

Unit-1 INTRODUCTION TO ENVIRONMENT

Environment is a complex of many variables, which surrounds man as well as the living organisms. Environmental studies describe the interrelationships among organisms, the environment and all the factors, which influence life on earth, including atmospheric conditions, food chains, the water cycle, etc.

It is a basic science about our earth and its daily activities, and therefore, this science is important for one and all.

Scope of environmental studies

1. The study creates **awareness** among the people to know about various **renewable and non-renewable resources** of the region. The endowment or potential, patterns of utilization and the balance of various resources available for future use in the state of a country are analysed in the study.
2. It provides the **knowledge about ecological systems** and cause and effect relationships.
3. It provides necessary **information about biodiversity richness** and the potential dangers to the species of plants, animals and microorganisms in the environment.
4. The study enables one to understand the **causes and consequences due to natural and main induced disasters** (flood, earthquake, landslide, cyclones etc.,) and pollutions and measures to minimize the effects.
5. It enables one to **evaluate alternative responses to environmental issues** before deciding an alternative course of action.
6. The study enables environmentally **literate citizens** (by knowing the environmental acts, rights, rules, legislations, etc.) to make appropriate judgments and decisions for the protection and improvement of the earth.
7. The study exposes the problems of over population, health, hygiene, etc. and the role of arts, science and technology in eliminating/ minimizing the evils from the society.
8. The study tries to identify and develop appropriate and indigenous eco-friendly skills and technologies to various environmental issues.

9. It teaches the citizens the need for **sustainable utilization** of resources as these resources are inherited from our ancestors to the younger generation without deteriorating their quality.

10. The study enables theoretical knowledge into practice and the multiple uses of environment.

Importance of environmental study

Environmental study aims to make the citizens competent to do scientific work and to find out practical solutions to current environmental problems.

The citizens acquire the ability to analyze the environmental parameters like the aquatic, terrestrial and atmospheric systems and their interactions with the biosphere and anthrosphere.

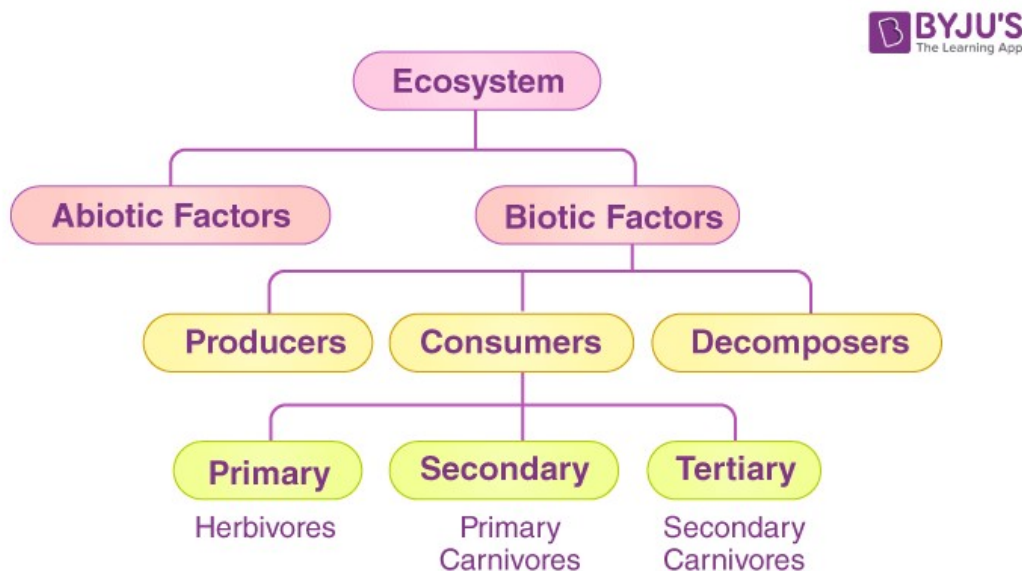
- The people should take a combined responsibility for the deteriorating environment and begin to take appropriate actions to space the earth.
- Education and training are needed to save the biodiversity and species extinction.
- The urban area, coupled with industries, is major sources of pollution.
- The study enables the people to understand the complexities of the environment and need for the people to adapt appropriate activities and pursue sustainable development, which are harmonious with the environment.
- The study motivates students to get involved in community action, and to participate in various environmental and management projects.
- Environmental studies take a multidisciplinary approach to the study of human interactions with the natural environment. It integrates different approaches of the humanities, social sciences, biological sciences and physical sciences and applies these approaches to investigate environmental concerns.

Ecosystem

An ecosystem is a structural and functional unit of ecology where the **living organisms interact with each other and the surrounding environment**. In other words, an ecosystem is a chain of interactions between organisms and their environment. The term “Ecosystem” was first coined by A.G.Tansley, an English botanist, in 1935.

Structure of the Ecosystem

The structure of an ecosystem is characterised by the organisation of both **biotic and abiotic components**. This includes the distribution of energy in our environment. It also includes the **climatic conditions prevailing in that particular environment**.



Biotic Components

Biotic components refer to all living components in an ecosystem. **Based on nutrition**, biotic components can be categorised into autotrophs, heterotrophs and saprotrophs (or decomposers).

- **Producers** include all autotrophs such as **plants**. They are called **autotrophs** as they can produce food through the process of photosynthesis. Consequently, all other organisms higher up on the food chain rely on producers for food.

- **Consumers or heterotrophs** are organisms that **depend on other organisms for food**. Consumers are further classified into primary consumers, secondary consumers and tertiary consumers.
- **Primary consumers** are always herbivores as they rely on producers for food.
- **Secondary consumers** depend on primary consumers for energy. They can either be carnivores or omnivores.
- **Tertiary consumers** are organisms that depend on secondary consumers for food. Tertiary consumers can also be carnivores or omnivores.
- **Quaternary consumers** are present in some food chains. These organisms prey on tertiary consumers for energy. Furthermore, they are usually at the top of a food chain as they have no natural predators.
- **Decomposers** include saprophytes such as fungi and bacteria. They directly thrive on the dead and decaying organic matter. Decomposers are essential for the ecosystem as they help in recycling nutrients to be reused by plants.

Abiotic Components

Abiotic components are the non-living component of an ecosystem. It includes air, water, soil, minerals, sunlight, temperature, nutrients, wind, altitude, turbidity, etc.

Functions of Ecosystem

The functions of the ecosystem are as follows:

1. It regulates the essential ecological processes, supports life systems and renders stability.
2. It is also responsible for the cycling of nutrients between biotic and abiotic components.
3. It maintains a balance among the various trophic levels in the ecosystem.
4. It cycles the minerals through the biosphere.
5. The abiotic components help in the synthesis of organic components that involve the exchange of energy.

So the functional units of an ecosystem or functional components that work together in an ecosystem are:

- **Productivity** – It refers to the rate of biomass production.

- **Energy flow** – It is the sequential process through which energy flows from one trophic level to another. The energy captured from the sun flows from producers to consumers and then to decomposers and finally back to the environment.
- **Decomposition** – It is the process of breakdown of dead organic material. The topsoil is the major site for decomposition.
- **Nutrient cycling** – In an ecosystem nutrients are consumed and recycled back in various forms for the utilisation by various organisms.

Types of Ecosystem

An ecosystem can be as small as an oasis in a desert, or as big as an ocean, spanning thousands of miles. There are two types of ecosystem:

- Terrestrial Ecosystem
- Aquatic Ecosystem

Terrestrial Ecosystem Terrestrial ecosystems are exclusively land-based ecosystems. There are different types of terrestrial ecosystems distributed around various geological zones. They are as follows:

1. Forest Ecosystem
2. Grassland Ecosystem
3. Tundra Ecosystem
4. Desert Ecosystem

Forest Ecosystem

A forest ecosystem consists of several plants, particularly trees, animals and microorganisms that live in coordination with the abiotic factors of the environment. Forests help in maintaining the temperature of the earth and are the major carbon sink.

Grassland Ecosystem

In a grassland ecosystem, the vegetation is dominated by grasses and herbs. Temperate grasslands and tropical or savanna grasslands are examples of grassland ecosystems.

