

# **Principle of Environmental Science**

## **Biodiversity**

The term Biodiversity was first coined by Walter G. Rosen in 1986.

The biosphere comprises of a complex collections of innumerable organisms, known as the Biodiversity, which constitute the vital life support for survival of human race. Biological diversity, or "biodiversity," refers to the variety of life on earth. Biodiversity in the broad sense means the different forms of life and life sustaining systems and processes available on the earth. Even though it is impossible to access the number of species of living things on earth an approximate estimate puts it at 10 to 80 million species.

Or

Biological diversity, abbreviated as biodiversity, represent the sum total of various life forms such as unicellular fungi, protozoa, bacteria, and multi cellular organisms such as plants, fishes, and mammals at various biological levels including gens, habitats, and ecosystem

Biodiversity is the vast array of all the species of plants, animals, insects and the microorganisms inhabiting the earth either in the aquatic or the terrestrial habitats. The human civilization depends directly or indirectly upon this biodiversity for their very basic needs of survival—food, fodder, fuel, fertilizer, timber, rubber, leather, medicines and several raw materials. This diversity's the condition for the long-term sustainability of the environment, continuity of life on earth and the maintenance of its integrity.

Although our understanding of the earth's organisms—its biological resources- is still imperfect, there is no doubt that the abundance and diversity of living organisms provide many benefits and make our world a beautiful and interesting place to live. Biodiversity is generally described in terms of its 4 fundamental and hierarchically related levels of biological organisms. This are-

### **Genetic diversity**

It includes the genetic variations within species, both among geographically separated populations and among individuals within single population.

### **Species diversity**

It includes full range of species from micro organisms to giants and mammoth varieties of plants and animals, *e.g.* single celled viruses and bacteria etc. and multi-cellular plants, animals and fungi.

### **Ecological Diversity**

This includes the different types of forests, grass lands, wet lands, water bodies like streams, lakes and oceans, coral reefs, rocky mountains etc.

### **Functional Diversity**

This includes the different types of biological and chemical processes such as mass and energy flow essential for the survival of living organisms.

Because genes are parts of species, and the species make up ecosystems- the concept of biodiversity reflects an interrelationship among its three components. Biodiversity

is distributed uniformly across the globe. It is substantially greater in some areas than in the others. Generally, species diversity increases from the poles towards the tropics- for instance, among the terrestrial systems, the tropical rain forests, which cover only 57% of the earth's land area, possess as much as over 50% of the world's species.

**Why is Biodiversity important?** Does it really matter if there aren't so many species? Biodiversity boosts ecosystem productivity where each species, no matter how small, all have an important role to play. For example, a larger number of plant species means a greater variety of crops; greater species diversity ensures natural sustainability for all life forms; and healthy ecosystems can better withstand and recover from a variety of disasters. And so, while we dominate this planet, we still need to preserve the diversity in wildlife.

## **DISTRIBUTION OF BIODIVERSITY**

Flora and fauna diversity depends on-

- Ø Climate
- Ø Altitude
- Ø Soils
- Ø Presence of other species

Most of the biodiversity concentrated in Tropical region.

## **LOSS OF BIODIVERSITY**

Biodiversity is destroyed in a number of ways either by natural changes or by human disruption. The loss of even a single species is considered as a tragedy as each form of life is a natural storehouse of irreplaceable substances the genetic materials. As species become extinct, the fine balance of nature is disturbed to great extent. The loss of even a single species can alter a food chain/food web, i.e. ecosystem disruption, and upset the delicate balance between one species that preys upon another.

### **Natural Causes**

Species arise through processes of mutation, isolation, and natural selection. Evolution can proceed gradually over millions of years or may occur in large jumps when new organisms migrate into an area or when environmental conditions change rapidly. In a sense, species that are replaced by their descendants are not completely lost. The much larger modern horse, for instance, has replaced the tiny Hypohippus, but most of its genes probably still survive in its distant offspring.

### **Human-Caused Extinction**

Man has a long history of dependence on biological resource hence depletion of resources is obvious. It has never been the pursuit of mankind to completely destroy other species, but in a variety of ways through ignorance or carelessness, we have reduced biological abundance and driven species into extinction. Man as a hunter in Stone Age may have been responsible for the extermination of the "Mega fauna" of both America and Eurasia during the Pleistocene era. Climatic change may have been partially or primarily responsible. Vast usage of bones in Europe and Siberia provide enough evidence that our ancestors have hunted upon animals mercilessly. The loss of

species and ecosystems extracts a high price. The water, the air, fertile soils and productive seas as a common resource are all products of healthy biological systems. The scale of human impact on the global biodiversity is huge. It is considered that man has disturbed his own life support system. Tropical forest areas or the world suffer a great loss, which are disappearing at the rate of 17 million hectares (17 sq. kms.) every year. The estimation from the fossil record suggests that the average life of a species is about 4 million years. According to an estimate, if there are about 10 million species a year at a moderate estimate, we are now likely to lose around 50,000 species a year over the next decades. The following is a broad list of threatened animals:

**Table List of Threatened Animals**

<b>Animal group</b>	<b>No. of species</b>
Mammals	507
Birds	1,029
Reptiles	169
Amphibians	57
Fish	713
Insects	1,083
Molluscs	409
Corals and sponges	154
Annelid worms	139
Crustaceans	126

In a large number of southern countries the seeds of biodiversity destructions were laid during the colonial era. In India, for instance, large-scale commercial forestry started in British colonial times speeded up the rate of forest exploitation for fodder, meat, milk and coffee demand. Deforestation and biodiversity destruction to sustain life after independence by our more recent ancestors added fuel to the fire. Our mental capabilities do not allow us to accept the growing changing demand of time. We still experience a lot of dependence on forest products especially for fuel wood. However, government has provided substitutes of solar driven appliances for cooking and lighting. Still it has failed to decrease pressure on wood resources.

