Chapter 2

Biodiversity -

Its Genesis & Conservation

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Life exists in many forms: plants range from grass to giant trees and animals from tiny worms and insects to elephants and whales; life is found everywhere, from the depths of oceans to the tops of mountains and from arid deserts to tropical rainforests. From a purely utilitarian view, life is represented in forms that can be both benign (e.g. periwinkle, which yields a life-saving drug) and malignant (e.g. curare, a deadly poison). It is this wide range that makes up biodiversity.

We share the earth with millions of other living beings. Just as we humans make up one species, there are perhaps five to thirty million other species: plants like neem and wheat, animals like the hippopotamus and the squirrel, and micro-organisms too small to be seen with naked eyes. India alone has more than one lakh recorded species and perhaps many more times that number which are as yet undiscovered. All these are connected together in one vast complex web - a web on which each is dependent. This range of life forms and the habitats they live in is called **Biological Diversity** or **Biodiversity**.

The term *biological diversity* was coined by Thomas Lovejoy in 1980, while the word *biodiversity* itself was coined by the entomologist E.O. Wilson in 1986.[1]

"Biodiversity" is often defined as the variety of all forms of life, from genes to species, through to the broad scale of ecosystems. Biological diversity has no single standard definition. One definition holds that biological diversity is a measure of the relative diversity among organisms present in different ecosystems. Diversity in this definition includes diversity within species and among species, and comparative diversity among ecosystems.

Another definition, simpler and clearer, but more challenging, is the totality of genes, species, and ecosystems of a region. An advantage of this definition is that it seems to describe most instances of its use. "Biodiversity" is now used sometimes to mean "life" or "wilderness" or other conservation values. "Biodiversity" has also served on occasion as a catch-all for "conservation" itself.

The 1992 United Nations Earth Summit in Rio de Janeiro defined *biodiversity* as "the variability among living organisms from all sources, including, *inter alia*, terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems".[2]

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[1] *Report for the first American Forum on biological diversity organized by the National Research Council*

[2] *www wikipedia org*

This is, in fact, the closest thing to a single legally accepted definition of Biodiversity, since it is the definition adopted by the United Nations Convention on Biological Diversity[3].

Biodiversity found on Earth today is the result of 4 billion years of evolution. India has a biological and natural diversity matched by few other nations. The world's greatest range of altitude, rainfall and geological conditions has given rise to an enormous diversity of ecosystems: forests, wetlands, coasts, grasslands, seas, and deserts. This supports a recorded figure of 81000 animal species and 45000 plant species, and possibly several times more yet undiscovered. This represents about 6.5% to 7% of the recorded species worldwide; remarkable, for India has only about 2% of the world's land mass. The list is being constantly added to, especially in the case of lower plants and invertebrate animals; scientists estimate that the actual diversity is probably several times what is yet recorded. In the case of microorganisms like bacteria and viruses, we have probably only scratched the surface; even globally, it is estimated that only about 3% of microorganisms have as yet been recorded.[4]

2.1 Types of Biodiversity

Scientists usually distinguish three levels of biodiversity:

1. **Genetic diversity**: This is a diversity of basic units of hereditary information that are passed down generations,

[3] *www wikipedia org*
[4] *Singh K S 1992, People of India An introduction, Anthropological survey of India, Laurens and Co*

found within a species (e.g. different varieties of the same rice species). This diversity is expressed through terms like subspecies, breeds, races, varieties and forms. While applicable to all species, the discussion on genetic diversity in this study is primarily focused on agriculture species. It is in the case of crop species that human influence has been remarkable, with the development of hundreds of thousands of cultivated varieties.

2. **Species Diversity**: This is the population diversity of organisms that interbreed, or are reproductively isolated from other such populations (e.g. different crops like rice, wheat, tomato, maize ...).

   Species are the most commonly discussed level of biodiversity. Comparisons of the diversity found in different countries or ecosystems, for instances, are almost always based on species number. Some 1.7 million species have so far been described worldwide, but there may be anywhere between 5 million to 30 million different species in the world. There must be many more species still awaiting discovery by science.[5]

3. **Ecosystem Diversity**: This is the diversity of ecological complexes, or biotic communities, found in a given area (e.g. forests, water bodies, grasslands). Ecosystems comprise a biotic community (an inter-related community of plants, animals and micro-organisms), along with its

[5] *Wilson E O , 1993, The Diversity of Life, W W Norton and Company, New York*

abiotic (soil, stone, air) habitat, with some identifiable boundary.

