

ENVIRONMENTAL STUDIES

3RD SEMESTER, MECHANICAL ENGINEERING

THEORY-5

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The Multidisciplinary Nature of Environmental Studies

Environmental Studies:

- Environment means Surrounding in which we are living. Environment includes all those things on which we are directly or indirectly dependent for our survival, whether it is living or non living component.
- Environmental studies are the scientific study of the environmental system. It includes the study of physical and biological characters of the environment and also the social and cultural factors and the impact of man on environment.
- The study of environmental components is *multidisciplinary* in nature, since it includes all disciplines such as Biological sciences or Life Sciences, Physical sciences, Mathematics, statistics, Computer sciences, Sociology, Economics, Management, Civil engineering, Chemical engineering, Environment law and Mass communication etc.

Scope of Environmental Studies:

The scope of environmental studies can be studied in the following ways.

- *Environmental Science:*

It deals with the scientific study of environmental system (air, water, soil and land), the inherent or induced changes on organisms and the environmental damages results from human interaction with the environment.
- *Environmental Engineering:*

It deals with the study of technical processes involved in the protection of environment and improving the environmental quality for the health and well beings of humans.
- *Environmental Management:*

It promotes the management of physical, social and economic environment of the enterprise or projects in order to achieve the planned investment at the start of the production chain.

Importance of Environmental Studies:

- To clarify modern environmental concept like how to conserve biodiversity.
- To know the more sustainable way of living.
- To use natural resources more efficiently.
- To know the behaviour of organism under natural conditions.
- To know the interrelationship between organisms in populations and communities.
- To aware and educate people regarding environmental issues and problems at local, national and international levels.

Need of Public Awareness about Environment:

- In today's world because of industrialization and increasing population, the natural resources has been rapidly utilised and our environment is being increasingly degraded by human activities, so we need to protect the environment.
- It is not only the duty of government but also the people to take active role for protecting the environment, so protecting our environment is economically more viable than cleaning it up once it is damaged.
- The role of mass media such as newspapers, radio, television, etc is also very important to make people aware regarding environment.
- There are various institutions, which are playing positive role towards environment to make people aware regarding environment.

Natural Resources

Renewable Energy Resources:

- The energy resources which cannot be exhausted and can be used again and again are called renewable energy resources.
- For example solar energy, wind energy, tidal energy and hydroelectric etc.

Non-Renewable Energy Resources:

- The energy resources which can be exhausted one day and cannot be used repeatedly are called non-renewable energy resources.
- The example of non-renewable energy resources are coal, petroleum, natural gases etc.

FOREST RESOURCES

Forests are one of the most important natural resources on this earth. These forests not only produce valuable material goods, but also provide several environmental services which are essential for life.

Uses of Forest Resources:

There are various uses of forest resources as follows.

Commercial Uses:

- Forests provide us a large number of commercial goods which include timber, firewood, food items, gum, resins, non-edible oils, rubber, fibres, bamboo canes, fodder, medicine, drugs and many more items.
- Many forest lands are used for mining, agriculture, grazing, and recreation.

Ecological uses:

- The trees produce oxygen by photosynthesis which is vital for life on this earth.
- The main greenhouse gas carbon dioxide (CO₂) is absorbed by the forests as a raw material for photosynthesis. It helps to reduce the problem of global warming.
- Forests are the homes of millions of wild animals and plants.
- Forest is useful for absorbing the rainfall, slowing down the runoff and slowly releasing the water for recharge of springs. It is mostly responsible for bringing rains.
- Forests bind the soil particles tightly in their roots and prevent soil erosion. They also act as windbreaks.
- Forests can absorb many toxic gases and can help in keeping the air pure. They have also been reported to absorb noise and thus help in preventing air and noise pollution.

Over-exploitation of Forest:

- Since time immemorial, humans have depended heavily on forests for food, medicine, shelter, wood and fuel.
- With growing civilization the demands for raw material like timber, pulp, minerals, fuel wood etc. has been increased. It results in large scale logging, mining, road-building and clearing of forests.
- Excessive use of fuel wood and charcoal, expansion of urban, agricultural and industrial areas and overgrazing have together led to over-exploitation of our forests leading to their rapid degradation.

Deforestation:

Deforestation is the removal of a forest or stand of trees where the land is thereafter converted to a non-forest use.

Causes of Deforestation:

Main causes responsible for deforestation are as under:

- Cutting of trees to meet the ever increasing demand of the cities.
- Grazing by the local cattle, goats, sheep etc.
- Meeting out the growing hunger for land.
- The increase in shifting cultivation.
- Construction of hill roads.

Consequences of Deforestation:

- It threatens the existence of many wild life species due to destruction of their natural habitat.
- Biodiversity is lost.
- Hydrological cycle gets affected, thereby influencing rainfall.
- Problems of soil erosion and loss of soil fertility increase.
- In hilly areas it often leads to landslides.
- Expansion of desert areas.

Prevention of Deforestation:

These steps can be adopted to prevent deforestation to a maximum extent.

- Expansion of forest area can be achieved by implanting trees in forest with people's participation.
- Strengthening the central and state forestry administration and institutions.
- Celebrate Environment day to create awareness among people about how forestation can help in improving environment.
- Use of pesticides to reduce damages to forest from pests.
- Encouraging reduce, recycle and reuse of forest products.
- Encouraging reforestation.
- Using alternate sources of energy like cooking gas instead of wood.

Timber extraction and its effect on forest and tribal people:

Timber is used as raw materials for various wood based industries like pulp and paper, composite wood, furniture etc. Timber is also used for various developmental activities like railways, boats, road construction etc.

