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Environment Science

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Syllabus for Environmental science
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Unit 1 Natural resources

- **Renewable resources**
- **Non renewable resources**
- **Types of natural resources**
- **Forest**
- **Water**
- **Energy**
- **Role of individual in conservation of natural resources**

Unit 2 Ecosystem

- **Introduction: concept &general definition**
- **Classification of ecosystem**
- **Components of ecosystem: Producers, consumers, decomposers**
- **Forest ecosystem**
- **Grassland ecosystem**

Unit 3 Biodiversity & conservation

- **Introduction, Definition and general concept**
- **Different types of biodiversity studies**
- **Uses of biodiversity**
- **IUCN categories of threats**
- **Conservation of biodiversity**

Unit 4 Environmental Pollution

- **Introduction, Definition and different type of pollution**
- **Causes effect and control of**
- **Air Pollution**
- **Water pollution**
- **Noise Pollution**
- **Nuclear Pollution**

References Books:

- Textbook of environmental studies by Erach Bharucha (Publisher: Universities Press)
- A textbook of environmental studies by D.K. Astahana and Meera Asthana
- (Publisher: S.Chand)
- Environmental studies by Sigalovda Sutta (Publisher: MJP)
- Environmental Biology by P.D.Sharma

Unit – 1 NATURAL RESOURCES

I) Introduction and types of natural resources

- Our environment provides us with a variety of goods and services necessary for our day to day lives.
- These are air, water, soil and minerals, along with the climate and solar energy.
- There are two parts of environment, such as.,
  1) Biotic or living. 2) Abiotic or Non-living.

What are natural resources?

Natural resources are natural things, organisms or products on which mankind are dependent for their day to day life. There are two types of natural resources.

1. **Renewable resources:** - renewable resources are those which can be replenish after every use.

2. **Non-new able resources**: Non renewable resources are those which cannot be replenish after use.

They are provided to us from various sources like,

1) Atmosphere (air) 2) Hydrosphere (water) 3) Lithosphere (soil) 4) Biosphere (air+water+soil+rocks)

1) Atmosphere (AIR)

- We get oxygen for human respiration
- Oxygen for animals used by man as food.
- Oxygen as a part of carbon dioxide, used
- for the growth of plants (in turn are used by man

2) Hydrosphere

- Clean water for drinking,. Water for washing and cooking.
- Water used in agriculture and industry
- Food resources from the sea, including fish, sea weed, etc.
- Food from fresh water sources, including fish, aquatic plants.
- Water flowing down from mountain, to generate electricity in hydroelectric projects.

3) Lithosphere

- Soil, the basis for agriculture to provide us with food.
- Stone, sand and gravel, used for construction.
- Micronutrients in soil, essential for plant growth. oil, coal and gas, extracted from underground sources. It provides power for vehicles, agricultural machinery, industry, and for our home

II) Renewable resources:

Definition:

- Renewable resources are those which can be replenished after every use with the help of proper recycling techniques.
- Renewable resources are linked to natural cycles, such water cycles, soil cycle, and carbon cycle.
- There are many different types of renewable resources like 1) solar energy 2) fresh water 3) Forests, 4) Marine sources etc.

1. Solar energy: - Solar energy is the main driving force of ecological systems, which provides energy to organisms, energy for the growth of plants in forests, grassland and aquatic ecosystem etc.

2.Forests; - We get wood, fruits medicinal plants,etc from Forests, once destroyed take thousands of years to regrow into fully developed natural ecosystems with their full complement of species. Forests thus can be said to behave like non-renewable resources if over used.

3. Water: - A large number of people use water for their daily needs such as drinking water, washing, cooking, watering animals, and irrigating fields.

Fresh water (even after being used) is evaporated by the sun's energy, forms water vapour and is reformed in clouds and falls to earth as rain.
However, water source scan be overused or wasted to such an extent that they locally run dry. Water sources can be so heavily polluted by sewage and toxic substances that it becomes impossible to use the water.
4. Marine sources: Fish is an important protein food in many parts of the world.
Fishes are used for preparation of food and fish oil is also used in food preparation are today being over-harvested until the catch has become a fraction of the original resource and the fish are incapable of breeding successfully to replenish the population.
5. Medicinal plants: we get so many important medicinal plants from forest, which are useful in our day to day life health issues. When the population of a species of plant or animal is reduced by human activities, until it cannot reproduce fast enough to maintain a viable number, the species becomes extinct. Many species are probably becoming extinct without us even knowing and other linked species are affected by their loss.

III) Non-renewable resources:
Non renewable resources are those which cannot be replenish after use. It is called non renewable resources.
There are mainly 3 types of non renewable resources. Such as,

1) Fossil fuels such as such as coal, petroleum, and gas, oils), etc.
2) Metal ores are other examples of non-renewable resources.

- The metals themselves are present in vast amounts in the earth's crust, and are continually concentrated a replenished over millions of years.
- However their extraction by humans only occurs where they are concentrated by natural processes (such as heat, pressure, organic activity, weathering and other processes) enough to become economically viable to extract.
- These processes generally take from tens of thousands to millions of years.
- Non renewable resources have been found in the lithosphere over millions of years and constitute a closed system.
- The end products of fossil fuels are in the form of and chemical compounds, this cannot be reconstituted as resources.
- Problems using non renewable resource in excess
- The use of fossil fuels raises serious environmental concerns.
- The burning of fossil fuels produces around 21.3 billion tons of carbon dioxide (CO_2) per year, but it is estimated that natural processes can only absorb about half of that amount.
- so there is a net increase of 10.65 billion tones of atmospheric carbon dioxide per year (one tone of atmospheric carbon is equivalent to 44/12 or 3.7 tons of carbon dioxide).
- Carbon dioxide is one of the greenhouse gases that enhances radioactive forcing and contributes to global warming, causing the average surface temperature of the Earth.
- Saving of renewable resource
- Less use of petrol and diesel vehicles.
- Using more and more biofuels for transport purpose.
- Use of solar energy for cooking purpose.