Tundra Ecosystem

Tundra ecosystems are devoid of trees and are found in cold climates or where rainfall is scarce. These are covered with snow for most of the year. Tundra type of ecosystem is found in the Arctic or mountain tops.

Desert Ecosystem

Deserts are found throughout the world. These are regions with little rainfall and scarce vegetation. The days are hot, and the nights are cold.

Aquatic Ecosystem

Are ecosystems present in a body of water. These can be further divided into two types, namely:

1. Freshwater Ecosystem
2. Marine Ecosystem

Freshwater Ecosystem

The freshwater ecosystem is an aquatic ecosystem that includes lakes, ponds, rivers, streams and wetlands. These have no salt content in contrast with the marine ecosystem.

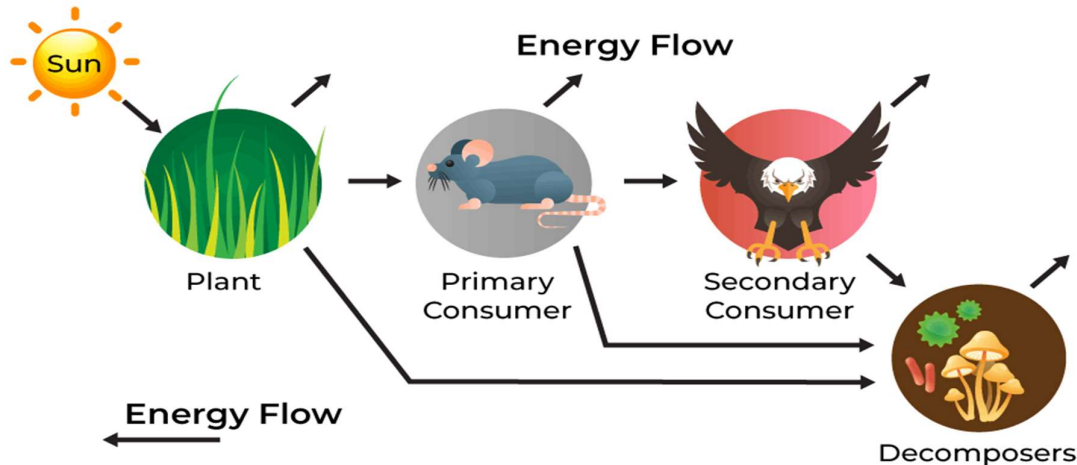
Marine Ecosystem

The marine ecosystem includes seas and oceans. These have a more substantial salt content and greater biodiversity in comparison to the freshwater ecosystem.

Energy Flow in Ecosystem

- The energy flow of an ecosystem means the pathway energy takes to move from one organism to another in an ecosystem. The energy flow of an ecosystem is a fundamental concept of ecological studies.
- The energy flow of an ecosystem is unidirectional and is typically in the form of food flow from one trophic level to another.
- The energy flow of the ecosystem harnesses the energy that cascades through the food chain and food webs.
- The energy flow of the ecosystem helps us to understand how different species of various trophic levels interact with each other.
- Energy flow is the phenomenon that is responsible to sustain life on this planet.

- All the biotic components in this ecosystem need energy for their survival. If the energy flow in an ecosystem is disturbed, then it leads to ecological imbalance.
- This energy flow occurs on the Earth through the biogeochemical cycle.



Laws of Thermodynamics in Ecosystem

First Law of thermodynamics

It states that energy can neither be created nor destroyed, but it keeps changing from one form to the other. Similarly in an ecosystem, the main source of energy is the sun, and this energy from the sun is transferred from one level to the other.

Second Law of thermodynamics

It states that when energy transforms from one form to another, some part of it is lost as heat to the surroundings. Thus the energy at one level is never completely transferred to the other.

Direction of Energy Flow

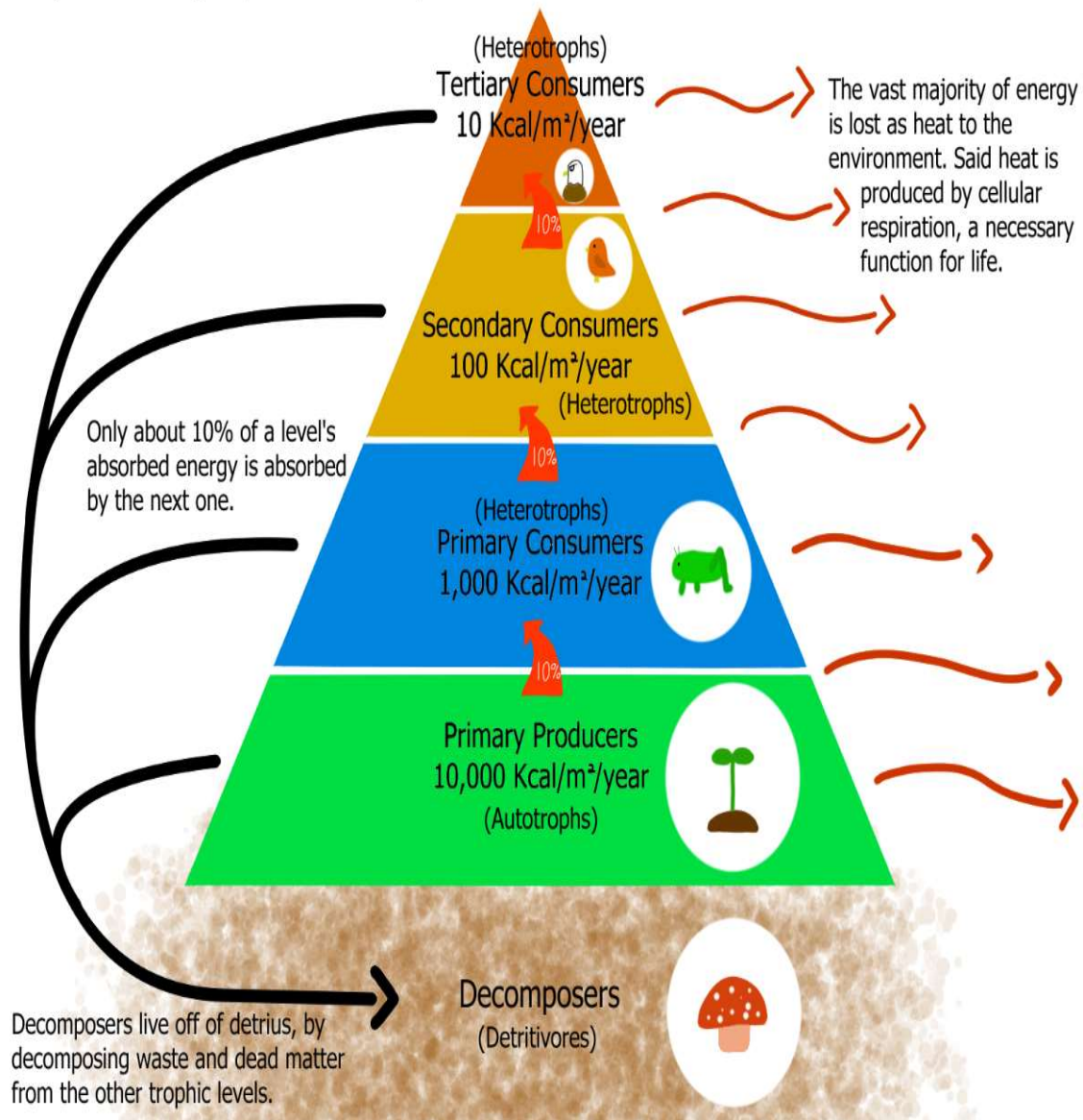
- The direction of the energy flow in an ecosystem is unidirectional. It flows from the primary source of energy i.e. the sun's light energy to producers or autotrophs which then transferred to the consumers.
- The producer uses the solar energy to produce organic food which flows through a series of trophic levels.
- Each trophic level captures a portion of this energy for its metabolic needs, while the rest is passed to the next level.
- The flow of energy follows the following pathway;

Solar Energy → Producer (autotrophs) → Consumer (herbivores) →

Consumer (carnivores) → Consumer (higher levels of carnivores)

Trophic Levels & Energy Transfer

Trophic levels are split by a who-eats-who system.