However due to unsustainable extraction of timber, there are adverse effects on forest and tribal people. Some of which are-

- Loss of biodiversity.
- Climate change such as lower precipitation.
- Poor logging results in a degraded forest.
- Floods may be intensified by cutting of trees or upstream watersheds.
- Exploitation of tribal people by the contractors.
- Soil erosion especially on the slopes occurs extensively.

Mining and its effect on forest:

Mining is the extraction of valuable minerals or other geological materials from the earth. The adverse effects of mining on forest are as follows :

- Vast areas of forest are directly cleared to accommodate mining sites, construction of roads, processing units and townships for workers. Destruction is vast in case of open cast mines.
- Forest land is also used to store the waste materials that remain after the extraction of usable ores.
- Mining also facilitates soil erosion, thereby decreasing the fertility of land leading to land degradation.
- Pollution of both air and water is a common effect of mining.

Dams and their effect on forest and tribal people:

When a dam is constructed across any river a huge artificial lake is developed in the catchment area of that dam. Covering a large surface area it creates a lot of ill effects on the living environment. They are as follows:

- It creates the loss of forest which is submerged under the back waters of the dam.
- It creates danger to the habitat of wildlife. The wildlife is forced to migrate.
- It also affects the land under cultivation as the crops get submerged under water.
- Water logging and Stalinisation affects the canal irrigated land, with varying degrees of severity.
- Diseases like malaria spread rapidly in the command areas of reservoirs which severely affect the health condition of tribal living nearby forest areas.

WATER RESOURCES

Uses of Ground Water:

- Fresh groundwater was used toward irrigating crops.
- Local city and county water departments withdraw a lot of groundwater for public uses, such as for delivery to homes, industries, organisations and for community uses such as fire fighting, water services at public buildings etc.

Use of Surface Water:

- The surface water of the rivers, streams, creeks, lakes, and reservoirs—are vitally important to our everyday life.
- The main uses of surface water include drinking-water and other public uses, irrigation uses etc.
- The majority of water used for thermoelectric power, public supply, irrigation, mining, and industrial purposes came from surface-water sources.

Impacts of Over Utilization of Underground and Surface Water:

The over utilization of underground and surface water has major impacts on the ecosystems. Some of the major impacts are summarized below:

➤ *Loss of integrity of freshwater ecosystems:*

Human activities for infrastructure development like creation of dams, land conversion, etc. are responsible for this loss of integrity of freshwater ecosystems. Water quality and quantity, fisheries, habitats, etc. are at risk due to this loss of integrity.

➤ *Risk to ecosystem functions:*

Population and consumption growth increases water abstraction and acquisition of cultivated land. Virtually all ecosystem functions including habitat, production and regulation functions are at risk.

➤ *Depletion of living resources and biodiversity:*

Overharvesting and exploitation causes groundwater depletion, collapse of fisheries. Production of food, quality and quantity of water and supply of water gets badly affected by these depletions of living resources and biodiversity.

➤ *Pollution of water bodies:*

Release of pollutants to land, air or water alters chemistry and ecology of water bodies. Greenhouse gas emissions produce significant changes in runoff and rainfall patterns. Because of water pollution, water supply, habitat, water quality, food production, climate change, etc. are at risk.

Floods:

➤ It is a natural event or occurrence where a piece of land (or area) that is usually dry land, suddenly gets submerged under water.

➤ Causes of floods:

- When there is more rain, there can be floods.
- Rivers can overflow their banks to cause flooding when there is more water upstream than usual.
- Sea water can be carried by massive winds and hurricanes onto dry coastal lands and cause flooding.
- Sometimes, too much water held up in the dam can cause it to break and overflow the area. Excess water can also be intentionally released from the dam to prevent it from breaking and that can also cause floods.
- Sometimes the ice suddenly melts when the temperature rises, resulting in massive movement of water into places that are usually dry and cause floods.

Drought:

- It is the absence of water for a long period of time, at a place where it is considered ‘not normal’ compared to its usual conditions.
- *Causes of Drought:*
 - Droughts can occur when there is the lack of expected precipitation of rain or snow.
 - Some regions are well distributed with surface water but these may dry out if the flow from their sources upstream is affected.
 - Deforestation exposes surface water to more evaporation. It reduces the ability of the ground to hold water.
 - Human activities lead to greenhouse gases. As a result increase in temperature results in drying out the surface and ground water, thereby causing drought.

Conflicts:

- Rapidly increasing population and limited water resources give rise to conflicts over water.
- These conflicts occur over both freshwater and saltwater, and both between and within nations. However, conflicts occur mostly over freshwater; because freshwater is being used as important resources for agriculture, energy generation, and industrial purpose. As freshwater is a vital, and its production is less, its unavailability put impacts on the living and economic conditions of a country or region.

Dams: Benefits and Problems:

Dams provide a range of economic, environmental, and social benefits, including recreation, flood control, water supply, hydroelectric power, waste management, river navigation, and wildlife habitat.

Problems of Dams:

- The larger dams are expensive to build and, as such, they can take many years to pay for themselves and become profitable.
- Building a dam requires diverting water temporarily and it also means a lot of digging and construction on the dam site. These constructions have long lasting effects on the environment and it will destroy local ecosystems.
- The weight of the larger dam actually resulted in the compression of the earth in that area which leads to cause minor earthquake and put serious effects on the society.
- Dams may be collapse and create problems for nearby people..
- Low oxygen levels in dam water are the result of the hydroelectric production process. The disruption of the natural flow of water can have impacts on the turbidity of water as well, which can seriously harm aquatic life.