**Table Direct and Indirect Impact of Humans on Biological Resources**

<b>Direct impact</b>	<b>Indirect impact</b>
Hunting and food Gathering	Habitat destruction
Fishing	Exotic species Introductions
Trade in Animal Products	Diseases
Harvesting wild plants	Pollution
Pet and scientific trade	Genetic assimilation
Predator and pest control	

### **Measuring Biodiversity**

Diversity can be defined as the number of species found in a community. Hence, biodiversity refers to the species richness of an area. Algorithms of biodiversity have been developed to connote species diversity at different geographical scales as follows:

#### **Alpha Diversity**

It indicates the number of species in a single community. The index can be used to compare the number of species in different ecosystem type.

#### **Beta Diversity**

It indicates the degree to which species composition changes along an environmental gradient.

#### **Gamma Diversity**

It indicates the rate at which additional species are encountered as geographical replacements within a habitat type in different localities.

### **The Value of Biodiversity**

The values of the earth's biological resources can broadly be classified into-

#### **Direct Values**

##### **Consumptive and productive uses.**

**Food Resources:** Grains, vegetables, fruits, nuts, condiments, tea-coffee, tobacco, oil from plant resources; and meat, fish, egg, milk (and milk products), honey, etc. from animal resources.

**Other Resources:** Medicine, fuel, timber, household accessories, fodder, fiber, fertilizer, wool, leather, paint, resin, wax, thatch. Ornamental plants, rubber, creams, silk, feathers, decorative items, etc.

#### **Indirect Values**

Non-consumptive uses and options for the future.

1. Carbon fixing through photosynthesis, which provides the support system for species.
2. Pollination, gene flow, etc.
3. Maintaining water cycles, recharging ground water, protecting watersheds.
4. Buffering from climatic extreme conditions such as flood and drought;
5. Soil production and protection from erosion;
6. Maintaining essential nutrient cycles, e.g. carbon, nitrogen, and oxygen and others.
7. Absorbing and decomposing pollutants, organic wastes, pesticides, and air and water pollutants;
8. Regulating climate at both macro and micro levels;
9. Preserving recreational, aesthetic, socio-cultural, scientific, educational, ethical and historical values of natural environments.

**(i) Consumptive Use.** Man is mostly dependent on plant and animal resources for his' dietary requirements. A major share of our food comes from domesticated crops and

animals. Still we derive major of food from wild species. A large section of human population is dependent on food, which we gather from seas and oceans that is harvested from free roaming wild organisms. Seafood is rich in minerals and vitamins and contains up to 60 percent of the protein.

**(ii) Productive Use.** Trade and commerce industry is very largely dependent on forests. Besides, timber, firewood, paper pulp, and other wood products, we get many valuable commercial products from forests. Herbs of medicinal value. Rattan, cane, sisal, rubber, pectins, resins, gums, tannins, vegetable oils, waxes, and essential oils are among the products gathered in the wild form forest areas.

**(iii) Medicine.** Many medicinal and aromatic plants are being exploited in the wild to tap their potential for different ailment cure in the field of drug extraction e.g. *Hippophae rhamnoides*, *Ephedra Kerardiana*. *Dactylorrahiza hatageria* etc. Besides, they are being cultured in plantations and protected in wild to encourage in-situ and ex-situ conservation viz. Valley of flowers, Rohtang in Kullu, Lahu & Spiti Valley. Animal products are also sources of drugs, analgesics pharmaceuticals, antibiotics, heart regulators, anticancer and ant parasite drugs, blood pressure regulators, anticoagulants, enzymes, and hormones.

**(iv) Ecological Benefits.** Man cannot have control over nature in the wild. It can only put “pressure on resources and pollute environment. Then what makes environment act as a self-replenishing system with respect to resource generation and self cleanliness. To answer this comes into picture the role of biological communities. The processes of soil formation, waste disposal, air and water purification, nutrient cycling, solar energy absorption, and management of biogeochemical and hydrological are all beyond the scope of man’s control.

**(v) Aesthetic Use.** Wild species of plants and animals have always appealed man’s psyche. Human society has evolved from his early habitat in the forests, which abounds in flora and fauna. Till date his instinct to observe nature in the wild calls him from socially and culturally an evolved society, as tourist from far and wide places. Thousands of tourists visit national park, sanctuaries and forests throughout the country and especially in mountainous areas. A glance of temperate grasslands perhaps the most beautiful landscape pleases and comforts man. All domestic plants have evolved from wild ancestors and food gathering is no longer a necessity for man but still thousands enjoy hunting, fishing and other adventurous outdoor activities that involve wild species.

**(vi) Option Values.** This refers to the use of various species for the benefit of mankind, sometime in future. The hunt for various species under the scope of biotechnology is already underway for finding solutions to various environmental problems. The environmental issues being addressed to be: pollution as a major problem, ways to fight various disease viz., cancer, diabetes etc., AIDS and others.