IV) Forest Resources

- Scientists estimate that India should ideally have 33 percent of its land under forests.
- Today we have only about12 percent. Thus we need not only to protect existing forests but also to increase our forest cover.
- People who live in or near forests know the value of forest resources first hand because their lives and livelihoods depend directly on these resources.
- However, the rest of us also derive great benefits from the forests which we are rarely aware of.

➢ The water we use depends on the existence of forests on the watersheds around river valleys.
➢ Our homes, furniture and paper are made from wood from the forest.
➢ We use many medicines that are based on forest produce. And we depend on the oxygen that plants give out and the removal of carbon dioxide we breathe out from the air.

FOREST FUNCTIONS

Watershed protection:

• Reduce the rate of surface run-off of water. • Prevent flash floods and soil erosion. • Produces prolonged gradual run-off and thus prevent effects of drought.

Atmospheric regulation:

• Absorption of solar heat during vapor-transpiration.
• Maintaining carbon dioxide levels for plant growth. • Maintaining the local climatic conditions.

Erosion control:

Holding soil (by preventing rain from directly washing soil away).

Land bank:

• Maintenance of soil nutrients and structure.

Local use - Consumption of forest produce by local people who collect it for subsistence – (Consumptive use)

• Food - gathering plants, fishing, hunting from the forest.
(In the past when wildlife was plentiful, people could hunt and kill animals for Food. Now that populations of most wildlife species have diminished, continued Hunting would lead to extinction.)
• Fodder - for cattle. • Fuel wood and charcoal for cooking, heating. • Poles - building homes especially in rural and wilderness areas. • Timber – household articles and construction. • Fiber - weaving of baskets, ropes, nets, string, etc. • Sericulture – for silk. • Apiculture - bees for honey, forest bees also pollinate crops.
• Medicinal plants - traditionally used medicines, investigating them as potential source for new modern drugs.

Market use - (Productive use)

• Most of the above products used for consumptive purposes are also sold as a source of income for supporting the livelihoods of forest dwelling people.
• Minor forest produce - (non-wood products): Fuel wood, fruit, gum, fiber, etc. which are collected and sold in local markets as a source of income for forest sellers.
• Major timber extraction - construction, industrial uses, paper pulp, etc. Timber extraction is done in India by the Forest Department, but illegal logging continues in many of the forests of India and the world.

Saving of forest sources

Deforestation:

➢ Where civilizations have looked after forests by using forest resources cautiously, they have prospered, where forests were destroyed, the people were gradually impoverished.
➢ Today logging and mining are serious causes of loss of forests in our country and all over the world.
➢ Dams built for hydroelectric power or irrigation have submerged forests and have displaced tribal people whose lives are closely knit to the forest. This has become.

Problems

One of India's serious environmental problems is forest degradation due to timber extraction and our dependence on fuel wood.

V) Water resources

Water is a renewable natural resource, which is essential for survival of life, without water life is impossible. All living creatures need water in their day to day life.

- All aquatic ecosystems are used by a large number of people for their daily needs such as drinking water, washing, cooking, watering animals, and irrigating fields.
- The world depends on a limited quantity of fresh water. Water covers 70% of the earth's surface but only 3% of this is fresh water.
- At a global level 70% of water is used for agriculture about 25% for industry and only 5% for domestic use.
- However this varies in different countries and industrialized countries use greater percentage for industry. India uses 90%for agriculture, 7% for industry and 3% for domestic use.
- Problems
- One of the greatest challenges facing the world in this century is the need to rethink the overall management of water resources.
- The world population has passed the 6 billion mark.
- Based on the proportion of young people in developing countries, this will continue to increase significantly during the next few decades.
- India is expected to face critical levels of water stress by 2025.
- At the global level 31 countries are already short of water and by 2025 there will be 48 countries facing serious water shortages.
- Overutilization and pollution of surface and groundwater: With the growth of human Population there is an increasing need for larger amounts of water to fulfill a variety of basic needs.
- Today in many areas this requirement cannot be met. Over utilization of water occurs sat various levels. Most people use more water than they really need. Most of us waste water.
- Studies indicate that a person needs a minimum of 20 to 40 liters of water per day for drinking and sanitation.
- More than one billion people worldwide have no access to clean water, and to man more, supplies are unreliable.
- Many agriculturists use more water than necessary to grow crops.
- There are many ways in which farmers can use less water without reducing yields such as the use of drip irrigation systems.
- Industry tends to maximize short-term economic gains by not bothering about its liquid waste and releasing it into streams, rivers and the sea.
- The polluting industry that does not care for the environment and pays off bribes to get away from the cost needed to use effluent treatment plants may eventually be caught, punished and even closed down.
- Public awareness may increasingly put pressures on industry to produce only eco-friendly products which are already gaining in popularity.

VI) Energy resources

- Energy is defined by physicists as the capacity to do work.
- Energy is found on our planet in a variety of forms, some of which are immediately useful to do work, while others require a process of transformation.
- There are so many different types of energy resources are thers,exmple wise,
- Sun energy
- Chemical energy
- Nuclear energy etc.
- The sun is the primary energy source in our lives.
- We use it directly for its warmth and through various natural processes that provide us with food, water, fuel and shelter.

- The sun's rays power the growth of plants, which form our food material give off oxygen which we breathe in and take up carbon dioxide that we breathe out.
- Energy from the sun evaporates water from oceans, rivers and lakes, to form clouds that turn into rain.
- Today's fossil fuels were once the forests that grew in prehistoric times due to the energy of the sun.
- Chemical energy, contained in chemical compounds is released when they are broken down by animals in the presence of oxygen. In India,
- Manual labour is still extensively used to get work done in agricultural systems, and domestic animals used to pull carts and ploughs.
- Electrical energy produced in several ways, powers transport, artificial lighting, agriculture and industry.
- Uses of energy resources
- We use energy for household use, agriculture, production of industrial goods and for running transport.
- Modern agriculture uses chemical fertilizers, which require large amounts of energy during their manufacture.
- Problems
- All energy use and creates heat and contributes to atmospheric temperatures.
- Many forms of energy release carbon dioxide and lead to global warming.
- Nuclear energy plants have caused enormous losses to the environment due to the leakage of nuclear material.
- The inability to effectively manage and safely dispose of nuclear waste is a serious global concern.
- At present almost 2 billion people worldwide have no access to electricity at all.
- While more people will require electrical energy, those who do have access to it continue to increase their individual requirements.
- In addition, a large proportion of energy from electricity is wasted during transmission as well as at the user level.
- It is broadly accepted that long-term trends in energy use should be towards a cleaner global energy system that is less carbon intensive and less reliant on finite non-renewable energy sources.
- It is estimated that the currently used methods of using renewable energy and nonrenewable fossil fuel sources together will be insufficient to meet foreseeable global demands for power generation beyond the next 50 to
- 100 years.
- Thus when we use energy wastefully, we are contributing to a major environmental disaster
- for our earth. We all need to become responsible energy users.
- An electrical light that is burning unnecessarily is a contributor to environmental degradation.
- Remember that even a single electerial light is burning unnecessarily is a contributor to environmental pollution.