MINERAL RESOURCES:

Minerals provide the material used to make most of the things of industrial- based society. A mineral is a pure inorganic substance that occurs naturally in the earth's crust.

Uses of Mineral Resources:

Some of the uses of mineral resources are:

- Used in construction of buildings, bridges and housing settlement.
- Development of industries and machinery.
- Used for generation of energy mainly Coal, petroleum and natural gas.
- Used for development of defence equipment.
- Used in the field of communication like telephone, cables, electronic devices etc.
- Formation of alloys for various purposes.
- Used for formation of ornaments like jewellery of gold, diamond, silver etc.
- Used for synthesis of fertilizers, fungicides etc.

Exploitation of Mineral Resources:

- Mining is hazardous occupation:
 - This occupation involves several health risk dust produced during mining operation are injurious to health and cause lung diseases.
 - Extraction of some toxic or radioactive minerals leads to life threatening hazards.
 - Dynamite explosion during mining is very risky as fumes produced are extremely poisonous.
 - Underground mining is more hazardous than surface mining as there are more chances if accidents like roof falls, flooding and inadequate ventilation etc.
- Rapid depletion of high grade minerals:

Increasing demand for high grade minerals has compelled miners to carry out more extraction of minerals, which require more energy sources and produce large amount of waste materials.
- Wastage of upper soil layer and vegetation:

Surface mining results in the complete destruction of upper soil layer and vegetation. After extraction, the wastes are dumped in an area which destroys the total surface and vegetation.

Environmental problems:

Over exploitation of mineral resources resulted in many environmental problems like:

- Conversion of productive land into mining and industrial areas.
- Mining and extraction process are one of the sources of air, water and land pollution.
- Mining involves huge consumption of energy resources like coal, petroleum, natural gas etc. which are in-turn non renewable sources of energy.
- Surface mining directly degrades the fertile soil surface thus effect ecology and climate if that particular area.

FOOD RESOURCES:

Food is essential for growth and development of living organisms. These essential materials are called nutrients and these nutrients are available from variety of animals and plants.

World food problems:

The following are the causes of world food problems which are divided into following categories:

Causes of World Wide Problems:

- Natural calamities:-drought, heavy rain and flooding, crop failures.
- Environmental degradation of soil erosion and inadequate water resources.
- Food supply-and-demand imbalances.
- Inadequate food reserves.
- Declining ecological conditions in agricultural regions.

Problems of the Developing World:

- Underdevelopment.
- Excessive population growth.
- Lack of economic incentives.
- Insufficient government attention to the rural sector.

Problems of the Industrialized World:

- Excessive use of natural resources.
- Pollution.
- Inefficient animal-protein diets.
- Inadequate research in science and technology.
- Excessive government bureaucracy.
- Loss of farmland to competing uses.

Changes Caused by Agriculture:

Agriculture has both primary and secondary environmental effects. A primary effect is an effect on the area where the agriculture takes place i.e. on-site effect. A secondary effect, also called an off-site effect, is an effect on an environment away from the agricultural site.

The effects of agriculture on the environment can be broadly classified into three groups, viz. global, regional and local:

- *Global Effects:-* These include climate changes as well as potentially extensive changes in chemical cycles.

- *Regional Effects:-* Regional effects include deforestation, desertification, large scale pollution, increase in sedimentation in major rivers and in the estuaries at the mouths of the rivers and changes in the chemical fertility of soils over large areas.
- *Local Effect:-* These occur at or near the site of farming. These changes / effects include soil erosion and increase in sedimentation downstream in local rivers. Fertilizers carried by sediments can also transport toxins and destroy local fisheries.

Changes Caused by Overgrazing:

The carrying capacity of land for cattle depends on the fertility of the soil and the rainfall. When the carrying capacity is exceeded, the land is overgrazed.

The changes that result from overgrazing include:

- Reduction in the growth of vegetation.
- Reduction in the diversity of plant species.
- Increased soil erosion as the plant cover is reduced.
- Damage from the cattle trampling on the land, like paths made by cattle develop into gullies, which erode rapidly in the rain.
- Dominance of plant species that is relatively undesirable to the cattle.
- Overgrazing is a primary contributor to desertification.
- The long term effects of overgrazing are food shortage which can make people and cattle die of starvation.

Effects of modern agriculture - Fertilizer Pesticide problems, Water logging, Salinity

Modern agriculture makes use of hybrid seeds of single crop variety, technologically advanced equipment, fertilizers, pesticides and water to produce large amounts of single crop.

Problems using fertilizers:

- *Micronutrient imbalance:-*
Chemical fertilizers used in modern agriculture contain Nitrogen, Phosphorus and Potassium (N,P,K) which are macronutrients. Excess use of fertilizers in fields causes micronutrient imbalance.
- *Nitrate pollution:*
Excess Nitrogenous fertilizers applied in fields leach deep into the soil contaminating the groundwater. If the concentration of nitrate in drinking water exceeds 25 mg/L, it leads to a fatal condition in new-born babies. This condition is termed "Blue Baby Syndrome".
- *Eutrophication:*
The application of excess fertilizers in fields leads to wash off of the nutrient loaded water into nearby lakes causing over-nourishment. This is called "Eutrophication".

Eutrophication causes the lakes to be attacked by "algal blooms". Algal blooms use nutrients rapidly and grow fast. Their life is short; they die and pollute water thereby affecting aquatic life in the lake.