These can include very broad categories, e.g. a forest is an ecosystem dominated by trees; or they can be more specific categories, e.g. a wet evergreen tropical forest is an ecosystem dominated by evergreen tree species and high rainfall.

2.2 Importance of Biodiversity

Biological diversity and its components are the very basis of human survival, providing food, medicine, energy, ecosystem functions, scientific insights, and cultural sustenance to over five billion people of the world. Biodiversity plays a very critical role in the day-to-day existence of entire humankind. There can be no genuine and long-lasting development without habitat and species diversity.

Plants, animals and even the invisible microorganisms around us sustain and recreate the quality of the water that we drink, the air that we breathe, and the soil on which we grow food. It is our forests, lakes, rivers, grasslands, coasts, seas and agricultural lands that provide us with oxygen, water and fertile soil, with food, medicine, clothing, housing, energy and other material needs. Most of the oxygen we breathe comes from marine algae whose existence is dependent on a complex chain of diverse life forms and inanimate matter. We would be nowhere without all this.

Wild plants and animals still constitute a substantial part of the diet of the majority of the world's rural people, in the case of many forest and coastal people, more than 50%.[6] These species are especially critical as 'famine foods' available at times when crops fail or cannot be grown. In urban areas also, poultry products like eggs and chicken form a part of the regular diet of thousands of people.

Three-fourth of the world's population is directly dependent on plants and animals (mostly wild) for its medicinal needs, according to the World Health Organization. Even modern medicine continues to depend on extracts from living beings: in the United States, about 4.5% of GDP (some $87 billion) is made up of economic benefits derived from wild species and one-fourth of all medicines contain active ingredients from plants. The struggle against malaria was greatly aided by the cinchona tree of South America, which yielded quinine. One insignificant looking plant from Madagascar, the rosy periwinkle, has yielded cures for certain forms of cancer.[7]

Agriculture, which provides 32% of GDP in low-income countries, may have of late become technologically sophisticated, but it still depends on traditional crop varieties and on wild plant relatives of crops.[8] In the 1970s, a wild rice species found in India was found to be resistant to one of the most dangerous pests (a species of plant hopper); genes from this plant were used to save

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[6] *www wikipedia org*
[7] *Kothari, Ashish - 'People, Patents and Profits' – Newsletter of Genetic Resources Action Intl, 2000*
[8] *ibid*

millions of hectares of cultivated rice in south and south-east Asia from being destroyed by a major epidemic. Diversity within agricultural systems is also crucial to the stability of farmers.

Fisheries which is heavily dependent on the maintenance of aquatic biodiversity, contributes about 100 million tones of food world wide (86% of this from marine areas), which is greater than the contribution made by livestock or poultry.[9]

Over centuries, knowledge and materials from wild plants and animals have revolutionized agriculture (the cross breeding of crops with wild relatives which have resistance or other desired characteristics), industry (rubber, cotton), medicine (quinine), and other fields of human endeavour. Since the great majority of the world's species remain unexplored for their potential, there is no doubt that further revolutionary discoveries such as cures for various kinds of cancer, are in store. But we will be able to tap this potential only if we are able to save these species in the first place.

2.3 Benefits of biodiversity

Biodiversity has contributed in many ways to the development of human culture, and, in turn, human communities have played a major role in shaping the diversity of nature at the genetic, species, and ecological levels.

[9] *Kothari, Ashish - 'People, Patents and Profits' – Newsletter of Genetic Resources Action Intl, 2000*

There are three main reasons commonly cited in the literature for the benefits of biodiversity.

1. Ecological role of biodiversity

All species provide some kind of function to an ecosystem. They can capture and store energy, produce organic material, decompose organic material, help to cycle water and nutrients throughout the ecosystem, control erosion or pests, fix atmospheric gases, or help regulate climate.

Ecosystems also provide various supports of production (soil fertility, pollinators of plants, predators, decomposition of wastes...) and services such as purification of the air and water, stabilisation and moderation of the climate, decrease of flooding, drought, and other environmental disasters. These functions are important for ecosystem and human survival.

Research suggests that a more diverse ecosystem is better able to withstand environmental stress and consequently is more productive. The loss of a species is thus likely to decrease the ability of the system to maintain itself or to recover from damage or disturbance. Just like a species with high genetic diversity, an ecosystem with high biodiversity may have a greater chance of adapting to environmental change. In other words, the more species comprising an ecosystem, the more stable the ecosystem is likely to be. The mechanisms underlying these effects are complex and hotly contested. In recent years, however, it has become clear that there are real ecological effects of biodiversity.