In the above food chain:

1. In the first stage, plants are eaten by herbivores such as grasshoppers.
2. Then herbivores such as deer are consumed by carnivores such as lions, tigers, etc.
3. On the death of carnivores, they are consumed by scavengers such as eagles and vultures.
4. When vultures die, their bodies are broken down by bacteria and fungi to nutrients.
5. These nutrients are again used by the plants for their growth.

Significance of Energy Flow in Ecosystem

Following are some of the significances of Energy Flow in an Ecosystem;

1. It is vital for all living things in ecosystem to survive and function properly.
2. It helps us to understand who eats whom in nature.
3. It helps us to see how human action are affecting the ecosystem.
4. It shows how all creatures in an ecosystem depend on each other and how changes can affect each other.

Importance of Biodiversity

Biodiversity and its maintenance are very important for sustaining life on earth. A few of the reasons explaining the importance of biodiversity are:

- **Ecological Stability**

Every species has a specific role in an ecosystem. They capture and store energy and also produce and decompose organic matter. The ecosystem supports the services without which humans cannot survive. A diverse ecosystem is more productive and can withstand environmental stress.

- **Economic Importance**

Biodiversity is a reservoir of resources for the manufacture of food, cosmetic products and pharmaceuticals.

Crops livestock, fishery, and forests are a rich source of food.

Wild plants such as Cinchona and Foxglove plant are used for medicinal purposes.

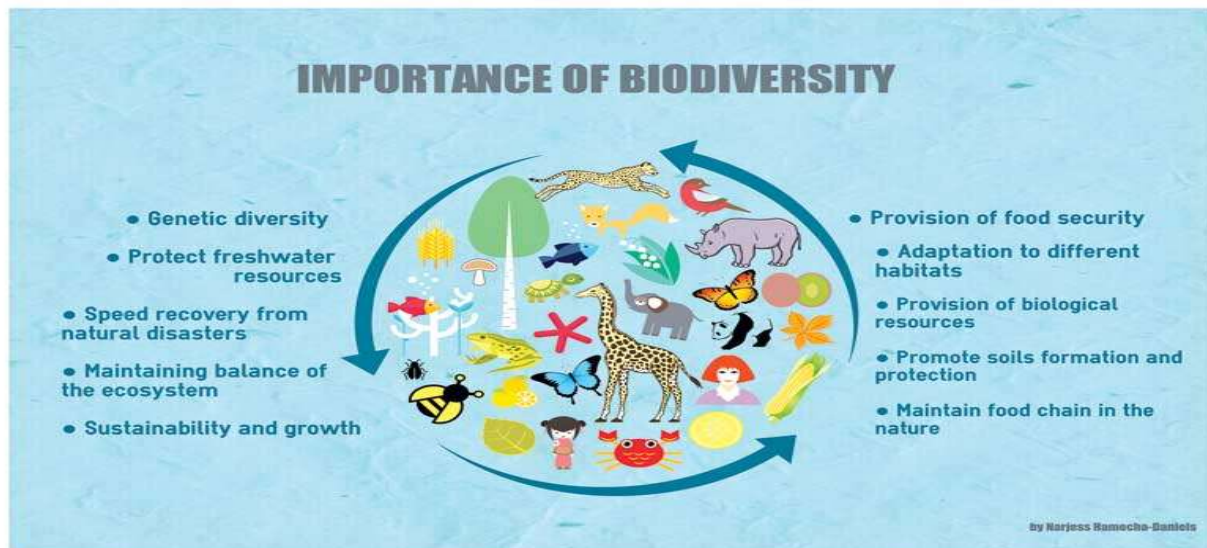
Wood, fibres, perfumes, lubricants, rubber, resins, poison and cork are all derived from different plant species.

The national parks and sanctuaries are a source of tourism. They are a source of beauty and joy for many people.

- **Ethical Importance**

All species have a right to exist. Humans should not cause their voluntary extinction.

Biodiversity preserves different cultures and spiritual heritage. Therefore, it is very important to conserve biodiversity.



THREATS TO BIODIVERSITY

Though the rate of loss of species has been a slow process in the past, the process of extinction has become fast in recent years. It has been reported that approximately 10,000 species become extinct every year. This raises an alarm regarding the threat to biodiversity. If this trend continues 1/3 or 2/3 of our current biodiversity would become extinct by the middle of the 21st century.

Factors causing loss of biodiversity

• Loss of Habitat

- Destruction of habitats due to clearing of forests and grasslands for agricultural lands, pastures, settlement areas or project development leads to loss of habitat. These factors are responsible for the disappearance of thousands of species.
- The wetlands, mangroves and estuaries with rich biodiversity are under threat. They are destroyed, as if they have no value.

• Poaching of wild life

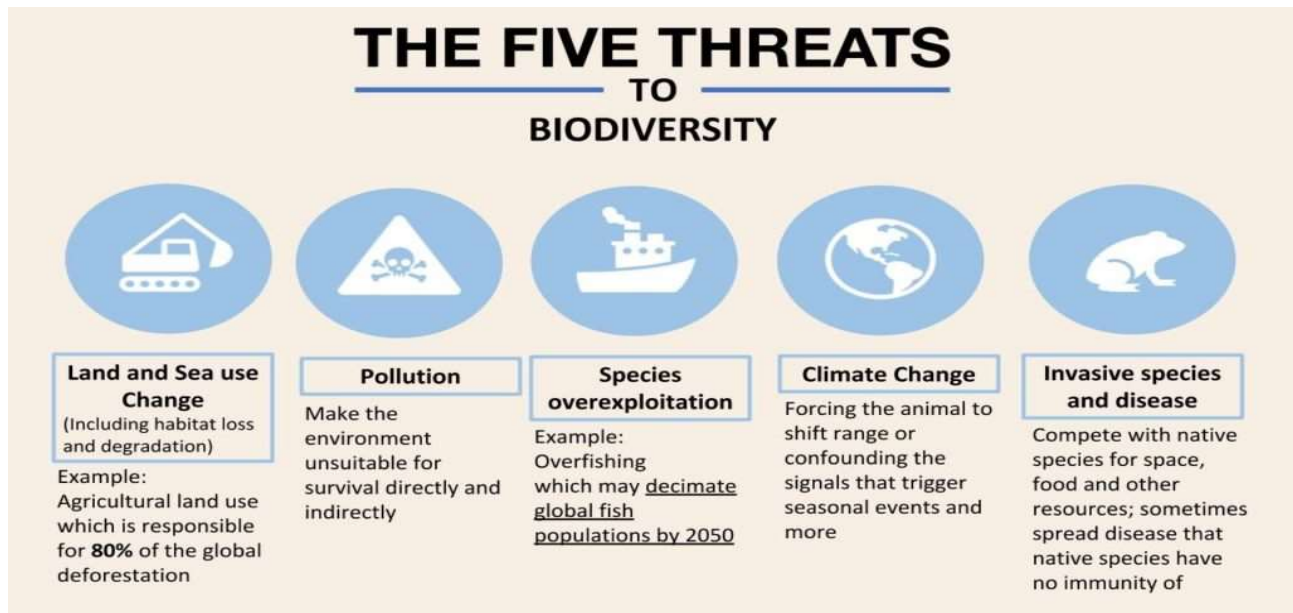
The illegal commercial hunting is called poaching. There are two types of hunting.

- I) subsistence hunting (killing animals for food) and
- II) sport hunting (killing animals to sell their meat, fur, horns, tusks etc.)

• Man-Animal conflicts

Sometimes, wild animals threaten human beings. This leads to conflict between wild life and man.

- When the habitats of wild animal are destroyed by man, the animals are forced to come out of the forest in search of food to the nearby human settlements and attack human beings when they come in contact with them accidentally.
- The weak and injured animals have a tendency to attack man. A tigress attacks man in order to protect its cubs. Once a tiger tastes the flesh of a man accidentally, it becomes a man-eater.
- When wildlife corridors are converted into human settlements, the path of wild life is disrupted and animals attack the settlements.