VII) Role of individual in conservation of natural resources

- Natural resources such as soil, water, forests and grasslands on the Earth's surface and extracting minerals and fossil fuels from underground.
- But, in the last few decades, it has become increasingly evident that the global ecosystem has the capacity to sustain only a limited level of utilization.
- Greed for material goods has become a way of life for a majority of people in the developed world.

- Population growth and the resulting shortage of resources most severely affects people in the developing countries.
- In nations such as ours, which are both developing rapidly, and suffering from a population explosion; both factors are responsible for environmental degradation.
- We must ask ourselves if we have perhaps reached a critical flash point, at which economic ‘development’ affects the lives of people more adversely than the benefits it provides.
- Turn off lights and fans as soon as you leave the room.
- Use tube lights and energy efficient bulbs that save energy rather than bulbs. A 40 Watt tube light gives as much light as a 100watt bulb.
- Keep the bulbs and tubes clean. Dust on tubes and bulbs decreases lighting levels by 20 to 30 percent.
- Switch off the television or radio as soon as the program of interest is over.
- A pressure cooker can save up to 75 percent of energy required for cooking. It is Also faster.
- Keeping the vessel covered with a lid during cooking, helps to cook faster, thus saving energy.

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Unit-2

Ecosystem: Introduction and Components

The word "Ecosystem" was first coined by British ecologist A. G. Tansley in 1935. It is derived from two words "eco" and "system". "Eco" refers to the environment and "system" refers to a complex co-ordinated unit. According to Odum, Ecosystem is a fundamental unit of Ecology.

- It includes all the organisms of a given area, interacting with their physical environment, so that a flow of energy leads to a clearly defined trophic structure, bio-diversity and material cycles within the system.
- All the ecosystems, whether terrestrial, marine, and fresh water or man-engineered consist of two main and major components: 1. Abiotic components 2. Biotic components.
- **Abiotic components of Ecosystem: (Non-living)**
- Structurally, Abiotic components of the ecosystem include non-living or physical factors of the environment.
- For example, **climate regime**: temperature, light, precipitation and other physical factors

Inorganic substances like C, N, H, P, S etc involved in material cycles or chlorophylls

Organic substances like proteins, lipids, carbohydrates etc and humic substances that link the biotic and Abiotic component.

Moreover, Abiotic substances of ecosystem also include,

1. Solid mineral matter on the earth (the lithosphere).
2. Water in the ocean, lakes, rivers, ice-caps etc (the hydrosphere).
3. The gaseous mixture in the air (the atmosphere).
4. Radiant solar energy.

- The position and movement of the Earth and its gravitation force are abiotic components of the environment. These components result in oxygen needed by all living organisms for respiration is a byproduct of photosynthesis. Moreover, certain chemosynthetic and photosynthetic bacteria, which can convert the light energy of Sun in the form of organic compounds, needed by plants for their own growth and development are also called the producers. Since all these organisms produce food for all the other organisms, they are known as producers.
- Consumers are those living members of the ecosystem, which consume food prepared by the producers. These are also called heterotrophs and also called macroconsumers. All the different types of animals are included in this category. They may be herbivores that eat plants, carnivores that eat animals or omnivores that eat all kinds of food.
- The herbivores are dependent upon the green plants and are called primary consumers. Algae found in ponds and oceans, are also primary consumers in their respective habitats. Insects, rodents and ruminant are the major herbivores on the terrestrial environment.
- The entire life of an ecosystem revolves around these herbivores and hence Elton (1939) called them key industry animals.
- The herbivores are used as food by primary carnivores (frog, grasshopper etc) and they in turn are used as food by secondary carnivores. For example, snakes, birds etc.

Grass → Grasshopper → Frog → Snake → Hawk →Tiger

Algae → Protozoans → Small fishes → big fishes → Birds → Lions

In addition several more stages of nutritional independency may occur. Lions, tigers, vultures etc are microconsumers. The decomposers are those living members of the ecosystem which are largely composed of microorganisms such as parasitic and saprophytic fungi and bacteria. These act on dead bodies of producers and consumers and are responsible for breaking up complex materials into simple substances. These substances are used an energy source by producers.

Classification of Ecosystem:

- Ecologist Clarke gave the classification of the ecosystem.
- Clarke classified the whole ecosystem into two major group, on the basis of their origin.

1. **Natural ecosystem**- borned naturally in the environment or respective habitats.
2. **Artificial ecosystem**- engineered by man

Natural ecosystem:

- It is again classified in to terrestrial and aquatic ecosystem. Terrestrial (land) ecosystem includes different grassland, forest and dessert ecosystems whereas aquatic (water) ecosystem is further classified into marine and fresh water ecosystem. Marine ecosystem includes the life cycling and physical interaction of organisms found in seas, oceans etc. the fresh water ecosystem is classified into lentic i.e. standing water and lotic i.e. running water. Lentic includes ecosystem of ponds, lakes, ditches etc while lotic.

Artificial ecosystem:

- Artificial ecosystems are man-engineered. Here, man create typical environment for an ecosystem which suites the organisms of that ecosystem particular. E.g. Aquarium, glass-houses, phytotrons, biotrons, artificial media, croplands etc.