Problems in using Pesticides:

In order to improve crop yield, pesticides are used in agriculture. Pesticides are of two types:

- First generation pesticides that use Sulphur, Arsenic, Lead or Mercury to kill pests
- Second generation pesticides such as Dichloro Diphenyl Trichloroethane (DDT)

Although these pesticides protect our crops from severe losses due to pests, they have several side-effects as listed below:

- Several insecticides kill not only the target species but also several beneficial not target organisms.
- Most pesticides are non-biodegradable and accumulate in the food chain. This is called bio-accumulation or bio-magnification. These pesticides in a bio-magnified form are harmful to human beings.
- Pesticide enhances the risk of cancer in two ways (i) It acts as a carcinogen and (ii) It indirectly suppresses the immune system.

Water Logging:

If water stands on land for most of the year, it is called water logging. In water logged conditions, pore-voids in the soil get filled with water and soil-air gets depleted. In such a condition the roots of plants do not get enough air for respiration. Water logging also leads to low mechanical strength of soil and low crop yield.

Causes of Water logging:

- Inadequate drainage of over-land run-off increases the rate of percolation and in turn helps in raising the water level.
- Seepage of water from earthen canals also adds significant quantity of water to the underground reservoir continuously.
- Sometimes subsoil does not permit free flow of subsoil water which may accentuate the process of raising the water level.
- Irrigation water is used to flood the fields. If it is used in excess it may help appreciably in raising the water level.

Effects of Water logging:

- Excessive moisture content creates anaerobic condition in the soil. The plant roots do not get the required nourishing food or nutrients. As a result crop growth is badly affected.

- When the soil is waterlogged, water loving wild plant life grows abundantly. The growth of the wild plants totally prevents the growth of useful crops.
- Waterlogged fields cannot be tilled properly. The reason is that the soil contains excessive moisture content.
- The upward water movement brings the toxic salts in the crop root-zone. Excess accumulation of these salts may turn the soil alkaline. It may hamper the crop growth.
- The presence of excessive moisture content lowers the temperature of the soil. In low temperature the bacteriological activities are retarded which affects the crop growth badly.

Preventive Measures of Water Logging:

Preventive measures include the following:

- By lining the canal section
- By introducing intercepting drains
- Quick disposal of rainwater
- Installation of lift irrigation systems
- Implementation of Drainage Schemes
- Provision of surface drains for drainage of rainwater; and
- Implementation of tube well projects both extensive and local.

Soil Salinity:

Soil salinity is a major limiting factor that endangers the capacity of agricultural crops to sustain the growing human population. It is characterized by a high concentration of soluble salts (like sodium chloride, calcium chloride, magnesium chloride, sodium sulphate, sodium carbonate and sodium bicarbonates) that significantly reduces the development of the crops.

Causes of Soil salinity:

The following are the causes of soil salinity:

- Salts are deposited via dust and precipitation.
- Human practices can increase the salinity of soils by the addition of salts in irrigation water.
- The change in the level of ground water due to soil erosion, which led to high concentration of salts in the water level.
- Salinity from irrigation can occur over time wherever irrigation occurs, since almost all water (even natural rainfall) contains some dissolved salts. When the plants use the water, the salts are left behind in the soil and eventually begin to accumulate.

Effects of Soil salinity:

The following are the effects of soil salinity:

- Due to salt deposit in the soil the growth of the plant will be reduced.
- The root of the of the plants will become weak due to salt deposit in the soil.
- Salinity affects production in crops, pastures and trees by interfering with nitrogen uptake, reducing growth and stopping plant reproduction.
- If the level of salts in the soil water is too high, water may flow from the plant roots back into the soil. This results in dehydration of the plant, causing yield decline or even death of the plant.

Remedies for soil salinity:

The following are the remedies for soil salinity:

- The first step for reducing soil salinity is to improve drainage system so that the salt deposited in the salt will be flushed out.
- Pour a 2- to 4-inch layer of compost or charcoal over the soil.
- Turn the additives into the top 6 inches of soil with a tiller or a shovel.

ENERGY RESOURCES:

An energy resource is something that can produce heat, power life, move objects, or produce electricity. All the developmental activities in the world are directly or indirectly dependent on energy.

Growing-Energy-Needs:

Energy is essential to the existence of mankind. All the industrial processes like mining, transport, lighting, heating and cooling in buildings need energy. With the growing population, the world is facing an energy deficit. Lifestyle change from simple to a complex and luxurious lifestyle adds to this energy deficit.

Renewable And Non-Renewable Energy Sources:

Based on continual utility, natural resources can be classified into two types:

- *Renewable energy sources:-* These resources can be generated continuously and are inexhaustible.
Ex: Wood, Solar energy, Wind energy, Hydro power, tidal energy, Geo-thermal energy.
- *Non-renewable energy sources:-*
Non-renewable energy sources are natural resources that cannot be regenerated once they are exhausted. They cannot be used again.
Ex: Coal, Petroleum, Natural gas and Nuclear fuels.

Comparison between Renewable and Non-renewable energy resources

S.No	Renewable energy resources	Non-renewable energy resources
1.	It can be used again and again throughout its life.	It cannot be used again and again but one day it will be exhausted.
2.	These are the energy resources which cannot be exhausted.	They are the energy resources which can be exhausted one day.
3.	It has low carbon emission and hence environment friendly.	It has high carbon emission and hence not environment friendly.
4.	It is present in unlimited quantity.	It is present in limited quantity and vanishes one day
5.	Cost is low	Cost is high.
6.	It has high maintenance cost.	It has low maintenance cost as compared with the renewable energy resources.
7.	Large land area is required for the installation of its power plant.	Less land area is required for its power plant installation.
8.	Examples: Solar energy, wind energy, tidal energy etc.	Examples: Coal, petroleum, natural gases etc.