Conservation of Biodiversity

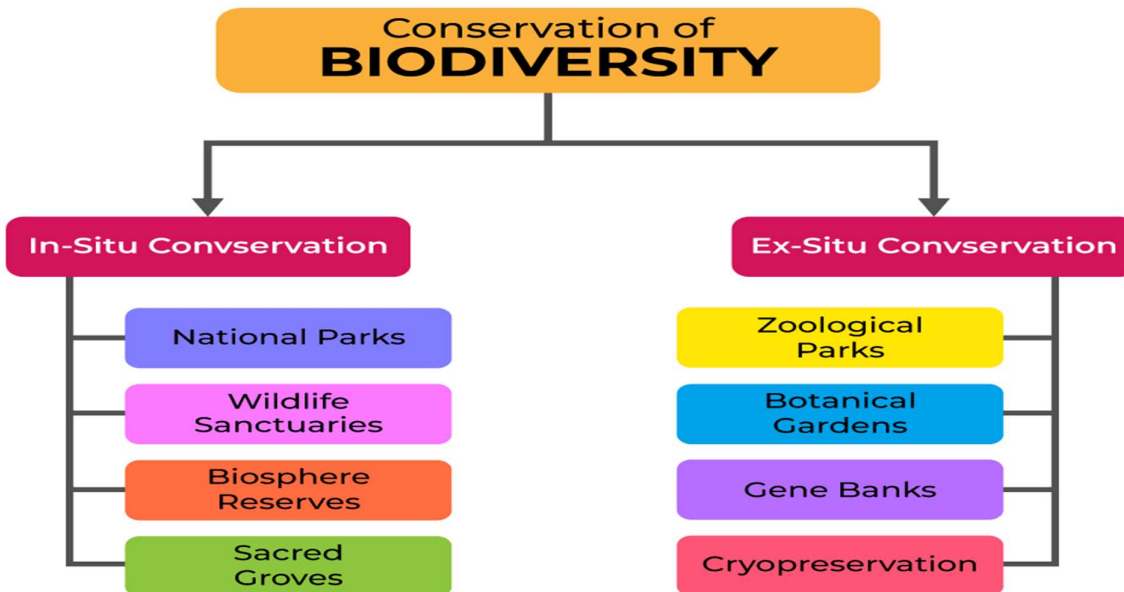
Conservation is defined as 'the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations'. Conservation of our natural resources has the following three specific objectives:

1. To maintain essential ecological processes and life-supporting systems.
 2. To preserve the diversity of species or the range of genetic material found in the organisms on the planet, and
 3. To ensure sustainable utilization of species and ecosystems which support millions of rural communities as well as the major industries all over the world.
- The wildlife conservation efforts are mostly centred on protecting plant and animal life in protected habitats, such as – botanical gardens, zoos, sanctuaries, national parks, biosphere reserves, etc.

Methods of Conservation

There are two methods of conservation of biodiversity.

- In-situ conservation (within habitat)
- Ex-situ conservation (outside habitats)



In-situ conservation

- In-situ or on-situ conservation means conservation of species in its natural ecosystem or even in man-made ecosystems (i.e. artificial ecosystems).
- This type of conservation applies only to wild fauna and flora, and not to the domesticated animals and plants because conservation is possible by protection of population in nature.
- In-situ conservation is a “protected area” (an area of land and/ or sea specially dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources and managed through legal or other effective means) , which involves setting aside large portions of earth’s surface for wildlife with emphasis either to save the entire area or an endangered species.
- There are different categories of protected areas which are managed with different objective. These include – national parks, sanctuaries, biosphere reserves, etc.

The advantages of In-situ conservation are:

- In-situ conservation is the best strategy for the long term protection of biodiversity.

- Large pockets/ areas of protected zones are essential for not only conserving vast number of species of living organisms but also provide opportunities to evolve. Otherwise, man-made habitats (e.g. zoo, aquarium, etc.) may end-up with static gene-pool.
- in-situ is cheaper to protect populations in their natural habitat than to reintroduce captive-bred ones.

Ex-situ conservation

- Ex-situ conservation means conservation of species (sample of genetic diversity), particularly of endangered species, away from their natural habitat under human supervision.
- In-situ conservation is the best strategy for the long-term protection of biodiversity; however, for many rare species or species having small remaining population, it is not a viable option in the light of increasing human disturbances.
- Further, species may decline and go extinct in the wild due to genetic drift and inbreeding, environmental and demographic variation, deteriorating habitat quality, competition from exotic species, disease or over-exploitation.
- Under such circumstances, the only possible way a species can be prevented from going extinct is to maintain individuals in artificial conditions under human care.
- In ex-situ conservation, the endangered species of animals are collected and bred under controlled conditions in zoos, game farms, aquaria, etc., while plant species are maintained in botanical gardens, arboreta and seed banks.

The advantages of ex-situ conservation are:

- The organism is assured of food, shelter and security, and hence can have longer life-span and breeding activity. Thus, increasing the possibility of having a greater number of off springs.
- Under human care and secure conditions, the chances of survival increase.
- Ex-situ conservation also provides the possibility of using genetic techniques to improve the concerned species.
- Captive breeding can provide animals for possible reintroduction to the wild at a later stage or for supplementing current populations with new stock.

Limitations and disadvantages of ex-situ conservation:

- Ex-situ conservation can be adopted only for a few selected species because of limitations of space, finances and facilities in the institutions that undertake captive breeding.

- Ex-situ conservation, under a set of favourable environmental conditions, deprives the organism the opportunity to adapt to the ever-changing natural environment. As a result, new life-forms cannot evolve and the gene-pool gets stagnant.

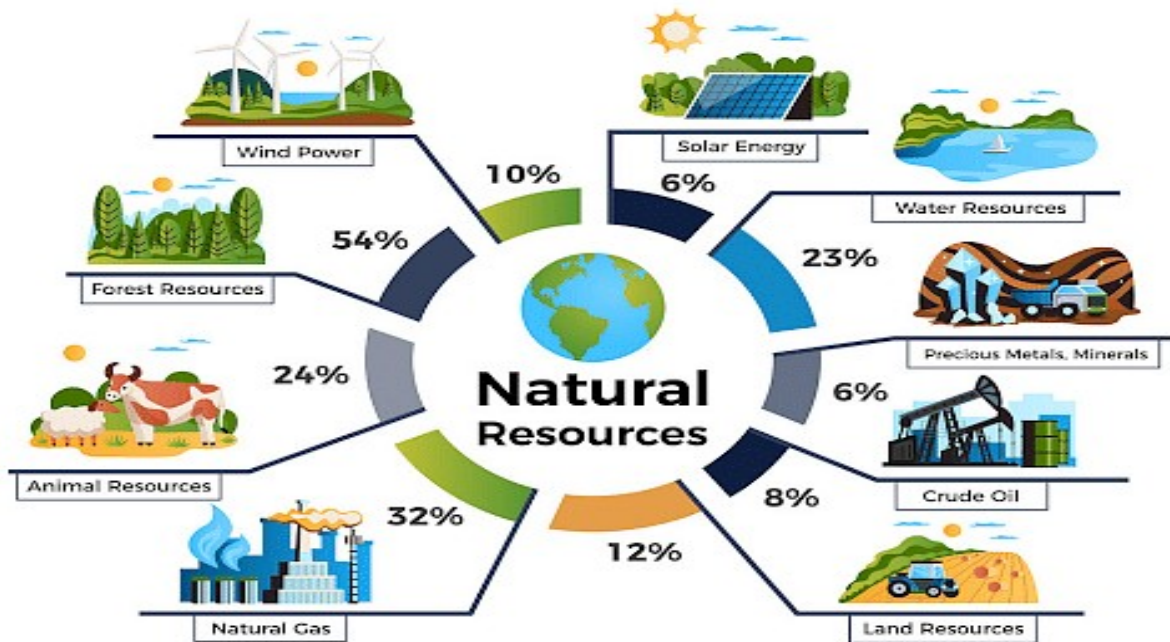
Following are the important strategies for biodiversity conservation:

1. All the varieties of food, timber plants, livestock, microbes and agricultural animals should be conserved.
2. All the economically important organisms should be identified and conserved.
3. Unique ecosystems should be preserved first.
4. The resources should be utilized efficiently.
5. Poaching and hunting of wild animals should be prevented.
6. The reserves and protected areas should be developed carefully.
7. The levels of pollutants should be reduced in the environment.
8. Deforestation should be strictly prohibited.
9. Environmental laws should be followed strictly.
10. The useful and endangered species of plants and animals should be conserved in their nature as well as artificial habitats.
11. Public awareness should be created regarding biodiversity conservation and its importance.