Terrestrial ecosystem: (on land):

Examples:

1. Grassland ecosystem:

- Grassland represents a terrestrial ecosystem.
- Grasslands occupy approximately 45.0 million sq.km. Area throughout the world in the tropics, temperate and alpine regions.
- Approximately 24% of the vegetation cover is grassland.
- The different components of the grassland ecosystem are as follows:

A. Abiotic components:

- These are the nutrients present in the soil and aerial environment.
- Thus, elements like C, H, O, N, P, S etc are supplied by CO_2, H_2O, NO_3, PO_4, SO_4 present in the air and soil of that area.
- In addition of the particular area including light, temperature, humidity, wind etc are also included in the Abiotic components.
- Ecological status of the Indian grasslands has been a debatable point. Bor (1942) and Champion (1936) consider that the grasslands are all existing due to biotic activities like lopping, burning, shifting, and cultivation and grazing of the forests for the last several thousand years.

-Manual of Plant Ecology, K.C.Misra, 2nd Edition (1980)

B. Biotic components:

The biotic components of the grass land ecosystem include the following:

1. **Producers:** these are mainly some grasses like Dicanthium, Desmodium, Digitaria, Sataria, Sporobolous, and Cynodon etc. Besides them some shrubs, trees and herbs also contribute to the primary production.
2. **Consumers:** they occur in the following sequence: deer, goats, rabbit, mouse etc. are the herbivores. Besides them some insects like Leptocorisa, Oxyrhachis, and Cincinella etc. Some termites and millipedes which feed on the leaves of grasses are also found.

Secondary consumers: they are the carnivores feeding on herbivores. They include animals like fox, jackals, snakes, frog, lizards, birds etc.

Tertiary consumers: hawks, peacocks etc which feed on secondary consumers occupy this level in the food chain.

3. **Decomposers:** Microbes, like fungi, some bacteria and actinomycetes are included in this group. Species of Mucor, Aspergillus, Penicillium, Rhizopus, Fusarium etc are active in the decay of dead organic matter of different form of higher life.
4. **Fresh water Ecosystem: (Aquatic ecosystem):**

1. **Pond ecosystem:** A pond as a whole serves a good example of fresh water ecosystem. It exhibits a self sufficient, self regulating system.

A. **Abiotic components:** the chief substances are heat or temperature, light, pH value of water and basic inorganic and organic compounds like H_2O, CO_2, O_2, Ca, N, P, humic acids, amino acids etc. These nutrients are found in the solution state as well as stored in particulate matter and also in living organisms.

B. **B. Biotic components:** these include the following:

1. **Producers:** they are represented by the autotrophic green plants and some photosynthetic bacteria. They may be of two types: larger aquatic plants, which include partly or completely sub-merged floating and emergent hydrophytes. Some of the common plant species are Trapa, Typha, Hydrilla, Vallisnaria, Nypheamarselia, Azolla, Wolffia, Pistia, Chara, Eichornia etc.
2. **Microproducers or Phytoplankton:** these include minute floating or suspended lower plants. Filamentous algae zygnema, ulothrix, spirogyra,oedogonium and also some chlorococcalws like Pendorina, Volvox, Diatoms, Anabaena, Spirullina etc are also included as producers.

Consumers: the consumers in a pond can be distinguished as follows:

A. **Primary consumers:** these are herbivores feeding directly on living plants. They can be differentiated as a**. Benthos:** animals associated with living plants.

b. Benthik: those bottom forms,

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UNIT-3

3.1 INTRODUCTION

- The great diversity of life on earth has provided for man's needs over thousands of years.
- This diversity of living creatures forms a support system which has been used by each civilization for its growth and development.
- Those that used this bounty of nature carefully and sustainably survived, while those that overused or misused it disintegrated.
- Science has attempted to classify and categorized the variability in nature for over century.
- This has led to an understanding of its organization into communities of plants and animals.
- This information has helped in utilizing the earths' biological wealth for the benefit of humanity and has been integral to the process of 'development'.
- The diversity of life on earth is so great that if we use it sustainably we can go on developing new products from biodiversity for many generations.
- This can only happen if we can manage biodiversity as precious resources and prevent the extinction of species.

3.2 DEFINITION AND CONCEPT

- The term **'BIOLOGICAL DIVERSITY'** is commonly shortened to '**BIODIVERSITY**'.
- Biodiversity is the variety of life forms on earth and the essential interdependence of all living things.
- It is describe the number, variety and variability of organisms.
- Primarily, diversity is the result of two opposite actions: the processes that produce new genotype, new varieties and new species and the processes that eliminate mutations, variants and species from the system.
- Biodiversity is ultimately the source of human sustenance.
- A loss of biodiversity can seriously affect the human welfare.

3.3 TYPES OF BIODIVERSITY

- **Genetic Diversity:** It is the total genetic information contained in the respect to the individuals of plants, animals, and microorganisms**.**
- **Species Diversity:** It is the variability of population with respect to the reproductive distinctiveness of each of the individuals.
- **Ecosystem Diversity:** It relates to the variety of habitats, biotic communities and ecological processes in the biosphere as well as the diversity within the biosphere.

3.4 USES OF BIODIVERSITY

- Biodiversity provides a variety of environmental services from its species and ecosystems that are essential at the global, regional and local levels.
- Biological biodiversity is use as directly or indirectly. It has social values, ethical and moral values, aesthetic value, and option value.
- **Direct uses:** Food, clothing, housing, energy, medicines, are all resources that are directly or indirectly linked to the biological variety present in the biosphere. This is most obvious in the case of tribal communities who directly gather resources from the forest or fisher folk who catch fish in marine or freshwater ecosystems.
- **Indirect uses:** The production of oxygen, reduction of carbon dioxide, maintaining the water cycle and protecting soil water are some important services. The world now acknowledges that the loss of biodiversity contributes to global climatic changes.
- Forests are the main mechanism for the conversion of carbon dioxide into carbon and oxygen. The loss of forest cover, coupled with the increasing release of carbon dioxide and other gases through industrialization, contributes to the 'greenhouse effect'. Global warming is melting ice caps, resulting in a rise in the sea-level, which will eventually submerged the low-lying areas in the world.