Use of Alternate Energy Sources:

Renewable energy provides:

- Reliable power supplies and fuel diversification, which enhance energy security, lower risk of fuel spills, and reduce the need for imported fuels.
- Renewable energy also helps conserve the nation's natural resources.

Wind Power:

Wind energy utilises the power of the wind to propel the blades of wind turbines. The rotation of turbine blades is converted into electrical current by means of an electrical generator. In the older windmills, wind energy was used to turn mechanical machinery to do physical work.

Advantages:

- Wind power produces no pollution. There is no risk due to harmful by-products left over.
- Since wind generation is a renewable source of energy, we will never run out of it.
- Wind farms can be built off-shore.

Disadvantages:

- Wind power is intermittent. Consistent wind is needed for continuous power generation.
- Large wind farms can have a negative effect on the scenery.

Solar Power:

Solar energy is used commonly for heating, cooking, the production of electricity, and even in the desalination of seawater. Solar power works by trapping the sun's rays into solar cells where this sunlight is then converted into electricity.

Advantages:

- Solar power is a renewable resource. As long as the Sun exists, its energy will reach Earth.
- Solar power generation releases no water or air pollution because there is no chemical reaction from the combustion of fuels.
- Solar energy can be used very efficiently for practical uses such as heating and lighting.
- The benefits of solar power are seen frequently to heat pools, spas, and water tanks all over.

Disadvantages:

- Solar power does not produce energy if the sun is not shining. Night time and cloudy days seriously limit the amount of energy produced.
- Solar power stations can be very expensive to build.

Geothermal Energy:

Geothermal energy utilises the heat energy present underneath the Earth. Hot rocks under the ground heat water to produce steam. When holes are drilled in the region, the steam that shoots up is purified and is used to drive turbines, which power electric generators.

Advantages:

- If done correctly, geothermal energy produces no harmful by-products.
- Once a geothermal plant is built, it is generally self-sufficient energy wise.
- Geothermal power plants are usually small and have little effect on the natural landscape.

Disadvantages:

- If done incorrectly, geothermal energy can produce pollutants.
- Improper drilling into the earth can release hazardous minerals and gases.
- Geothermal sites are prone to running out of steam.

Hydroelectric Energy:

Hydroelectric power comes from the potential energy of dammed water driving a water turbine and generator. Hydropower works by utilising the gravitational flow of a river that is compressed from a long run to a single location with a dam. This is used to turn turbines or water wheels to drive an electric generator..

Advantages:

- Water can be accumulated above the dam and released to coincide with peaks in demand.
- Electricity can be generated constantly.
- Hydroelectric power produces no waste or pollution since there is no chemical reaction to produce power.
- Water used for hydropower can be reused.

Disadvantages:

- The creation of big reservoirs of water or dams intervenes not only in reshaping and changing the condition of the bodies of water but also to the condition of the fish species.
- The water that flows from the dam creates a flood on the rivers or in the wetland bodies affecting the organisms living on it.
- The construction of hydroelectric power plant is very costly.

LAND RESOURCES:

Land as a Resource:

Land is a very valuable resource. It provides food, fibre, wood, medicine and other biological materials needed for food. Soil is a mixture of inorganic materials and (rocks and minerals) and organic materials (dead materials and plants).

- Land provides food, wood, minerals, etc
- Land nurtures plants and animals that provide us food and shelter
- Land may be used as watershed or reservoir.
- Land acts as a dustbin for the wastes generated by modern society.
- Land is used for constructing buildings and industries.

Land Degradation:

Land degradation is the major consequences of direct interference of human activities in the natural phenomenon.

Land degradation means:

- Loss of natural fertility of soil because of loss of nutrients.
- Less vegetation cover
- Changes in the characteristic of soil.
- Pollution of water resources from the contamination of soil through which water sweeps into ground or runoff to the water bodies.
- Changes in climatic conditions because of unbalanced created in the environment.

Causes of Land Degradation:

- *Deforestation:-* Deforestation is taking place at a faster rate due to increasing demands of timber, fuel and forest products which results into degradation of land resources.
- *Overgrazing:-* Overgrazing refers to excessive eating of grasses and other green plants by cattle. It results into reduced growth of vegetation, reduced diversity of plant species, excessive growth of unwanted plant species, soil erosion, and degradation of land due to cattle movement.
- *Agricultural practises:-* The modern agricultural practises, excessive use of fertilizers and pesticides has adversely degraded the natural quality and fertility of the cultivation land.
- *Industrialization:-* Development of industries for the economic growth of the country leads to excessive deforestation and utilization of land in such a way that it has lost its natural up gradation quality.
- *Urbanization:-* Increasing growth of population and demand for more residential areas and commercial sectors is also one of the reasons for land degradation.

Soil Erosion:

Soil erosion is defined as the wearing away of topsoil. Topsoil is the top layer of soil and is the most fertile because it contains the most organic, nutrient-rich materials.

Causes of Soil Erosion:

- *Rain and rainwater runoff:-* Due to rain water runoff, the water starts to break down the soil and water will runoff organic matter and other nutrients, hence causes soil erosion.
- *Farming:-* When land is worked through crops or other agricultural processes, it reduces the overall structure of the soil, in addition to reducing the levels of organic matter, making it more susceptible to the effects of rain and water and causes soil erosion
- *Slope of the land:-* The physical characteristics of the land can also contribute to soil erosion.
- *Lack of vegetation:-* Plants and crops help maintain the structure of soils, reducing the amount of soil erosion. Areas with less vegetation cause erosion.
- *Wind:-* Wind can be a major factor in reducing soil quality and promote erosion, particularly if the soil's structure has already been loosened up.