The recent disaster caused by a tsunami in Indonesia can be attributed to ecological imbalance due to loss of biodiversity.

2. Economic role of biodiversity

For all humans, biodiversity is first a resource for daily life. One important part of biodiversity is 'crop diversity', which is also called agrobiodiversity.

Most people see biodiversity as a reservoir of resources to be drawn upon for the manufacture of food, pharmaceutical, and cosmetic products. This concept of biological resources management probably explains most fears of resources disappearance related to the erosion of the biodiversity. However, it is also the origin of new conflicts dealing with rules of division and appropriation of natural resources.

Some important economic commodities biodiversity supplies are:

- **Food**: Crops, livestock, forestry, and fish without which human life cannot be sustained.
- **Medication**: Wild plant species have been used for medicinal purposes since before the beginning of recorded history. For example, quinine comes from the cinchona tree (malaria), digitalis from the foxglove plant (chronic heart trouble), and morphine from the poppy plant (pain relief). According to the National Cancer Institute, over 70 % of the promising anti-cancer drugs come from plants in the tropical rainforests. Animals may also play a role, in particular in research. Of the 250,000 known plant

species, only 5,000 have been researched for possible medical applications[10].

- **Industry** : For example, fibers for clothing, wood for shelter and warmth. Biodiversity may be a source of energy (such as biomass). Other industrial products are oils, lubricants, perfumes, fragrances, dyes, paper, waxes, rubber latexes, resins, poisons, and cork, which can all be derived from various plant species. Supplies from animal origin include wool, silk, fur, leather lubricants, and waxes. Animals may also be used as a mode of transport.
- **Tourism and Recreation** : Biodiversity is a source of economic wealth for many areas, such as parks, forests and wild life sanctuaries, where wild nature and animals are a source of beauty and joy for many people. Ecotourism, in particular, is a growing outdoor recreational activity. The islands in the Indian territory namely Andaman and Nicobar which are rich in biodiversity have become tourist spots for many and are able to generate high revenue out of tourism and recreation in spite of lack of industry in the islands.

Ecologists and environmentalists were the first to insist on the economic aspect of biological diversity protection. Thus, it has been said that - *'The biodiversity is the one of the bigger wealths of the planet, and nevertheless the less recognized as such.[11]'*

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[10] *www wikipedia org*
[11] *Wilson, E O , The Diversity of Life Cambridge Belknap Press, 1992*

If biological resources represent an ecological interest for the community, their economic value is also increasing. New products are developed because of biotechnologies, and new markets created. For society, biodiversity also is a field of activity and profit. It requires a proper management setup to determine how these resources are to be used.

The majority of species have yet to be evaluated for their current or future economic importance.

3. Ethical role of biodiversity

Biodiversity has an ethical role if humans consider that other species have an intrinsic right to exist. This makes it morally wrong to voluntarily cause extinction. The level of biodiversity is a good indicator of the state of our relationships with other living species. It is also a part of the spiritual heritage of many cultures.

The ancient Indian culture believes in live and let live. The world is like a whole family and every single life on the earth has equal right to the resources of nature. Mankind cannot claim absolute ownership on the resources of nature which are in the form of biodiversity. It will be totally unethical for man to claim absolute and sole ownership on the biodiversity which is basically not his own creation and to deprive other living creatures which also have equal right to biodiversity.

Jain mythology propagates the idea of 'Ahimsa' which extends to the smallest creature of the world. Jainism believes that even

the smallest creatures have the right to live and every precaution should be taken by men to protect their lives.

4. Scientific role of biodiversity

This is a fourth benefit separate from the three main ones. Biodiversity is important because each species can give scientists some clue as to how life evolved and will continue to evolve on earth. Biodiversity also helps scientists understand how life functions and the role of each species in sustaining ecosystems.

It is the rich biodiversity that helped Darwin evolve his theory of evolution. Animals and creatures living in extreme weather conditions have helped scientists to understand how their life can be sustained in such extreme weather conditions and thus to provide a solution to man to live in the same conditions.

Many inventions are based on biodiversity. The Wright Brothers who invented aeroplanes got the idea after seeing birds fly, which are a part of biodiversity. Fish swimming across rivers and seas are the source for the invention of today's ships. The fragrance of flowers led to the making of perfumes, which is now extended to the science of aroma-therapy for treating various ailments.

