977 and 1982 respectively with distinction at both the FSLC and WASC levels. These signalled the beginnings of a rewarding and high flying live experience in scholarship. After the feat at the famed Uli High School, Uli in 1982, our inaugural lecturer for today proceeded to the University of Port Harcourt armed with a high JAMB aggregate score of 248 (the highest in Botany for that year) for his tertiary education. By choice Professor Benjamin Ndukwu enrolled for B.Sc. degree programme in Botany despite offers to go for one of the so called "professional" courses.

True to his billing, the young Benjamin obtained the Bachelor of Science (B.Sc.) degree in Botany, in 1986 blazing the trail of excellence once again with a First Class (Honours) – a record that would stay for a long while before another followed in that department. He then did the mandatory NYSC in the 1986-1987 service year as a lecturer at the Imo State Polytechnic (formally College of Agriculture) Umuagwo.

Thrilled, challenged and encouraged by that experience, Professor Ndukwu applied and was admitted for a Master of Science Programme in the University of Port Harcourt. This time around his academic excellence had earned him both the University of Port Harcourt and Federal Government of Nigeria scholarship awards. He yet again performed true-to-type by completing the programme on record time and bagged a Master of Science degree in Biosystematics and Taxonomy in 1988.

Working Experience and Career Development

While on the Masters programme Professor Ndukwu secured a job as an Assistant Lecturer in the Department of Botany, Horticulture and Microbiology, University of Uyo (then Cross River State University), Uyo. Professor Ndukwu's academic influence is still highly respected by colleagues of that University today. It was during this brief sojourn in Uyo that Professor Ndukwu met his beloved wife and partner in progress Geraldine then a 4th year medical student at the University of Calabar.

Our 96th inaugural lecturer also had a brief stint with Abia State University in 1990 but could not resist the call of his Alma Mata – University of Port Harcourt in November, 1990 with the offer of Assistant Lecturer position and admission to pursue the Doctoral Degree programme in Biosystematics and Taxonomy.

Consistent with his scholarly antecedents, Professor Ben Ndukwu completed the doctoral programme on record time and bagged the Doctor of Philosophy (PhD) degree in Biosystematics and Taxonomy in 1994, despite being engaged with teaching and research.

The man, Professor Ndukwu is driven principally by a self-crafted career objective which is 'to *systematically improve on innate abilities through continuous acquisition of knowledge and thereafter use these to enhance the welfare of mankind and society'*. Thus armed with sound orthodox education and pragmatic "street sense" Ben determined to make meaningful contributions to humanity delved head-on into research and teaching in the pure

and applied aspects of Plant Science. His research interests span the areas of plant cytogenetics, taxonomy, biosystematics, ethnobotany, histochemistry, bioremediation and biotechnology. In the process, he has produced significant results, published widely and has risen through all the ranks to become a Professor of Plant Science and Biotechnology in 2009 here in the University of Port Harcourt. To date he has to his credit about 63 published articles in local and international peer reviewed journals, several chapter contributions in edited books and six (6) indexed books. He has also delivered several invited papers and keynote addresses.

Professor Ben Ndukwu has supervised over 50 projects at both undergraduate and postgraduate levels. He has served and is still serving as senior consultant to a number of firms and corporate bodies with environmental protection concerns. These include Shell Petroleum Development Company, Total, NNPC, Laser Engineering, Pan Ocean, NDDC and CORDEC. In this regard, he has been involved in the execution and preparation of over 40 impact assessment technical reports. He was part of those who pioneered the rehabilitation of impacted mangrove ecosystems in most of Niger Delta for various oil and gas service and producing companies.

Administrative and Public Assignments: Professor B.C. Ndukwu has been involved in different administrative, corporate and national assignments where he has demonstrated exceptional qualities, abilities and capabilities to the admiration of colleagues.

In the University of Port Harcourt, he has served as member of the Housing Committee from 1998 – 2000. He was Head, Department of Plant Science and Biotechnology between 2003 and 2005. While still serving in that capacity he was beckoned to help re-engineer the Institute of Science Laboratory Technology (ISLT) as Director. He served the Institute (now School of Science Laboratory Technology, SSLT) for good five years from 2005 to 2010 and records indicate that he really transformed the place indeed.

Professor Ndukwu has also served as Director Regional Centre for Bioresources Development and Conservation between 2010 and 2011. It was during this period that he hosted the 1st Niger Delta Sensitization Workshop on Bioresources and Traditional Medicine Development where he brought representatives of Traditional Medicine Practitioners from the entire region to this University for brainstorming and training.

Professor Ndukwu has been Senate Representative in the Delta Series Editorial Board (Science) since 2009. He is also a serving member of the Editorial Board of *Scientia Africana* – an international journal based in the Faculty of Science of our University. He serves as Faculty of Science representative in the Academic Board of Faculty of Pharmaceutical Sciences. He is currently a member of the Senate Committee on Membership of Senate, 2012; member Marketing and Communication Unit, Vice Chancellor's Office, 2012; member, Advisory Board of Centre for Malaria Research and Phytomedicine, 2012 and Chairman, Faculty of Science/Alumni Committee, 2012.