Natural Resources and Associated Problems

Natural resources are the resources that exist without any actions or intervention of human beings in nature. People cannot make natural resources; however, they can collect them.

It consists of water, sunlight, atmosphere, land including all minerals along with all the vegetation, crops, and animal life that naturally subsists on or within these known and identified substances and characteristics.



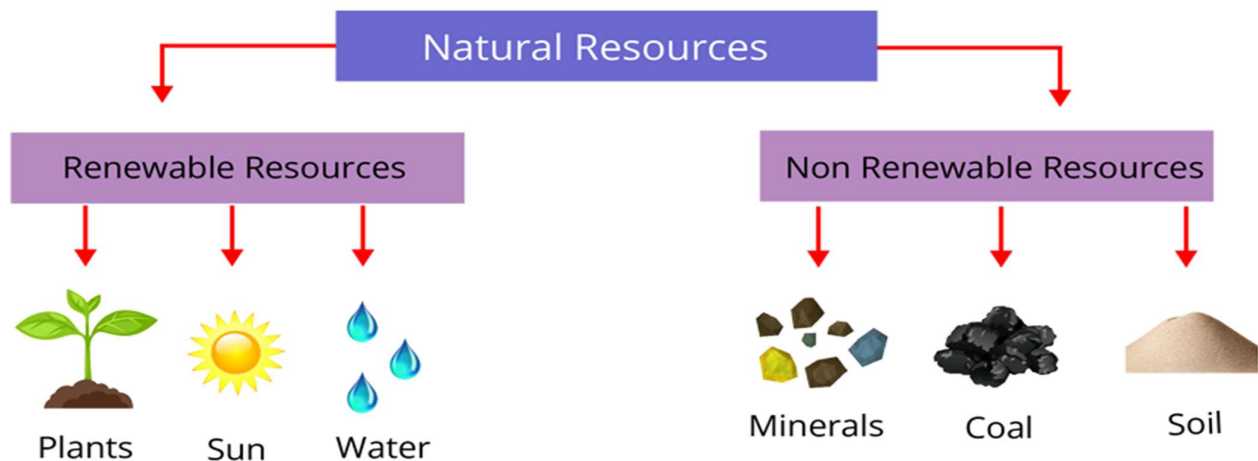
There are several problems that are attached to natural resources.

1. The irrational consumption and overuse of these natural resources have led to several socio-economic and environmental problems.
2. Natural resources are available in a fixed quantity and are non-renewable.
3. There is an increasing scarcity of these natural resources as the population is increasing day by day.
4. Non-renewable natural resources take millions of years to form.
5. Planning land use as a major resource, needed for not only for food production and animal husbandry, but also for industry and growing human settlements. These forms of intensive land use are frequently extended at the cost of 'wild lands', our remaining forests, grasslands, wetlands and deserts.
6. The need for sustainable lifestyles, Human standard of living and the health of the ecosystem are indicators of sustainable use of resources in any country or region. Ironically, both are not in concurrence with each other. Increasing the level of one, usually leads to degradation of other. Development policies should be formulated to strike a balance between the two.

Classifications of Natural Resources

Depending upon availability of natural resources can be divided into two categories:

1. Renewable natural resources and
2. Non-renewable natural resources



Renewable natural resources are the resources that can be generated again once they are used. Renewable resources are in a way inexhaustible resources. They have the ability to replenish themselves by means such as recycling, reproduction and replacement.

Examples of renewable resources are sunlight, animals and plants, soil, water, etc.

Non-renewable natural resources are the ones that exhaust after their frequent usage and sometimes it takes a really long time for them to regenerate. the resources that cannot be replenished once used or perished. An example of this includes natural gas, coal, minerals, fossil fuels, etc.

Natural Resources and their Conservation

It is highly important that we conserve these natural resources since they are getting exhausted at an alarming rate. Apart from that, it has an adverse effect on the environment that is indirectly causing harm to living beings. However, if we follow some tips in our day to day lives, we can conserve these natural resources.

1. Use an alternative source of power like solar and wind energy
2. Plant more trees for preventing the soil erosion
3. Use pipelines for transporting oil
4. Treat the industrial sewage and wastage even before they get released into the water bodies
5. Include the rainwater harvesting system in the house
6. Use biogas in the house

7. Use biofuels instead of the conventional petroleum-based fuels
8. Ensure that the wastes are being recycled
9. Use electronic mails
10. Make use of the energy-saving tube lights and bulbs
11. Practice the method of crop rotation
12. Construct reservoirs

Forest

Forests are complex land ecosystems that support a wide variety of plants, trees and animals. It provides a lot of resources like fruits, timber, firewood, honey, herbal medicines etc. The forests also provide several raw materials for different manufacturing industries.

Forest Resources

Forest is important renewable resources. Forest vary in composition and diversity and can contribute substantially to the economic development of any country. Plants along with trees cover large areas, produce variety of products and provide food for living organisms, and also important to save the environment.

Significance of forests

Forest can provide prosperity of human being and to the nations. Important uses of forest can be classified as under

- Commercial values
- Ecological significance
- Aesthetic values
- Life and economy of tribal

Commercial values

- Forests are main source of many commercial products such as wood, timber, pulpwood etc. About 1.5 billion people depend upon fuel wood as an energy source. Timber obtained from the forest can used to make plywood, board, doors and

windows, furniture, and agriculture implements and sports goods. Timber is also a raw material for preparation of paper, rayon and film.

- Forest can provide food, fibre, edible oils and drugs.
- Forest lands are also used for agriculture and grazing.
- Forest is important source of development of dams, recreation and mining.

Life and economy of tribal

Forest provides food, medicine and other products needed for tribal people and play a vital role in the life and economy of tribes living in the forest.

Ecological uses

Forests are habitat to all wild animals, plants and support millions of species. They help in reducing global warming caused by greenhouse gases and produces oxygen upon photosynthesis.

Forest can act as pollution purifier by absorbing toxic gases. Forest not only helps in soil conservation but also helps to regulate the hydrological cycle.

Aesthetic values

All over the world people appreciate the beauty and tranquillity of the forest because forests have a greatest aesthetic value. Forest provides opportunity for recreation and ecosystem research.

Deforestation

1. Forest are burned or cut for clearing of land for agriculture, harvesting for wood and timber, development and expansion of cities .These economic gains are short term where as long term effects of deforestation are irreversible
2. Deforestation rate is relatively low in temperate countries than in tropics If present rate of deforestation continues, we may losses 90% tropical forest in coming six decades

Effects of deforestation


Deforestation adversely and directly affects and damages the environment and living beings. Major causes of deforestation are

- Soil erosion and loss of soil fertility
- Decrease of rain fall due to effect of hydrological cycle
- Expansion of deserts
- Climate change and depletion of water table
- Loss of biodiversity ,flora and fauna


- Environmental changes and disturbance in forest ecosystems

teachoo.com


Consequences of Deforestation




Global Warming




Pollution




Drought




Desertification



Animal & Plant Life Affected



Shortage of food



Flooding of Rivers

WATER RESOURCES

Water is a very important source and essential for life because it has very unique characteristic. It is the natural resource. There is an uneven distribution of water resources, tropical rain forest are receiving maximum rainfall where as desert receive only little rainfall.

Due to its unique properties water is of multiple uses for all living organisms. Water is absolutely essential for all the living organisms. One can survive for weeks without food but cannot survive more than a few days without water. Since the earliest days of mankind water availability was the major factor to decide the place of human settlements. Water dissolves nutrients and distributes them in different parts of plants and regulates the temperature and removes the waste.

Water is the universal solvent and plays a key role in the existence of various forms of life on the planet earth. It is widely used for various purposes such as washing, bathing, cleaning, cooking, drinking, and other industrial and domestic uses.

There are various sources of water such as wells, rivers, ponds, lakes, oceans, big dams, and streams. As we all know, nearly 70 to 80 percent of the Earth's surface is covered by water, among which only 1-2 per cent water is pure and suitable for human use.