2.4 Threats to Biodiversity

Globally, biodiversity is under siege. The 2000 IUCN (World Conservation Union) Red List of Threatened Species indicates that species extinction is on an increasing spiral. Since the last assessment of globally threatened species in 1996, the number of

Critically Endangered primates has increased from 13 to 19. While the 1996 IUCN Red List of Threatened Animals listed 169 Critically Endangered and 315 Endangered mammals, the 2000 analysis lists 180 Critically Endangered and 340 Endangered mammals.[12]

Similarly, for birds there is an increase from 168 to 182 Critically Endangered and from 235 to 321 Endangered species. As many as one in four of mammal species and one in eight bird species are threatened and the number of threatened animal species has increased from 5,201 to 5,435. Approximately, 25% of reptiles, 20% of amphibians and 30% of fishes are listed as threatened. The number of Critically Endangered Reptiles has increased from 10 to 24 and Endangered from 28 to 47 species. Turtles and tortoises in particular are greatly threatened. The number of Critically Endangered species among freshwater turtles went from 10 in the 1996 IUCN assessment to 24 in the 2000 IUCN assessment, and this can be ascribed to unregulated harvests for food and medicines. Trends suggest that the trade in turtles after depleting populations in Southeast Asia is shifting to the Indian subcontinent and even to the Americas and Africa.[13]

Madagascar has the most Critically Endangered and Endangered primates and has lost 90% of its original vegetation. Indonesia harbours the highest numbers of threatened mammals with both India (80 species) and Brazil (75 species) having moved ahead of China (72 species). For birds, the Philippines have lost 97% of

[12] *IUCN 2000, Red List of Threatened Species, Switzerland The World Conservation Union*
[13] *ibid*

their original vegetation and have more Critically Endangered birds than any other country. The most threatened birds are in tropical Central and South America and Southeast Asia. Indonesia has the most threatened birds (115) followed by Brazil, Colombia, China, Peru and India with 113, 78,76,75 and 74 species respectively.[14]

Plant species are declining in South and Central America, Central and West Africa and Southeast Asia. Malaysia has the most threatened species (681) involving a large proportion of tropical timber trees followed by Indonesia, Brazil and Sri Lanka with 384, 338 and 280 species. Globally the number of threatened plants listed is 5,611, but this is based on an assessment of only 4% of the world's total described plants. Therefore, the percentage of threatened plant species is likely to be much higher.[15]

During the last century, erosion of biodiversity has been increasingly observed all over the world. Estimates of extinction rates are controversial, ranging from very low to upwards of 200 species a day, but all scientists acknowledge that the rate of species loss is greater now than at any time in human history, with extinctions occurring at rates hundreds of times higher than background extinction rates.[16]

There has been a sharp decline in the biological and cultural diversity of India over the last few decades. The relatively

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[14] *IUCN 2000, Red List of Threatened Species, Switzerland The World Conservation Union*
[15] *ibid*
[16] *ibid*

harmonious relationship between local communities and nature. has soured, primarily due to forces external to both. The dominant elite in India have conventionally viewed such communities, their homelands, and the wildlife inhabiting these homelands, as 'resources' to be subjugated and exploited. Declining local community control over natural resources (e.g. the takeover of forests by British colonialists), the commercialization of these resources for the market, unsustainable development processes, and increasing populations of humans and livestock, are major destructive factors.

The dramatic rise in population in the early 20th century and the advent of industrialization and modern technologies are the root cause of loss of biodiversity. Other factors that caused loss of biodiversity are as follows-

- Commercial forestry practices and centralization of control.
- Agricultural expansion causing deforestation and degrading of land by shifting cultivation.
- Large scale development projects like river valley projects, mining, etc.
- Grazing and fuel wood collection.
- Habitat destruction, hunting, over-exploitation and pollution.