- It is also causes atmospheric changes, leading to increased temperatures, serious droughts in some areas and unexpected floods in other areas.
- Biological diversity is also essential for preventing ecological processes, such as fixing and recycling of nutrients, soil formation, circulation and cleansing of air and water, global life support (plants absorb CO_2, give out O_2), maintaining the water balance within ecosystems, watershed protection, maintaining stream and river flows throughout the year, erosion control and local flood reduction.
- For other, such as agriculture communities, biodiversity is used as grow their crops to suit the environment.
- Urban communities generally used the greatest amount of goods and services, which are all indirectly drawn from natural ecosystem.
- **Social values**: While traditional societies that has a smaller population and required less resources had preserved their biodiversity as a life-supporting resource, modern man has rapidly depleted it up to the extent of leading to the irrecoverable loss due to extinction of several species.
- **Ethical and moral values:** Biodiversity conservations are based on the importance of protecting all forms of life. Apart from the economic importance of conserving biodiversity, there are several cultural, moral and ethical values, which are associated with sanctity of all forms of life.
- **Aesthetic value:** The appreciation of the presence of biodiversity for its inherent value and beauty, as well as for the contribution it makes to our knowledge-our aesthetics, imagination and creativity- are other reasons to preserve it.
- **Option value:** Keeping the future possibility open for their use is called the option value. It is impossible to predict which of our species or traditional varieties of crops and domestic animals will be of greatest use in the future. To continue to improve cultivars and domestics livestock, we need to returns to wild relatives of crop plants and animals. Thus the preservation of biodiversity must also include traditionally used strains already in existence in crops and domestic animals.

1.5 IUCN CATEGORIES OF THREAT

- IUCN is **International Union of Conservation of Nature and Natural Resources.**
- It is also known as the **World Conservation Union**. It has headquarters at **Gland, Switzerland**.
- It is the premier coordinating body to highlight the legal status of rare species.
- For purpose of conservation, the IUCN has established 5 main conservation categories.
- ***Extinct, endangered, vulnerable, rare and insufficiently known species.***

1. **Extinct:** Species that are no longer known to exists in the wild. All the localities where they were once found and other possible sites show no more of these species.

2. **Endangered:** Species that have a high likelihood of going extinct in the near future are designated as 'Endangered'.

3. **Vulnerable:** Species that may become endangered in the near future because populations of these species are decreasing in size throughout its range.

4. **Rare:** Species that have small total numbers of individuals often due to limited geographical ranges or low population densities.

5. **Insufficiently Known:** Species that probably belong to one of the conservation categories but are not sufficiently well known to be assigned to a specific category are put in this type.

1.6 CONSERVATION OF BIODIVERSITY

The International Union for Conservation of Nature and Natural Resources (IUCN) states that it is essential to include at least 10% of all ecosystems as Protected Areas if biodiversity is to be conserved in the long-term.

- Two types of conservation of biodiversity which is follow as: **1) *In- situ* and 2) *Ex- situ***

1) *In-situ* Conservation:

- The conservation of a species is best done by protecting its habitat along with all the other species that live in it in nature. This is known as in-situ conservation, which is, conserving a species in its own environment by creating national parks and wildlife sanctuaries.
- Biodiversity can be best preserves *in-situ* by setting aside an adequate representation of wilderness as ***Protected Areas.*** These should consist of a network of ***National Parks and Wildlife Sanctuaries***.
- The objective of these areas should be, to preserve biological diversity from microscopic, unicellular plants and animals, to the giant trees and large mammals.
- However, species cannot be protected individually as they are all interdependent on each other-the whole ecosystem must be protected.
- As rare endemic species are found only in a small area, these easily become extinct due to human activity. Such areas must be given an added importance as their biodiversity is a special feature of the region.
- Animal such as elephants require different types of habitats to feed in during different seasons. They utilize open grasslands after the rains when the young grass shoots are highly nutritious.
- Some imp projects by govt of india:
- As the grasses dry, the elephants move into the forest to feed on foliage from the trees.
- Project tiger was launched by the Government of India with the support of WWF-International in 1973 and was the first initiative aimed at protecting this key species and all its habitats.
- Crocodiles have been threatened as their skin is used for making leather articles. This led to the near-extinction of crocodile in the wild in the 1960s in India. A crocodile breeding and conservation program was initiated in 1975 to protect the remaining population of crocodilians in their natural habits abs by creating breeding centers.
- Project Elephant was launched in 1992 to ensure the long-term survival of elephants in their natural habitats. It is being implemented in 12 states.
- There are 589 protected areas in India, of which 89 are National Parks and 500 are Wildlife Sanctuaries. They include a variety of ecosystems and habitats.
- Some imp. are as follows:
- The Great Himalayan National Park is the largest sanctuary in this ecosystem and is one of the last homes of the beautiful snow leopard.
- The Dachigam Sanctuary is the only place where the rare Hangul or Kashmir stag is found.
- Bharatpur is one of the most famous water-bird sanctuaries in the world. Thousands of ducks, geese herons, and other wading birds can be seen here.
- The sanctuaries of the Western Ghats and associated hill rages protect some of the most diverse forest types in the country. The few examples of highly-threatened species include the Malabar giant squirrel, the flying squirrel and a variety of hill birds, several species of amphibians, reptiles and insects. These region are also rich in highly endemic plant life.
- Sanctuaries such as Bhimashankar, Koyana, Chandoli and Radhanagari preserve this rich flora in Maharastra; Bandipur, Bhadra, Dandeli, Nagarhole, etc. in Karnataka; and Eravilulum, Parambikulum, Periyar, and the silent Valley, in Kerala.