Effects of Soil Erosion:

Some of the greatest effects of soil erosion include:

- *Loss of topsoil:-* Obviously, this is the biggest effect of soil erosion. Because topsoil is so fertile, if it is removed, this can cause serious harm to farmer's crops or the ability to effectively work their land.
- Reduced organic and fertile matter:- As mentioned, removing topsoil that is heavy with organic matter will reduce the ability for the land to regenerate new flora or crops. When new crops or plants can't be placed successfully in the area, this perpetuates a cycle of reduced levels of organic nutrients.
- *Issues with plant reproduction:-* When soil is eroded in an active cropland, wind in that particular area usually puts effect on new seeds which leads to less poor future production.
- *Soil acidity levels:-* When the structure of the soil becomes compromised, and organic matter is greatly reduced, there is a higher chance of increased soil acidity, which will significantly impact the ability for plants and crops to grow.
- *Long term erosion:-* Unfortunately, if an area is prone to erosion or has a history of it, it becomes even harder to protect it in the future. The process has already reduced the soil structure and organic matter of the area, meaning that it will be harder to recover in the long run.

Desertification:

“Desertification is a type of land degradation in which a relatively dry land region becomes increasingly arid, typically losing its bodies of water as well as vegetation and wildlife. It is caused by a variety of factors, such as climate change and human activities. Desertification is a significant global ecological and environmental problem.”

Causes of Desertification:

- *Overgrazing:-* When there are too many animals that are overgrazing in certain spots, it makes difficulty for the plants to grow back.
- *Deforestation:-* When people are looking to move into an area, or they need trees in order to make houses and do other tasks, then they are contributing to the problems related to desertification.
- *Farming Practices:-* Some farmers do not know how to use the land effectively. They may essentially strip the land of everything that it has before moving on to another plot of land. By stripping the soil, desertification becomes more and more.
- *Urbanization and other types of land development:-* Development can cause people to go through and kill the plant life. As areas become more urbanized, there are less places for plants to grow, thus causing desertification.
- *Climate Change:-* Climate change plays a huge role in desertification. As the days get warmer and periods of drought become more frequent, desertification becomes more and more eminent.
- *Stripping the land of resources:-* If an area of land has natural resources like natural gas, oil, or minerals, people will come in and mine it or take it out. This usually strips the soil of nutrients, harms the plant life, which in turn moves to desertification.
- *Natural Disasters:-* Sometimes the land gets damaged because of natural disasters, including drought.

Effects of Desertification:

- *Farming becomes next to impossible:-* If an area becomes a desert, then it's almost impossible to grow substantial crops there without special technologies.
- *Hunger:-* Without farms in these areas, the food scarcity will appear and the people and animals will be affected with hunger problems.
- *Flooding:-* The desert area could experience a lot of flooding because there will be no tress to stop the water from gathering and going all over the place.
- *Poor Water Quality:-* If an area becomes a desert, the water quality is going to be worst. This is because the plant life plays a significant role in keeping the water clean and clear.
- *Overpopulation:-* When areas start to become desert, animals and people will go to other areas where they can actually thrive. This causes crowding and overpopulation, which will further continuing the cycle of desertification.

Man Induced Landslides:

Landslides are the downward movement of a slope composed of earth materials such as rock, soil or artificial fills.

During construction of roads and mining activities huge portions of mountainous breakable areas are cut down and thrown into adjacent areas and streams. These land masses weaken the already broken mountain slopes leading to man-induced landslides.

Mining:- Mining activities that utilize blasting techniques contribute mightily to landslides. Vibrations emanating from the blasts can weaken soils in other areas susceptible to landslides. The weakening of soil means a landslide can occur anytime.

Clear cutting:- Clear cutting is a technique of timber harvesting that eliminates all old trees from the area. This technique is dangerous since it decimates the existing mechanical root structure of the area.

Role of an Individual in Conservation of Natural Resources:

'Environment protection' means limiting the impairment of environment and it includes conservation of resources. It has three main objectives:

- To prevent damage and discomfort
- To improve productivity and pleasure and,
- To maintain balance of the ecosystem.

Conservation is sustainable use of natural resources, such as soils, water plants, animals and minerals. To conserve natural resources an individual can do the following things.

- Turn off the lights when you leave a room.
- Replace energy-hungry incandescent lights with fluorescent lighting.
- Check with your utility company for energy conservation tips.
- Use a programmable thermostat that automatically turns off the air conditioner or heater when you don't need them.
- Use a fan instead of air-conditioning.
- Choose recycled products.
- Have your gas appliances and heaters regularly inspected and maintained.
- Replace your car's air filter.
- Report smoking vehicles.
- Improve the quality of landscapes, which includes soils, water, etc.
- Maintain the production of 'clean' food.
- Don't waste water.
- Stop hunting and over-exploitation, mainly for commercial and often illegal purposes.
- Stop improper use of agro-chemicals, and reduce the pollution.
- Plant trees. Stop illegal cutting of trees.

Equitable use of resources for sustainable lifestyles

Sustainable Development (SD) implies economic growth together with the protection of environmental quality, each reinforcing the other. Sustainable Development, thus, is maintaining a balance between the human needs to improve lifestyles and feeling of well-being on one hand, and preserving natural resources and ecosystems, on which we and future generations depend.