Uses of Water

- The hydrological system forms rivers and lakes and support in a variety of aquatic ecosystems.
- All aquatic ecosystems (well, lake, pond, river, etc.,) are used by a large number of people for their daily needs such as, drinking water, washing, cooking, watering animals, and irrigating fields.
- Many agriculturists use water to grow crops.
- Industries uses water their productivity.
- Paper industries use water for manufacturing paper.

Conservation of water

Conservation of water mainly refers to protect, preserve, and control the usage of water and its resources. It is the system introduced to manage freshwater, reduce the wastage and protect the water and its resources in order to reduce and to avoid the scarcity. Conservation of water is very much essential as it saves life on earth.

- Keeping the tap closed when not in use.
- Check for the openings or leaks in water distribution pipes.
- Make sure to use collected rainwater for gardening or washing purpose.
- Do not run more water than necessary while washing and cleaning clothes, utensils, etc.
- Do not prolong your bathing. Go for a quick shower rather than wasting buckets of water
- Rainwater harvesting is one of the best methods used for conserving water. There are different methods used to preserve rainwater instead of getting it wasted.

Mineral Resources

- A mineral is a naturally occurring substance, representable by a chemical formula, that is usually solid and inorganic, and has a crystal structure.

- Minerals are essential for the formation and functioning of organisms, plant animals and human beings.

Environmental Impacts of Mineral Extraction

Extracting and use of mineral resources can affect the environment adversely.

Environmental affect may depend on factors such as mining procedures, ore quality, climate, size of operation, topography, etc. Some of major environmental impacts of mining and processing operations are as under

1. Degradation of land.
2. Pollution of surfaces and ground water resources.
3. Effect on growth of vegetation due to leaching out effect of minerals.
4. Surface water pollution and groundwater contamination lead to occupational health hazards etc.
5. Air pollution due to emission of gases.
6. Deforestation affects flora and fauna.
7. Rehabilitation of affected population.

Conservation of Minerals

Conservation of minerals can be done in number of ways and these are as follows,

- Industries can reduce waste by using more efficient mining and processing methods.
- Some mineral products can be recycled. Aluminum cans are commonly recycled. Although bauxite is plentiful, it can be expensive to refine. Recycling aluminium products does not require the large amounts of electric power needed to refine bauxite.
- Products made from many other minerals, such as nickel, chromium, lead, copper, and zinc, can also be recycled.
- Strict laws should be made and enforced to ensure efficient management of mining resources.

Role and Responsibilities of engineer in environmental protection



- Environmental engineers design the different processes to handle large volumes of pollutants with the principles of optimization, socio- economic effects and rapid treatment to convert any objectionable material to a less objectionable material.
- Natural resources Environmental engineer also keep in mind to protect from the effect of disposal of hazardous waste, toxic chemicals and radioactive waste.
- Environmental engineer has a special role of having good coordination with other technocrats and engineers to make rapid advancement in cleaning up the environment with eco-friendly techniques.
- The basic challenging role of an environmental engineer is to make public aware about the environmental degradation and also to impart training in such a way, so that people participate in the programs of keeping the environment clean.

Responsibilities of engineers in environment protection.

To derive solutions for:

- waste water management
- water and air pollution control
- recycling
- waste disposal
- public health

To design:

- municipal water supply systems
- industrial wastewater treatment systems
- plans to prevent waterborne diseases
- improve sanitation in urban, rural and recreational areas
- Provide system and component design that reduce negative impact on environment

To evaluate

- hazardous-waste management systems
- environmental impact of proposed construction projects
- Conduct research and technical audits on environmental impact of project, analyse data and perform quality control checks
- Monitor progress and provide recommendations reports
- Document and maintain plans, requirement, protocols, permits and standard operating procedures.

To advise on:

- treatment
- containment
- Achieving quality, sales, revenue and profitability goals

To develop:

- regulations to prevent mishaps
- resources management schemes
- Integrate latest technologies into systems
- Collaboration with scientists, planners and experts

To implement:

- environmental engineering law
- Jurisdictions about safety of environment and ecosystems



Environment, health and safety

- Protecting the environment and maintaining health and safety at occupation.
- What organizations must do to make sure that their activities do not cause harm to anyone.
- From a safety standpoint, it involves creating organized efforts and procedures for identifying workplace hazards and reducing accidents and exposure to harmful situations and substances.
- It also includes training of personnel in accident prevention, accident response, emergency preparedness, and use of protective clothing and equipment.
- the development of safe, high quality, and environmentally friendly processes, working practices and systemic activities that prevent or reduce the risk of harm to people in general, operators, or patients.
- Ensures well-being through advanced technology and professional development

Fire hazards, prevention and precaution.

Fire is an exothermic chemical reaction between oxygen and fuel. The effect of fire on people takes the form of skin burns.

HAZARD is a situation that possess a level of threat to life, health, property or environment

Common fire hazards include faulty wiring, flammable materials, and electrical appliances left unattended.

Fire Prevention Measures

- Safe Electrical Practices

Proper electrical practices are essential in preventing electrical fires. With the use high-quality equipment.

- Safe Storage of Flammable Materials

Storage of flammable materials must be done cautiously. Keep them away from sources of heat or open flames.

- Preparing for Fire Emergencies

- i) Fire Extinguishers

Having the right type of fire extinguisher is vital. Use them effectively and keep them accessible in case of emergencies.

- ii) Smoke Detectors

Smoke detectors are first line of defence. Regularly test and maintain them to ensure they are in working order.

- Creating an Effective Evacuation Plan

Plan escape routes and ensure everyone knows them. Designate a meeting point outside the building for accountability.

- Communication

Effective communication during a fire emergency is crucial.

- **Fire Safety Equipment**

- Fire Blankets

Fire blankets can smother small fires. Have them readily available in the kitchen and other high-risk areas.

- **Fire Sprinkler Systems**

Fire sprinkler systems can rapidly control and extinguish fires. They are highly effective in commercial settings

- **Importance of Fire Drills**

Regular fire drills at home and in the workplace help people practice their escape plans. The more you practice, the more prepared you'll be during a real emergency.

- **Fire Safety in the Workplace**

Employers are responsible for ensuring a safe working environment. Fire safety in the workplace is not only a legal requirement but also a moral obligation.

Industrial hazards prevention and protection

INDUSTRIAL HAZARD may be defined as any condition produced by industries that may cause injury or death to personnel or loss of product or property.

INDUSTRIAL SAFETY refers to the protection of workers from the danger of industrial accidents.



Air and noise pollution

Air and noise pollution is the type of pollution that may occur due to developmental activities such as construction, transportation, and manufacturing.

Air and noise pollution in the environment occurs due to harmful ingredients and unwanted noise, respectively. Air pollution can be due to harmful gases, solid particles or colloidal particles present in the environment. But noise pollution is the occurred due to unwanted noise in the surrounding.

Air pollutants are of two types

- suspended particulate matter, and
- gaseous pollutants like carbon dioxide (CO₂), NO_x, etc.

Protection from air pollution

1. Source Control Technology

- Air quality management sets the tools to control air pollutant emissions.
- Control measurements describe the equipment, processes, or actions used to reduce air pollution.
- The extent of pollution reduction varies among technologies and measures.
- The selection of control technologies depends on environmental, engineering, economic factors, and pollutant type.

2. Settling Chambers

- Settling chambers use the force of gravity to remove solid particles.
- The gas stream enters a chamber where the gas velocity is reduced. Large particles drop out of the gas and are recollected in hoppers. Because settling chambers are effective in removing only larger particles, they are used in conjunction with a more efficient control device.

3. Cyclones

- The general principle of inertia separation is that the particulate-laden gas is forced to change direction. As gas changes direction, the particles' inertia causes them to continue in the original direction and be separated from the gas stream.
- The walls of the cyclone narrow toward the bottom of the unit, allowing the particles to be collected in a hopper.

- The cleaner air leaves the cyclone through the top of the chamber, flowing upward in a spiral vortex, formed within a downward moving spiral. Cyclones are efficient in removing large particles but are not as efficient with smaller particles. For this reason, they are used with other particulate control devices.