IN GUJARAT:

- In the Thar Desert, the wildlife is protected in the Desert National Park. Here, large numbers of blackbuck, nilgai and chinkara can be seen. The Great Indian Bustard lives in these arid lands.
- The Great and Little Rann of Kachchh have been made into sanctuaries to protect the very rare wild ass, the flamingo, the star tortoise and desert fox.
- In Gujarat, the Gir Sanctuaries protects the last population of the majestic Asiatic Lion. This thorn and deciduous forest is also the home of large herds of chital, sambhar, and nilgai.
- Two important sanctuaries meant for preservation of **coastal ecosystems** are the Chilka Lake in Orissa and Point Calimere in Tamil Nadu. The Sunderbans protect the largest mangroves delta in India. The Marine National Park in Gujarat protects shallow areas in the sea, islands, coral reefs and extensive mudflats.
- As it is not practical to notify more Pas without affecting the lives of people, alternate strategies such as Community Reserves or Community Conserved Areas (CCAs) need to be created. These should be managed by local people to bring about the conservation of biodiversity, while using the area's resources in an equitable and sustainable way. A major drive for conservation of biological diversity can only come from a mass environmental education program on the value of protecting our dwindling biological resources.

2) ***EX-situ***:

- There are situation in which an endangered species is so close to extinction for that species conserve the outside its natural habitat in carefully controlled situation such as botanical garden for plants, or zoological park for animals, where is expertise to multiply the species under artificially-managed condition. This is known as *ex- situ* conservation.
- These breeding programs for rare plants and animals are however more expensive than managing a PA.
- There is also another form of preserving a plant by preserving its germplasm in a gene bank so that it can be used if needed in future. This is even more expensive.
- In India, successful ex-situ conservation programs have been done for all our three species of crocodile; this has been highly successful. Another recent success has been the breeding of the very rare pygmy hog in the Gauhati Zoo. The Delhi zoo successfully breed the rare Manipur brow-antlered deer.
- However, the most important step of a successful breeding program is the reintroduction of a species into its original wild habitat. This requires rehabilitation of the degraded habitat and removal of the other causes such as poaching, disturbances, or other man-made influences that have been the primary cause of reducing the population of the species.
- Conservation of cultivars and livestock breeds: There were an estimated 30,000 varieties of rice grown in India till about 50 years ago. Now, only few of these are still grown. The new varieties which are now being cultivated everywhere have been developed using the germplasm of these original types of rice. If all the traditional varieties vanish completely, it will be difficult to develop new disease-resistant varieties of rice in the future.
- Encouraging farmers to continue to grow several traditional varieties is, thus, an important concern for the future of mankind.
- At present, gene-bank collections have over 34,000 cereals and 22,000 pulses.

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Unit IV: ENVIRONMENT POLLUTION

1. Introduction

2. What is Environmental Pollution? Any undesirable change in physical, chemical, or biological characteristics of any component of the environment i.e. air, water, soil which can cause harmful effects on various forms of life or property.

OR

"The introduction of contaminants into the natural environment that cause adverse change i.e. instability, disorder, harm or discomfort to the ecosystem, physical systems or living organisms. Pollution can take the form of chemical substances or energy, such as noise, heat or light".

3. What is pollutant? Any substance causing nuisance or harmful effects or uneasiness to the organisms, then that particular substance may be called as the pollutant. Pollutants can be solid, liquid or gaseous substances; they may be natural or anthropogenic and have harmful effect on environment and organisms.

4. Explain various types of pollution.

- **AIR POLLUTION:** Air pollution is the contamination of air by smoke and harmful gases, mainly oxides of carbon, sulfur, and nitrogen. (And maybe by that smelly uncle.)
- **WATER POLLUTION:** Contamination of any body of water (lakes, groundwater, oceans, etc)
- **NOISE POLLUTION:** Any loud sounds that are either harmful or annoying to humans and animals.
- **NUCLEAR/RADIATION POLLUTION:** Caused by Ionizing radiations which are harmful and emitted from disintegrating atomic nuclei.
- **LAND POLLUTION:** Degradation of the Earth's surface caused by a misuse of resources and improper disposal of waste.
- **THERMAL POLLUTION:** Increase of temperature caused by human activity.

According to ecological perspective, pollutants can be classified as follows:

• **Degradable or Non persistent pollutants**: Rapidly broken down by natural processes e.g.: domestic sewage, discarded vegetables

• **Slowly degradable or persistent pollutants:** Remain in environment for many years in an unchanged condition and take long time to degrade. e.g.: DDT, plastics

• **Non degradable pollutants:** Cannot be degraded by natural processes, once they are release into environment, they are difficult to eradicate and continue to accumulate. e.g.: Toxic elements like lead, mercury

A.) Air Pollution

- **Definition:** Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or cause damage to the natural environment or built environment, into the atmosphere.

OR

"Any visible or invisible particle or gas found in the air that is not part of the original, normal composition."

- A substance in the air that can cause harm to humans and the environment is known as an **air pollutant.**

- **Causes of Air Pollution**

- **Natural:** Forest fires, Pollen, Dust storm, smoke that comes from wildfires, volcanoes, methane, dust
- **Unnatural/Anthropogenic/Man-made: P**ower plants, automobiles, fumes, burning wood stoves, Mining, Burning of fossil fuels and fires and furnaces, Deforestation, Rapid industrialization, Wars
- **Types of pollutants:**

1.) Primary pollutant:

- Emitted directly from identifiable sources. Produced by both human and natural events
- Eg. Carbon monoxide (CO), Sulfur Dioxide (SO_2), Nitrogen Oxides, Volatile Organic Compounds (VOCs) (methane, propane, chlorofluorocarbons, etc), Particulate Matter (soot, ash), Toxic metals (lead, mercury)

2.) Secondary pollutant:

- Not directly emitted from source but forms when other pollutants (primary pollutants) react in the atmosphere.
- Ozone is formed when hydrocarbons (HC) and nitrogen oxides (NO_x) combine in the presence of sunlight;
- NO_2 is formed as NO combines with oxygen in the air
- Acid rain is formed when sulfur dioxide or nitrogen oxides react with water.
- **Effects of Air Pollution**

1.) Health effects of humans, plants and animals:

- Cause or worsen human illnesses
- Respiratory system problems to human and animal
- Headache, nausea, dizziness, eye irritation, lungs damage, breathing problems
- Damage plants and its waxy coating on leaves lead to water loss, increase hardness, stiffness of flower buds and leaves.
- Increased skin cancer
- **Agriculture:** Decrease or affect Crop production
- **Wild life damage:** Reduced or destroyed aquatic life