2.5 Circle of death

Permanent endings or mass extinctions of living species of flora and fauna are forever. Impossibly fantastic creatures that once

roamed the earth, flew through the air and swam its seas for epochs extending back to some 500 million years have periodically disappeared in waves of universal dying sprees. In fact, scientists estimate that up to a staggering 99% of species that ever lived have vanished during the course of five gigantic prehistoric extinctions. And now, if large sets of data collected over the past 20 to 40 years in England, Wales and Scotland which have been analyzed at the Natural Environment Research Council Centre for Ecology and Hydrology in Dorchester, UK, are to be believed, then, a sixth massive extinction event in the history of life; is upon us yet again. The latest study which shows a 28% decline of native plants, a 54% decrease in abundance of native birds and a 71% decline of butterflies, supports the view that the world is indeed on the cusp of another great species wipeout – especially since it is estimated that the current extinction rate could be up to 10,000 times higher than it should be under normal circumstances. The most frightening aspect of all is that there now appears to be concrete evidence that insects that account for more than half the described species on earth are disappearing faster than birds.[17]

A sweeping new computer-modelled study conducted by scientists from 14 laboratories worldwide and reported in the journal, 'Nature', regarding the effects of climate change on the planet's ecosystem has confirmed most people's worst fears. The researchers who studied six regions rich in biodiversity around the globe, including Mexico, Australia, Brazil, South America and

[17] *Times of India, Ahmedabad, dt 29 3 04*

Europe, came to the startling conclusion that more than 1/3 of 1,103 native species of mammals, birds, reptiles, insects and plants they looked at could become extinct in another 50 years' time. They include an Australian lizard called Boyd's forest dragon, Europe's azure-winged magpie and Mexico's Jico deer.[18] For some species there simply would not be any suitable place left to live in, whereas others would be unable to make to places with a viable climate. According to Chris Thomas, professor of conservation biology at England's University of Leeds and the lead author of the report, the reason is because greenhouse-gas emissions from cars and factories could make the earth hotter than it has been in 10 million years, before most existing species evolved. Also, if these projections were extrapolated globally to other groups of land animals and plants, analyses suggest that well over a million species could be threatened with extinction as a result of such warming. This is comparable roughly to the dinosaur extinction event that occurred about 65 million years ago.

Mass extinctions are of course nothing new. Starting with the great Cambrian Extinction of 500 million years ago when more than 50% of all animal species vanished, to the Pleistocene one of 10,000 years ago which saw the end of mammoths, mastodons and the sabre-toothed tiger among others, there have been several mega extinctions. In fact at least 99% of all species that ever existed are now extinct.[19]

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[18] *Times of India, Ahmedabad, dt 14 1 04*
[19] *ibid*

But what makes the findings all the more poignant is that whereas the previous extinctions have all been due to various cataclysmic changes on the planet and in the cosmos, which could not be prevented, such as depletion of the ozone layer and greenhouse effect due to volcanic activity, continental break-up, ice ages, meteorite and comet impactions, deadly supernovae radiation – with the last Cretaceous extinction that wiped out the dinosaurs 65 million years ago being attributed to an asteroidal impact – the latest one is man-made. The extinction this time around is totally – and therefore tragically – preventable. Something as subtle but widespread as habitat loss and degradation because of human activity may be the reason, albeit compounded by depletion of the ozone layer and greenhouse effects, deforestation and toxic pollution of the soil and water. It is true that in the cases of the previous extinctions life had always bounced back firmly in all its multiplicity, but to do so it had required millions of years. That may be a blink in geological terms but is considerably longer when viewed against human life expectancy. Or more to the point, even human civilization expectancy. But if humans – the only species to be cognizant of its own demise – were to die out, extinction itself would cease to be.

Some studies show that about one of eight known plant species is threatened with extinction. Some estimates put the loss at thousands of species per year, though these are based on Species-area theory and are controversial. This figure indicates unsustainable ecological practices, because only a small number

of species come into being each year. All agree that the losses are due to human activities, in particular destruction of plant and animal habitats.

An increasing number of studies indicate that elevated rates of extinction are being driven by human consumption of organic resources. While most of the species that are becoming extinct are not food species, their biomass is converted into human food when their habitat is transformed into pasture, cropland, and orchards. It is estimated that more than 40% of the Earth's biomass is tied up in only the few species that represent humans, our livestock and crops. Because an ecosystem decreases in stability as its species are made extinct, these studies warn that the global ecosystem is destined for collapse if it is further reduced in complexity.

Some justify this situation not so much by a species overuse or ecosystem degradation as by their conversion in very standardized ecosystems (e.g., monoculture following deforestation). Before 1992, others pointed out that no property rights or no access regulation of resources necessarily lead to their decrease (degrading costs having to be supported by the community).

Dissenters (notably economist Bjorn Lombord) argue that there is not enough data to support the view of mass extinction, and say abusive extrapolations are being made on the global destruction

of rainforests, coral reefs, mangrove swamps, and other rich habitats.