System

Concept of an Eco system:

An ecosystem is defined as a natural functional ecological unit consisting of living organisms (biotic community) and their non-living (abiotic or physio-chemical) environment that interact to form a stable self-supporting system. A pond, lake, desert, grassland, meadow, forest etc. are common examples of ecosystems.

Structure of an Ecosystem:

Each ecosystem has two main components: - Abiotic & Biotic Components.

➤ Abiotic Components:

Abiotic components are the physical and/or the chemical factors that act on the living organisms at any part of their life. These are also called as the ecological factors. The physical and chemical factors are characteristic of the environment. Light, air, soil, and nutrients, etc. form the abiotic components of an ecosystem.

Abiotic components are mainly of two types:

- *Climatic Factors* which include rain, temperature, light, wind, humidity etc.
- *Edaphic Factors* which include soil, pH, topography minerals etc.

➤ Biotic Components:

The living organisms including plants, animals and micro-organisms (Bacteria and Fungi) that are present in an ecosystem form the biotic components.

On the basis of their role in the ecosystem the biotic components can be classified into three main groups:

❖ Producers:

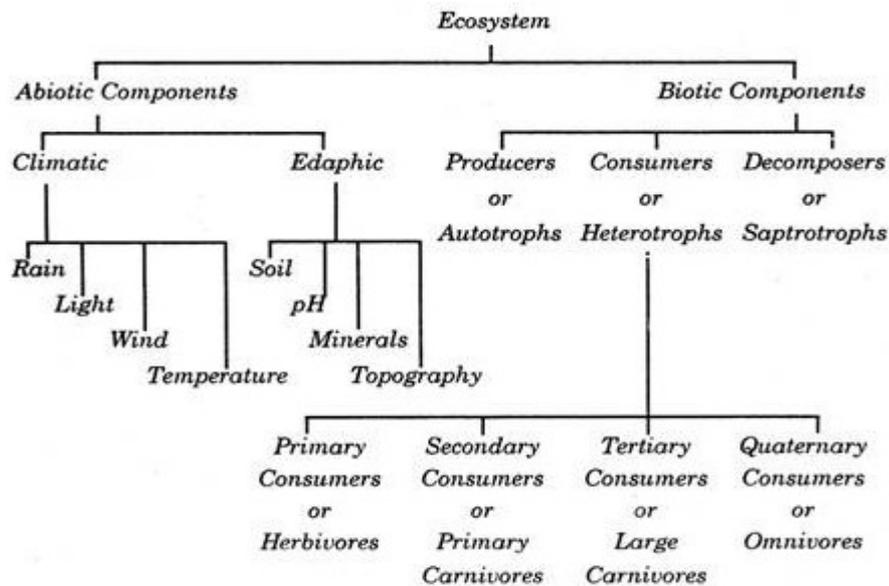
Producers are the plants in the ecosystem, which can generate their own energy requirement through photosynthesis, in the presence of sunlight and chlorophyll.

❖ Consumers:

Consumers include herbivores, carnivores, and omnivores. The herbivores are the living organisms that feed on plants. Carnivores eat other living organisms. Omnivores are animals that can eat both plant and animal tissue.

❖ Decomposers or Reducers:

Decomposers are the fungi and bacteria, which are the saprophytes. They feed on the decaying organic matter and convert this matter into nitrogen and carbon dioxide.



Schematic Representation of the Structure of an Ecosystem.

Function of an Ecosystem:

The principal steps in the operation of ecosystem are as follows:

- Reception of radiant energy of sun and Manufacture of organic materials from inorganic ones by the producers.
- Consumption of producers by consumers and further elaboration of consumed materials.
- After the death of producers and consumers, complex organic compounds are degraded and finally converted by decomposers and converters into such forms as are suitable for reutilization by producers.

The principal steps in the operation of ecosystem not only involve the production, growth and death of living components but also influence the abiotic aspects of habitat. It is now clear that there is transfer of both energy and nutrients from producers to consumers and finally to decomposers and transformers levels.

Energy flow in an Ecosystem:

Each organism living in an ecosystem plays an important role in the flow of energy within the food web. Ecologists have defined three ways that living creatures use energy and interact with one another. Organisms are defined as producers, consumers, or decomposers.

- In most ecosystems, the sun is the source of energy that producers use to create energy. The main role of producers is to capture the energy from the sun and convert it into food by photosynthesis. Plants, algae, and some bacteria are producers.
- Most organisms in an ecosystem cannot make their own food. They depend upon other organisms to meet their food needs. They are called consumers. Herbivores are consumers that only eat plants. Carnivores are consumers that only eat other animals. Omnivores are consumers that eat both plants and animals. Animals of all types grow and add organic matter to their body weight and their source of energy is complex organic compound taken as food. They are known as secondary producers.

- Decomposers are organisms that break down and feed off of the waste and dead organisms within an ecosystem. Decomposers are nature's built-in recycling system. By breaking down materials - from dead trees to the waste from other animals, decomposers return nutrients to the soil and create another food source for herbivores and omnivores within the ecosystem. During the process of decomposition of organic molecules, the energy which kept the inorganic components bound together in the form of organic molecules gets liberated and dissipated into the environment as heat energy.

Ecological Succession:

- Ecological succession is a process through which ecosystems tend to change over a period of time.
- Succession can be related to seasonal environmental changes which create changes in the community of plants and animals living in the ecosystem.
- Other succession events may take much longer periods of time, extending to several decades.
- The most frequent example of succession changes occur in a pond ecosystem where it fluctuates seasonally.