2.) Environmental Effects

- **Acid rain:** Increased smog, acid deposition
- Forest damage: Damaged and dying forests
- Reduced phytoplankton, disrupted food chain
- **Ozone Depletion:** Thinning of the protective ozone layer of atmosphere leads to climate change
- **Global Climate Change/ Global warming**
- **Green House Effect:** Damage to ozone layer, leads to ozone layer depletion and heating atmosphere with unbalanced condition of heat reflection causes green house effect.
- **Damage to property:** Affect on house, paints, historic monuments, natural beauty sites i.e. leads to formation of damaged/destroyed buildings and art

- **Control of Air Pollution**

- Removal of pollutants by two fundamental approaches:
  - (1) Prevention of pollution
  - (2) Effluent control
- Air quality monitoring instruments and air samplers:
  - Mechanical collectors (dust cyclones, multicyclones)
  - Dry and wet filters
  - Electrostatic precipitators
  - Bag Filters
  - Ventury Scrubbers
- Use of raw material that cause less pollution
- Reduce sulphur content before burning
- Increased planting of vegetation
- Increased use of renewable energy sources i.e. Use of energy sources other than fossil fuels
- Legal measures from authorities:
  - The Air (Prevention and Control of Pollution) Act, 1981
  - The Environment (Protection) Act, 1986

B.) WATER POLLUTION

➢ **Definition:** Water Pollution can be defined as alteration in physical, chemical, or biological characteristics of water through natural or human activities and making it unsuitable for its designated use.

➢ Fresh Water present on the earth surface is used for many activities in day to day life. eg. Drinking, domestic and municipal uses, agricultural, irrigation, industries, navigation, recreation. The used water becomes contaminated and is called waste water.

- **Sources Water Pollution: Types**

➢ **Point sources**:

o Located at specific places i. e. comes from a specific source, like a pipe

o Easy to identify, monitor, and regulate

o e.g., factories, industry, sewage treatment plants, mines, oil wells, oil tankers)

➢ **Nonpoint sources:**

o Broad, diffuse areas

o Difficult to identify and control i.e. NPS pollution cannot be traced to a direct discharge point

o Expensive to clean up

o e.g., storm water, acid deposition, substances picked up in runoff, seepage into groundwater)

- **Causes of Water Pollution**

➢ Macroscopic pollution: Large visible items (floatables) pollute water

➢ Oxygen Demanding Wastes: organic waste that needs oxygen often from animal waste, paper mills and food processing.

➢ Thermal Pollution: Rise or fall in the temperature of a natural body of water caused by human influence. It changes physical properties of water.

➢ Use water as a coolant by power plants and industrial manufacturers leads to thermal pollution.

➢ Elevated water temperatures decrease oxygen levels, which can kill fish and alter food chain composition, reduce species biodiversity, and foster invasion by new thermophilic species.

➢ Infectious agents: Disease-causing microorganisms are referred to as pathogens. Bacteria, fungi, viruses, protozoa are come from various sources like fecal, industrial waste, medical waste etc, which makes water non potable.

➢ Radioactive isotopes, detergent, suspended matter, gasoline, plastics, pesticides etc are also water pollution causative agent

➢ Oil exclusion areas near marine water create major issue of water pollution and affect marine biodiversity.

➢ Sediment: Soils and silts from land erosion can disrupt photosynthesis, destroy spawning grounds, clog rivers and streams

➢ Inorganic pollutants:

o Nitrate & phosphate fertilizers that cause excessive growth of algae and aquatic plants. This phenomenon is called eutrophication which create problem like water clogging in water pipe, change in water test, odour, color.

o Other water soluble inorganic chemicals: Acid, salts and metal toxic compound like mercury, lead. High levels of this pollutant make water unfit for drink, reduce crop yield, create corrosion problem in pipes.

➢ Organic pollutants:

o Oils, fats, phenols, organic acids , fats, grease

o Food processing waste, which can include oxygen-demanding substances, fats and grease

- Oxygen depleting substances that can be decomposed by aerobic bacteria, which leads decreased level of oxygen and cause increased BOD (Biological oxygen demand)
- Insecticides and herbicides, a huge range of organohalides and other chemical compounds
- Petroleum hydrocarbons, including fuels (gasoline, diesel fuel, jet fuels, and fuel oil) and lubricants (motor oil), and fuel combustion by products, from storm water runoff
- Volatile organic compounds, such as industrial solvents, from improper storage.
- Chlorinated solvents, which are dense non-aqueous phase liquids, may fall to the bottom of reservoirs, since they don't mix well with water and are denser. Eg. Polychlorinated biphenyls (PCBs), Trichloroethylene

- **EFFECTS of WATER POLLUTION**

- Devastating to people and animals, fish, and birds.
- Decreasing the quantity of potable water
- Water borne diseases (Hepatitis, Cholera) occur, skin disease may occur if water becomes chemical mixture,
- Lower water supplies for crop irrigation which leads to reduced plants yield, Decrease of photosynthesis
- Change in quality of products, which use water in their ingredients,
- Negative impact on fish and wildlife populations that require water of a certain purity for survival.
- Leads to eutrophication: Nutrient enrichment of water bodies mostly from runoff of plant nutrients (nitrates and phosphates)
- Corrosion issue and pipe line blockage due to eutrophication, acidic or basic water and bacterial contamination
- Oil spills: The oil can wash up on nearby beaches, devastate the ecosystem and severely affect tourism. This may also affect economy of fisher folk community.
- Sewage discharged into coastal waters can wash up on beaches and cause a health hazard. People who bathe or surf in the water can fall ill if they swallow polluted water
- Sewage discharge poison shellfish (such as cockles and mussels) that grow near the shore. People who eat poisoned shellfish risk suffering from an acute and sometimes fatal illness called paralytic shellfish poisoning.

- **Control of WATER POLLUTION**

- Find substitutes for toxic chemicals
- Keep toxic chemicals out of the environment
- Reuse treated waste water for irrigation
- Prevent ground water contamination
- Follow principle of 3R's i.e. Reduce, Reuse, Recycle
- Install monitoring wells near landfills and underground tanks
- Require leak detectors on underground tanks
- Ban hazardous waste disposal in landfills and injection wells
- Store harmful liquids in aboveground tanks with leak detection and collection systems
- Develop effluent treatment plants to treat polluted water from domestic to industrial
- Reduce pollution by individual effort like create awareness, give note to society about law of water conservation and pre activity to reduce pollution.