4. Absorption

- Removing one or more selected components from a gas mixture by absorption is probably the most important operation in controlling gaseous pollutant emissions.
- Absorption is when a gaseous pollutant is dissolved in a liquid.
- As the gas stream passes through the liquid, the liquid absorbs the gas in much the same way sugar is absorbed in a glass of water when stirred.
- Absorbers are often referred to as scrubbers, and there are various types of absorption equipment.
- The principal types of gas absorption equipment include spray towers, packed columns, spray chambers, and venturi scrubbers.

In general, absorbers can achieve removal efficiencies greater than 95 percent. One potential problem with absorption is the generation of wastewater, which converts an air pollution problem into a water pollution problem.

Protection from noise pollution

- Road traffic noise can be reduced by better design and proper maintenance of vehicles.
- Noise abatement measures include creating noise mounds, noise attenuation walls, well-maintained roads and smooth surfacing of roads.
- Air traffic noise can be reduced by appropriate insulation and introducing noise regulations for the take-off and landing of aircraft at the airport.
- Industrial noises can be reduced by soundproofing equipment like generators and areas producing a lot of noise.
- Power tools, loud music, land movers, public functions using loudspeakers, etc., should not be permitted at night. The use of horns, alarms, refrigeration units, etc., is to be restricted. The use of noisy firecrackers that cause air pollution should be restricted.
- A green belt of trees is an efficient noise absorber.

Environment Protection Acts

OBJECTIVES

- The act to provide for protection and improvement of environment

- Prevention of hazards to human beings, other living creature's plants and property
 - For prevention and control of environment pollution
 - Laying standards for quality of environment
 - Restriction of areas for location of industries
 - Safeguards for handling hazardous substances
 - Research relating to environmental pollution
-
- Water pollution and control of pollution act, 1947
 - The air pollution control act, 1981
 - The environment protection act, 1986
 - The Indian Forest act, 1972
 - The wildlife act (protection) 1972 and 2003
 - The public liability insurance act, 1991
 - The national environment tribunal act, 1995
 - Biological diversity act, 2002

OBJECTIVES OF ENVIRONMENTAL ISSUES AND ACTS

1. Conservation and survey of flora, fauna (forests and wildlife)
2. Prevention and control of pollution
3. Afforestation and regeneration of degraded areas
4. Protection of environment
5. Ensuring the welfare of animals

THE ENVIRONMENT (PROTECTION) ACT, 1986

- ☐ Central govt. to take measures to protect and improve environment
- ☐ Govt. to make rules to regulate environment pollution
- ☐ To regulate the standards of quality of air, water or soil
- ☐ Safeguards for handling of hazardous substances
- ☐ Restriction on location of industries

Wildlife Protection Act, 1972

- This Act provides for the protection of the country's wild animals, birds, and plant species, in order to ensure environmental and ecological security.

- The Act lays down restrictions on hunting many animal species.

Constitutional Provisions for the Wildlife Act

- Article 48A of the Constitution of India directs the State to protect and improve the environment and safeguard wildlife and forests. This article was added to the Constitution by the **42nd Amendment** in 1976.
- Article 51A(g) imposes certain fundamental duties for the people of India. One of them is to protect and improve the natural environment including forests, lakes, rivers, and wildlife and to have compassion for living creatures.

History of wildlife protection legislation in India

- The first such law was passed by the British Indian Government in 1887 called the Wild Birds Protection Act, 1887. The law sought to prohibit the possession and sale of specified wild birds that were either killed or captured during a breeding session.
- A second law was enacted in 1912 called the Wild Birds and Animals Protection Act. This was amended in 1935 when the Wild Birds and Animals Protection (Amendment) Act 1935 was passed.
- During the British Raj, wildlife protection was not accorded a priority. It was only in 1960 that the issue of protection of wildlife and the prevention of certain species from becoming extinct came into the fore.

Need for the Wildlife Protection Act

1. A drastic decrease in the flora and fauna can cause ecological imbalance, which affects many aspects of climate and the ecosystem.
2. There were only five national parks in India prior to the enactment of this Act.

Salient Features of Wildlife Protection Act

This Act provides for the protection of a listed species of animals, birds, and plants, and also for the establishment of a network of ecologically-important protected areas in the country.

- It helped India become a party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (**CITES**).
- The Act **prohibited the hunting of endangered species**.

- The Act provides for licenses for the sale, transfer, and possession of some wildlife species.
- It provides for the establishment of wildlife sanctuaries, national parks, etc.
- Its provisions paved the way for the formation of the **Central Zoo Authority**. This is the central body responsible for the oversight of zoos in India. It was established in 1992.
- The Act created **six schedules** which gave varying degrees of protection to classes of flora and fauna.
- Schedule I and Schedule II (Part II) get absolute protection, and offences under these schedules attract the maximum penalties.
- The schedules also include species that may be hunted.

Protected Areas under the Wildlife Protection Act

There are five types of protected areas as provided under the Act. They are described below.

- 1. Sanctuaries:** “Sanctuary is a place of refuge where injured, abandoned, and abused wildlife is allowed to live in peace in their natural environment without any human intervention.”
 1. They are naturally-occurring areas where endangered species are protected from poaching, hunting, and predation.
 2. Here, animals are not bred for commercial exploitation.
 3. The species are protected from any sort of disturbance.
 4. Animals are not allowed to be captured or killed inside the sanctuaries.
 5. A wildlife sanctuary is declared by the State government by a Notification. Boundaries can be altered by a Resolution of the State Legislature.
 6. Human activities such as timber harvesting, collecting minor forest products, and private ownership rights are permitted as long as they do not interfere with the animals’ well-being. **Limited human activity is permitted.**
 7. They are open to the general public. But people are not allowed unescorted. There are restrictions as to who can enter and/or reside within the limits of the sanctuary. Only public servants (and his/her family), persons who own immovable property inside, etc. are allowed. People using the highways which pass through sanctuaries are also allowed inside.
 8. Boundaries of sanctuaries are not generally fixed and defined.

9. Biologists and researchers are permitted inside so that they can study the area and its inhabitants.
10. Sanctuaries can be upgraded to the status of a 'National Park'.
11. **Examples:** Indian Wild Ass Sanctuary (Rann of Kutch, Gujarat); Vedanthangal Bird Sanctuary in Tamil Nadu (oldest bird sanctuary in India); Dandeli Wildlife Sanctuary (Karnataka).

2. National Parks: "National Parks are the areas that are set by the government to conserve the natural environment."

1. A national park has more restrictions as compared to a wildlife sanctuary.
 2. National parks can be declared by the State government by Notification. No alteration of the boundaries of a national park shall be made except on a resolution passed by the State Legislature.
 3. The main objective of a national park is to protect the natural environment of the area and biodiversity conservation.
 4. The landscape, fauna, and flora are present in their natural state in national parks.
 5. Their boundaries are fixed and defined.
 6. Here, **no human activity is allowed.**
 7. Grazing of livestock and private tenurial rights are not permitted here.
 8. Species mentioned in the Schedules of the Wildlife Act are not allowed to be hunted or captured.
 9. No person shall destroy, remove, or exploit any wildlife from a National Park or destroy or damage the habitat of any wild animal or deprive any wild animal of its habitat within a national park.
 10. They cannot be downgraded to the status of a 'sanctuary'.
 11. **Examples:** Bandipur National Park in Karnataka; Hemis National Park in Jammu & Kashmir; Kaziranga National Park in Assam.
- 3. Conservation Reserves:** The State government may declare an area (particularly those adjacent to sanctuaries or parks) as conservation reserves after consulting with local communities.

3. Conservation Reserves.

4. Community Reserves: The State government may declare any private or community land as a community reserve after consultation with the local community or an individual who has volunteered to conserve the wildlife.

5. Tiger Reserves: These areas are reserved for the protection and conservation of tigers in India. They are declared on the recommendations of the National Tiger Conservation Authority.

Schedules of the Wildlife Protection Act

There are six schedules provided in the Wildlife Protection Act.

Forest Conservation Act 1980

- The Forest Conservation Act 1980 is an important legislation enacted by the Government of India to regulate the diversion of forestland for non-forestry purposes.
- The Act was passed in response to the growing concern over the rapid depletion of India's forests, which had serious environmental and ecological consequences.