2.6 Man-made mega death

We live in a world where even the most frivolous news captures headlines: But, unfortunately the disappearance in 1993 of several tall, stately visitors, who had been coming to India for centuries, probably millennia, did not make similar news, except within the narrow confines of the country's environmentalists. The reference is to the Great White, or Siberian Crane (Grus leucogeranus), a regular winter migrant to the Bharatpur marshes in Rajasthan. From an estimated population of 2000 in the 1880s, the number of these birds crashed to just 17 a century later.[20] Desperate attempts to augment their flock and help monitor their movements by introducing captive-bred, radio-collared cranes failed, and in 1993, what conservationists dreaded happened. None came. Three winters later, the cranes made a miraculous reappearance one cold misty morning. But only three of them came. Most experts feel that India may soon not see this bird in the wild unless ongoing measures to introduce some captive bred cranes succeed.

The Siberian crane is not an isolated example. We have lost many species of plants and animals, and are in danger of losing thousands more unless we are able to make some drastic

[20] *Kothari, Ashish - 'Understanding Biodiversity' Life, sustainability and Equity, Orient Longman India Ltd, 1997*

changes in the way we treat our natural surrounds commonly called Biodiversity.

Like water, air, and soil, biological diversity is the hub of the wheel of life. Destroy it and the wheel, however technologically sophisticated, will no longer run.

Unfortunately, human activity, especially in the last few decades, has ended up causing large-scale loss of biodiversity. A single species, the one to which we belong, now dominates much of the earth's land surface, and even parts of its seas. If one flies over the Indian landmass, or for that matter over almost any other region of the world, the human impact is starkly visible: vast stretches of cultivated rectangular patches, large expanses of concrete jungle, thousands of artificial reservoirs, a network of roads, railways and canals snaking across the landscape, and in isolated patches here and there a forest or a natural wetland.

These landscape changes, along with activities like hunting, fishing, pollution and the introduction of organisms from one region to the other, have brought about a severe and continuing erosion of biodiversity. Most of the world's ecosystems are under threat, with one-fifth to one-fourth of forests already destroyed and the rest going at the rate of over 1,00,000 sq. km. every year. The majority of the world's freshwater wetlands are being drained or polluted, and the grasslands are diminishing rapidly[21].

[21] *World Conversation Monitoring Centre 1992, Global Biodiversity Status of the World's Living Resources, Chapman and Hall, London*

The extinction of species has accelerated manifold over its natural rate; whereas in pre-human times 4 out of 10 million species would be wiped out each year, the period is seeing extinction rates which are thousands of times greater. In the time it takes one to read this study, several species would have gone into oblivion. Some scientists estimate that extinction is now at the rate of one an hour.

There is also a growing awareness that the movement and the introduction of exotic species around the world by humans is a potent threat to biodiversity.

When exotic species are introduced to ecosystems by humans and establish self-sustaining populations, the species endemic to that ecosystem, which have not evolved to cope with the exotic species in question, cannot automatically be expected to survive. Indeed, in many situations some will not. The exotic organisms in questions may be predators and/or have features due to their evolutionary background and environment that makes them very competitive, and similarly makes endemic species very defenceless and/or uncompetitive against these exotic species.

The rich diversity of unique species across many parts of the world that humans treasure exists only because they are separated by barriers - particularly seas and oceans - from other species of other land masses, particularly the highly fertile, highly prolific, ultra-competitive, generalist "super-species". These are barriers that could never be crossed by natural

processes, except for many millions of years in the future through continental drift. However human beings have invented ships and aeroplanes. Now human beings have the power to bring into contact species that would never have encountered each other in their evolutionary history, and to do it with ease in weeks, days or even just hours.

As a result, it is likely that if human beings continue to unleash species of the world against each other by introductions - species that otherwise would never have encountered each other in their evolutionary history - many of the worlds ecosystems will end up dominated by a very few, cosmopolitan "super-species".
Extinction is forever. Even the most brilliant scientists cannot recreate a species once it disappears. Like the wiping out of entire human tribes and cultures, the extinction of a species is a tragedy of massive proportions. It is frightening to think that we can put to naught within a couple of centuries, what has taken Nature millions of years to evolve. It is not only the global loss of wild plant and animal diversity that has attracted attention, but also the erosion of genetic diversity in livestock (including poultry) and crops. The human landscape is increasingly characterized by monotony - a single breed of livestock adapted by thousands of shepherds and mirroring this, a single consumerist culture sweeping across communities and nations.