Only recently, Professor Ndukwu was appointed by the Vice Chancellor as the Assistant Director, Institute of Natural Resources, Environment and Sustainable Development (INRES), following a high profile grant he jointly got with two others from Mac Arthur Foundation of the United States of America.

Mr. Vice Chancellor Sir, as expected of a man with such profound training and exceptional desire to serve humanity, Professor Ndukwu is highly sought after by public and corporate organizations for one service or the other. In this regard he has served as Environmental Adviser, Shell Petroleum Development Company of Nigeria Limited (SPDC) from 2002 to 2003; Member of Board & HSE Lecturer, Laser Geosciences Training and Research Centre (A Federal Government-Approved Centre for Postgraduate Training in Petroleum Geosciences) since 2008; Member, Technical Committee on Compilation and Documentation of Research Works and Findings in Natural Medicines in Nigeria, 2004 - date; Member, Steering Committee for the Establishment of the Nigerian Chapter of International Association for the Promotion of Traditional Medicine (PROMETRA) – 2004; and Research Fellow in Environmental Protection and Control of the Niger Delta Development Commission (NDDC), Port Harcourt, 2011.

Professor Ndukwu is also an External Examiner for Undergraduate and Postgraduate Botany Degree Programmes, to Rivers State University of Science & Technology, Nkpolu, Port Harcourt;

University of Uyo, Uyo etc. He has also served as the Publicity Secretary, Genetics Society of Nigeria from 1991 – 1993; Assistant Secretary General, Botanical Society of Nigeria, 1998 – 2001 and Welfare Secretary, University of Port Harcourt Alumni Association from 1999 -2001.

Awards/Honours

Professor Ndukwu has received several honours and awards over time. These include: Head of Department's Price for Best Graduand, 1986; Dean of Science's Price for Best Graduand, 1986; University of Port Harcourt Scholar, 1987; Federal Government of Nigeria Scholar, 1987 and 1988; Special Merit Award by NMA, Ihiala Zone, 2009 and most recently a special Platinum Award by the elitist 'Cousin's Group' of Uli, 2010.

Membership of Professional Bodies

Professor Ndukwu is an active member of the following professional bodies: Genetics Society of Nigeria (GSN), Botanical Society of Nigeria (BOSON), Nigerian Society for Biological Conservation (NSBC), Nigerian Environmental Society (NES), Nigerian Conservation Foundation (NCF). Others are African Ethnobotany Network (AEN), Association for the Taxonomic Study of the Flora of Tropical Africa (AETFAT). He is also a member of Mangrove Action Project (MAP) and Biodiversity Education and Public Awareness (BEPA) both United States of America-based Organizations.

Workshops/Training Courses Attended

Professor Ndukwu has participated in several training workshops including ABN/UNESCO Training Workshop on Tissue Culture & Biotechnology – 1996; SHELL/AMEC Training Workshops on Environmental Impact Assessment – 2002; SHELL Training Workshop on GIS/ESI Protocols - 2002, 2003, SHELL Environment/Community Development Workshop – 2004; ICASA HIV Workshop – 2005 and the Niger Delta Sensitization workshop on Bioresources and Traditional Medicine Practice, 2010.

Religious and Private Life

Professor Benjamin Ndukwu is one committed Christian who insists that the fear of God should be regarded at all times above denominational affiliations. He expresses his Christian service through a number of groups and Ministries. He currently serves as the National Director of the Student's arm of the Charismatic Renewal Ministries Inc. He is also an active member of the Monday Prayer Group here in the University of Port Harcourt.

Our Inaugural Lecturer today enjoys reading, traveling and swimming. He is a devoted family man and happily married to only one wife, Dr (Mrs) Geraldine Ndukwu – Consultant Family Physician at University of Port Harcourt Teaching Hospital. That marriage is blessed with five children – Olive, Ben-Franklin, Glory, Ben-Justice and Ben-Daniel.

Conclusion

Mr. Vice Chancellor, distinguished ladies and gentlemen, it is my singular honour, pleasure and privilege to introduce to you today -

an accomplished scholar,
an erudite academic;
a man of many parts;
a consultant of international standing,
a devoted Christian and family man,
a team builder and peace maker,

a motivator per excellence,
a great lover, supporter and promoter of nature,
a conservationist and environmentalist to the core,
a man who came here 30 years ago as young student,
He is today the 96th Inaugural Lecturer on the topic '*Biological Diversity – Incredible Generosity, Incredible Responsibility*'

Here is the man - Professor Benjamin Chinyem Ndukwu!!!

Professor Godian C. Obute
Head, Department of Plant Science and Biotechnology,
Faculty of Science.