Forest Conservation Act Objectives

- To conserve forests and ensure their sustainable management.
- To regulate the diversion of forestland for non-forestry purposes, such as mining, industrial projects, or infrastructure development.
- To ensure that any diversion of forestland is done only for a specific purpose and with the prior approval of the central government.
- To compensate for any loss of forest cover that may occur due to such diversion by undertaking afforestation and reforestation activities.

Forest Conservation Act 1980 Salient Features

- Salient features of the Forest Conservation Act 1980 aim to regulate the diversion of forestland for non-forestry purposes.
- ensure the sustainable use of forest resources,
- promote afforestation and reforestation activities.

Forest Conservation Act 1980 Amendments

- Amendment in 1988-This amendment introduced the concept of "deemed forest" and brought all forestland under the purview of the Act, regardless of its legal classification.

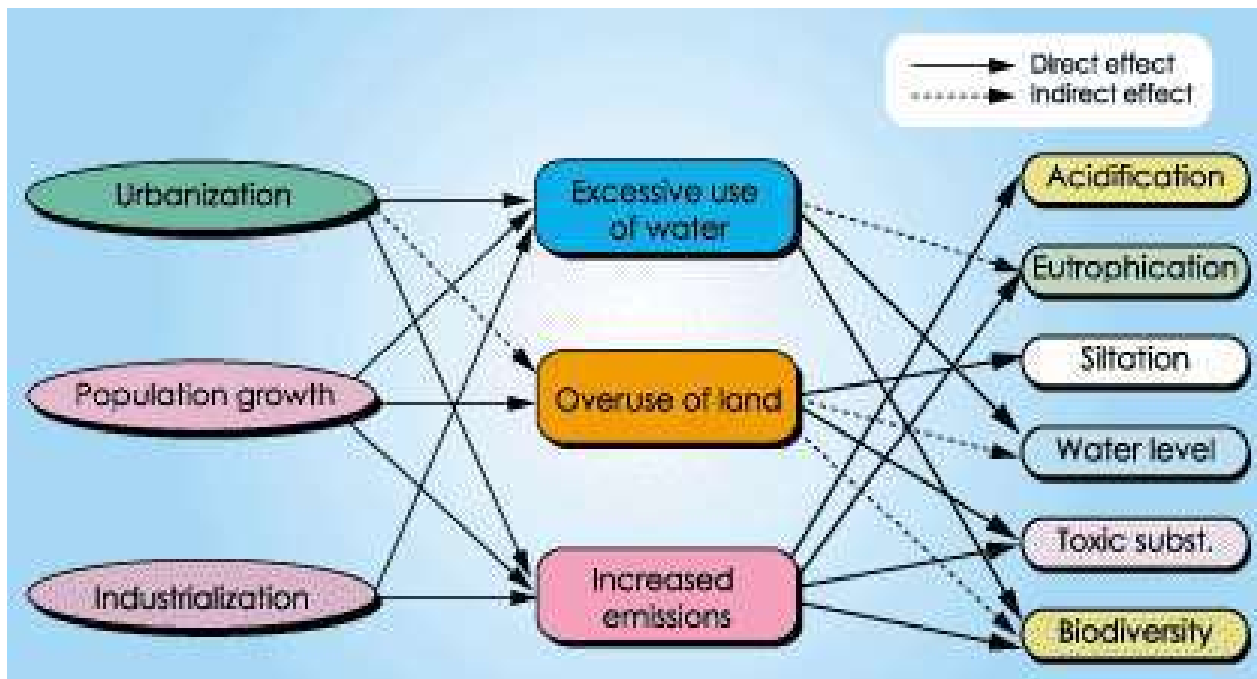
- Amendment in 1991 -This amendment made the central government's approval mandatory for the diversion of forestland for non-forestry purposes, even if it is less than one hectare.
- Amendment in 2003 -This amendment made it mandatory for the user agency to provide an undertaking to carry out compensatory afforestation before the diversion of forestland.
- Amendment in 2015-This amendment introduced the provision for granting forest clearance through a transparent online process, which is now known as the Forest Clearance Portal.
- Amendment in 2017-This amendment allows state governments to carry out compensatory afforestation activities on non-forest land with the approval of the central government

Forest Conservation Act 1980 Limitations

While the Forest Conservation Act 1980 is an important piece of legislation that has helped to protect India's forests and regulate the diversion of forestland for non-forestry purposes, it has certain limitations that have prevented it from achieving its full potential. Some of the limitations are:

- **Limited Implementation:** Despite the Act's provisions, forest diversion for non-forestry purposes continues to take place, sometimes illegally. The implementation of the Act has been weak in some areas, leading to the degradation and loss of forest cover.
- **Lack of Transparency:** The decision-making process for forest diversion under the Act lacks transparency, making it difficult for stakeholders to understand the basis for the approvals.
- **Limited Scope:** The Act focuses primarily on the conservation of forests and the regulation of forestland diversion but does not address issues such as forest management, biodiversity conservation, and sustainable use of forest resources.

Population growth aspects and importance and effects on environment.



- Rapid population growth could lead to environmental deterioration. In many developing countries, continued population growth has resulted in pressure on land, fragmentation of land holding, collapsing of fisheries, shrinking forests, rising temperatures, loss of plant and animal species.
- Severe pressure on forests due to rate of resource use and nature of use. Adverse effects on species diversity.
- Conversion of habitat to some other land use such as agriculture, urban development, forestry operation.
- In India, 70-80 per cent of fresh water marshes and lakes in Gangetic flood plains had been lost in last 50 years.
- Tropical deforestation and destruction of mangroves for commercial needs and fuelwoods is used.
- Poaching and illegal harvesting of wildlife which is a threat to ecosystem and environment.
- Increase in agricultural area, high use of chemical fertilizers, pesticides, and weedicides, water stagnation, soil erosion, soil salinity, and low productivity.
- Degradation of coastal and other aquatic ecosystems for domestic sewage, pesticides, fertilizers, and industrial effluents.
- Environmental degradation is a result of the dynamic interplay of socio-economic, institutional and technological activities.
- Environmental changes may be driven by many factors including economic growth, population growth, urbanization, intensification of agriculture, rising energy use and transportation.

- Environmental pollution is one of the serious problems faced by the people in the country, especially in urban areas, which not only experiences a rapid growth of population due to high fertility, low mortality and increasing rural-urban migration, but also industrialization which is accompanied by growing number of vehicles.
- Population impacts on the environment primarily through the use of natural resources and production of wastes and is associated with environmental stresses like biodiversity, air and water pollution and increased pressure on arable land.
- Increase in the human population activity, pollute the environment and disturb the ecosystem and above all and first one is the pollution. Pollution may be found in air, water and soil, which directly imbalance the ecosystem and environment.

Human health and human rights

- Human rights is defined as the supreme, inherent, and inalienable rights to life, to dignity, and to self-development.
- **Environmental rights** are right to a clean, healthy environment; right to clean air; right to safe drinking water; right to natural food; right to adequate standard of living and adequate housing; right to a safe and healthy workplace; freedom from pollution; preservation of unique site.
- Rights Access is available to all community members, who have the opportunity to use their land in a sustainable manner.
- The community has the right to a sustainable, free of risks lifestyle. Research and monitoring of the land are available so that best practice is enabled and the land is conserved for future generations.
- Deforestation rights It is the citizens' right to ask authorities to supervise all activities in the ecological reservations. Citizens are entitled to take part in political decisions about the environment. It is advisable to preserve the environment, especially if there is the risk of deforestation.
- The government has the right to take measures after any act that can harm the environment.
- **Toxic waste disposal rights responsibilities**
Any citizen is entitled to live in an environmentally safe community. All information held by the governmental, environmental and commercial agencies regarding the disposal of toxic waste and its effects on the environment must be available to all citizens. Citizens can take part in the making of decisions concerning the disposal of toxic waste in their community. The government is

entitled to require and supervise environmentally safe methods to treat toxic waste in industries and communities.

- **Sustainable use of energy and resources**

People have the right to live in clean areas surrounded by water, without harmful chemical substances and radioactivity. Citizens have the right to demand the government to restrict industry and create a cleaner and safer environment and to conserve resources and energy. Citizens can ask the government to be informed about the current condition of pollution including water and air pollution. Government and industry can be required to set up an international cooperation system to solve issues concerning the environment and save resources and energy across the border.

Concept of Carbon Credits