DNA technology can create disease resistant crops and produce varieties that can grow on agriculturally hostile grounds with high growth rate or size, greater crop uniformity and increased

capabilities in nitrogen fixation, in photosynthetic capabilities and in stress tolerance. A large proportion of the varieties and breeds used in traditional agriculture are no longer in active use (though many of these are stored in frozen gene banks), having been displaced by a handful of new, laboratory bred crops and livestock. Thus, increases in food crop yields assume much significance for the developing countries where agricultural growth performance is poor and population growth rate is high, putting increased pressure on arable land to feed increasing number of people. But these very high yielding varieties also result in the extinction of existing plant genetic variety, as farmers tend to use the new varieties at the cost of neglecting the traditional ones, leading to the depletion of biodiversity of the planet and the genetic base of the crops and animals. Furthermore, patenting thrives on mass production and harbours large markets. Patentees tend to ignore existing varieties over the protected ones and thus endanger the biodiversity.

One of the root causes of the loss of biological diversity is the simultaneously increasing inequities in access to resources and a share of the benefits arising from the use of these resources. The aims of justice and equality appear to be universally held now, along with the aims of conservation and the sustainable use of resources. However, these aims still remain distant dreams. Internationally, the industrial nations have benefited tremendously from access to the biodiversity of the tropics, while denying the tropical countries free access to the resulting

biotechnological products or a share in the economic returns. Within each nation, including within India, local communities have been squeezed of their resources and knowledge by dominant classes, without commensurate returns in cash or kind. The rapidly expanding world of patents and other Intellectual Property Rights is only intensifying these inequities and threatening the maintenance of biodiversity.

For instance Hodgkin's disease and paediatric lymphocyte leukemia can be cured by vinblastine and vineristine, two alkaloids derived from the rosy periwinkle. Eli Lilly, the corporate producer of these pharmaceuticals earns roughly more than US $100 million each year from these drugs, while Madagascar, the original home of the rosy periwinkle, earns nothing from them.[22] The recent trends in International Law, represented by the General Agreement on Trade and Tariffs (GATT) and the agreement on Trade Related aspects on Intellectual Property Rights (TRIPs) on the one hand and the Convention on Biological Diversity (CBD) on the other, are likely to have contradictory effects on the goals of conservation, sustainable use, and equitable benefit-sharing. Within nations, however, there is an increasing demand for local community participation in decisions relating to natural resources and everywhere, mass movements and individual groups are fighting against the monopolization of biological and intellectual resources.

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[22] *Kothari Ashish, 'People, patents and profits'- Newsletter of Genetic Resources Action Intl, 2000*

2.7 Conservation of Biodiversity

Conservation of biodiversity can be defined as "the conceptualization, planning, and management of protected areas and their surroundings, with the objective of conserving natural ecosystems and their wildlife, while ensuring the livelihood security of local traditional communities, through mechanisms which ensure a partnership between these communities, Government agencies and other concerned parties."

Traditional communities lived in harmony with environment and wildlife, though certain kinds of hunting, and the expansion of agriculture, led to the destruction of natural habitats and the extinction of plant and animal species. However, until recent times, this impact was small, compared to the scale and kind of changes that modern societies are bringing about. Moreover, there were several traditional beliefs and practices, which in combination with the absence of technologies of mass destruction, consciously or inadvertently led to conservation.

The conservation of biological diversity has now become a global concern. Although everybody does not agree on the actual extent and significance of the current extinction, most consider biodiversity essential. There are basically two main types of conservation options, *in-situ* conservation and *ex-situ* conservation. *In-situ* is usually seen as the ultimate conservation strategy. *In-situ* conservation means conservation of biodiversity where it is situated, i.e. at the place of its existence. However, its implementation is sometimes unfeasible. For example,

destruction of rare or endangered species' habitats sometimes requires *ex-situ* conservation efforts. *Ex-situ* conservation is conservation away from the place where it is situated. Furthermore, *ex-situ* conservation can provide a backup solution to in-situ conservation projects. Some believe both types of conservation are required to ensure proper preservation. An example of an *in-situ* conservation effort is the setting-up of protection areas. An example of an *ex-situ* conservation effort, by contrast, would be planting germplasts in seedbanks. Such efforts allow the preservation of large populations of plants with minimal genetic erosion.