- **Legislative measures:**

- The Water (Prevention and Control of Pollution) Act, 1974
- The Environment (Protection) Act, 1986
- Clean Water Act, 1977

- London Dumping Convention (1975): International treaty regulating disposal of wastes generated by normal operation of vessels
- Oil Pollution Act,1990

C.) **NOISE POLLUTION**

- Noise pollution is excessive, displeasing human, animal, or machine-created environmental noise that disrupts the activity or balance of human or animal life.

OR

"Unwanted/ undesirable sound, which create disturbance to individual or to environment called noise. And it affects to environment quality, which is called noise pollution."

- Sound becomes undesirable when it disturbs the normal activities such as working, sleeping, and during conversations.
- World Health Organization stated that "Noise must be recognized as a major threat to human well-being"
- Intensity of sound can be measured in **decibel (dB)** unit

- **Sources of Noise Pollution**

- Noise may not seem as harmful as the contamination of air or water, but it is a pollution problem that affects human health and can contribute in disturbance of environment quality.
- Not all sound is noise, but what may be considered as music to one person, may be noise for another.
- Transportation systems are the main source of noise pollution in urban areas.
- Construction of buildings, highways, and streets cause a lot of noise, due to the usage of air compressors, bulldozers, loaders, dump trucks, and pavement breakers.
- Industrial noise also adds to the already unfavorable state of noise pollution.
- Loud speakers, plumbing, boilers, generators, air conditioners, fans, and vacuum cleaners add to the existing noise pollution

- **Effects OF NOISE POLLUTION**

- According to USEPA, there are direct links between noise and health.
- Noise pollution adversely affects the lives of millions of people.
- Noise pollution can damage physiological and psychological health.
- Major harmful effect of noise pollution is directly to eat, temporary or permanent hearing loss.
- High blood pressure, stress related illness, sleep disruption, irritability, anxiety, stress, lack of concentration is the effect of noise pollution and productivity loss are problems related to noise pollution.
- Exposure to high sound level can range in severity from being extremely annoying to being extremely painful to ear. Continuous exposure to more than 100 dB sounds can affect ear drum.
- It can also cause memory loss, severe depression, and panic attacks.

- **Control of Noise Pollution**

- **Block path of noise:** Planting bushes and trees in and around sound generating sources is an effective solution for noise pollution.
- **Reduce noise at sources:** Regular servicing and tuning of automobiles can effectively reduce the noise pollution.
- Similar to automobiles, lubrication of the machinery and servicing should be done to minimize noise generation.
- **Social awareness programs** should be taken up to educate the public about the causes and effects of noise pollution.

- **Protect recipient i.e. ear.:** Workers should be provided with equipments such as earplugs and earmuffs for hearing protection.
- Increase path length of noise
- Soundproof doors and windows can be installed to block unwanted noise from outside.
- Factories and industries should be located far from the residential areas.
- Regulations should be imposed to restrict the usage of play loudspeakers in crowded areas and public places.
- **Legislative measures:** Noise Pollution (Regulation and Control) Rules, 2000

D.) Nuclear Pollution

- Radioactive molecule is used to generate energy
- They also found applications in medical field
- When radioactive rays come out from closed environment to open due to accident or radioactive waste is thrown in open environment, it affects to human, plants, animal and environment called nuclear pollution/nuclear hazard.
- Radioactive pollution is a special type of physical pollution which is related to all major life supporting systems like air, water and soil.
- It is caused by ionizing radiations which are harmful and emitted from disintegrating atomic nuclei.
- Radioactivity is the phenomenon of emission of energy from radioactive isotopes (i.e., unstable isotopes), such as Carbon- 14, Uranium- 235, Uranium- 238, Uranium- 239, Radium- 226, etc.
- The emission of energy from radioactive substances in the environment is often called as 'Radioactive Pollution'/Nuclear Pollution.
- Nuclear energy (power plants) is used to produce electricity. But fuel used in power plants is radioactive, which is very hazardous.
- Generally, the radiation exposure is measured by the unit called roentgen (R).

- **Sources of Nuclear Pollution:**

1. Natural resources:

- Cosmic rays from outer space. The quantity depends on altitude and latitude; it is more at higher latitudes and high altitudes.
- Emissions from radioactive materials from the Earth's crust.

2. Man-made sources:

- Nuclear power plants
- X-rays
- Nuclear bombs
- Nuclear accidents
- Mining and processing of radioactive ores
- Use of radioactive materials in nuclear weapons

Among these X rays which produce out 95% of radiation exposure

- **Effects of Nuclear Pollution**

- The biological effects of nuclear radiation are as folllows

(i) Short term recoverable effects(small effect which leads to loss of hair)

(ii) Long term irrecoverable effects and

Genetic effect: The future generations are affected. Radiations can cause mutations, which are changes in genetic make up of cells. This is due to the damages to DNA molecules. eg. Hirosima and Nagasaki issue, Chernobyl issue

- Internal bleeding & blood vessel damage may show up as red spots on the skin.
- Cancer is considered to be major health problem from radiation exposure.

- Acute exposure appears as burns & radiation sickness (nausea, hair loss, weakness etc.)

- **Control measures for Nuclear Pollution**
- Laboratory generated nuclear wastes should be disposed off safely and scientifically.
- Nuclear power plants should be located in areas after careful study of the geology of the area, tectonic activity and meeting other established conditions.
- Appropriate protection against occupational exposure.
- Leakage of radioactive elements from nuclear reactors, careless use of radioactive elements as fuel and careless handling of radioactive isotopes must be prevented.
- Safety measure against accidental release of radioactive elements must be ensured in nuclear plants.
- Unless absolutely necessary, one should not frequently go for diagnosis by X-rays.
- Regular monitoring of the presence of radioactive substance in high risk area should be ensured.

Legislative measures: The hazardous waste (management and handling) rules 1989

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