Food Chains, Food Webs And Ecological Pyramid:

Food Chain:-

It is the sequence of transfer of matter and energy in the form of food and energy from organism to organism. For example, plants which convert solar energy to food by photosynthesis are the primary food source. When herbivores animal feed on plants, energy is transferred from the plants to the animals. In all ecosystems some of the animals feed on other living organisms while some feed on dead organic matter.

Producer→primary consumer→secondary consumer→tertiary consumer→quaternary consumer.

Food Web :-

Food web is an important ecological concept. Basically, food web represents feeding relationships within a community. It also implies the transfer of food energy from its source in plants through herbivores to carnivores. Normally, food webs consist of a number of food chains meshed together. A food chain is a linear network of links in a food web starting from producer organisms and ending at predator species.

Producer→primary consumer→secondary consumer→tertiary consumer→quaternary consumer.

Plant→Rabbit, Goat, Deer→cats, fox, snakes, jackal→wolves→Lion, Tiger

Difference between food chain and food web- :

- Food chain is a single linear pathway through which food energy and nutrients travels in the ecosystem while food web is number of interconnected food chains through which energy and nutrients travels in the ecosystem.
- In food chains, usually member of high tropic level feed upon a single type of organism of lower tropic level while in food web members of higher tropic level feed upon many organisms of lower tropic level.

- In food chains, separate and isolated food chains increase the instability of the ecosystem. In food web, stability of the ecosystem increases by the presence of complex food webs.
- Food chains have no effect on improving the adaptability and competitiveness of the organisms while more complex food webs improve the adaptability and competitiveness of the organisms.

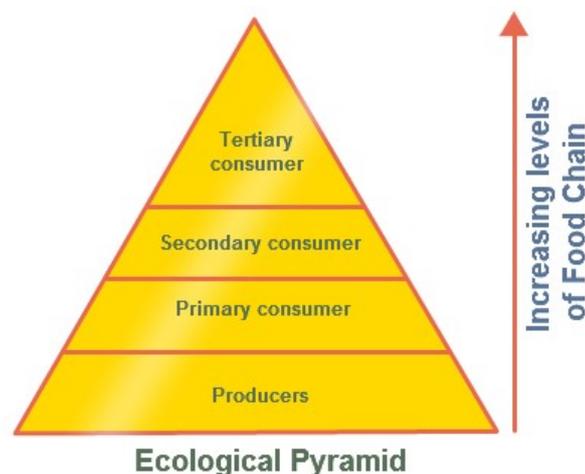
Ecological Pyramid:

- *It is a graphic representation of the relationship between organisms at various trophic levels in a food chain.*
- It is graphically represented to show the biomass or productivity at each trophic level in an ecosystem.
- All ecological pyramids begin at the bottom with the producers and processed through different trophic level.
- The basis of an ecological pyramid is the biomass, energy, and number.
- The bottom of an ecological pyramid is the broadest and is occupied by the producers, which form the first trophic level. Producers are at the lowest level.
- Just as in a food chain, the producers are consumed by the primary consumers, in an ecological pyramid; the next level is occupied by the primary consumers.
- The next level of the pyramid is occupied by the secondary consumers.
- The last level of the pyramid is occupied by the tertiary consumers.

Types of Ecological Pyramids:

Depending on the factors that we use to represent an ecological pyramid, there are three types. They are:

- *Pyramid of numbers:*– Here the factor that is taken into account is the number of organisms in each trophic level. As we go up the levels of the pyramid, the number of organisms decreases. The producers form the largest number and hence are at the bottom of the pyramid.
- *Pyramid of energy:*– This is an upright pyramid that represents the flow of energy from the producers to the final consumers.
- *Pyramid of biomass :*– This pyramid represents the amount of biomass of the organisms present at each trophic level.



Forest Ecosystem:

A forest ecosystem describes the community of plants, animals, microbes and all other organisms in interaction with the chemical and physical features of their environment.

Types of Forest Ecosystem:

➤ Temperate Forest Ecosystem:

Temperate forests are in regions where the climate changes a lot from summer to winter. Temperate forests are almost always made of two types of trees, deciduous and evergreen. Deciduous trees are trees that lose their leaves in the winter. Evergreens are trees that keep them all year long, like pine trees.

➤ The Tropical Rainforest Ecosystem:

Tropical rain forests are one of the most important areas on Earth. These special ecosystems are homes to thousands of species animals and plants. Rain forests are not only densely packed plants, but are also full of tall trees that form a ceiling from the Sun above.

➤ Boreal or Taiga Forests:

The boreal forest ecosystem is the green belt of conifer and deciduous trees that encircles a large portion of the Northern Hemisphere. It has long been identified as one of the world's great forest ecosystems.

Function of Forest Ecosystem:

- Nutrient cycling
- Maintaining biodiversity
- Providing wildlife habitat
- Affecting rainfall patterns
- Regulating stream flow
- Storing water
- Reducing flooding
- Preventing soil erosion
- Reclaiming degraded land
- Provides Fire Wood & Timber, Fruits, Gums, Herbs & drugs.

Structure of Forest Ecosystems:

Different organisms exist within the forest layers. These organisms interact with each other and their surroundings. Each organism has a role in sustaining the ecosystem. Some provide food for other organisms; others provide shelter or control populations.

➤ Producers:

In a forest ecosystem, trees and other plants get their energy from sunlight. Plants produce their own food, in the form of carbohydrates and are called the primary producers. They produce the basic foodstuffs for other organisms within food chains and food webs.

➤ *Consumers:*

All animals, including mammals, insects, and birds, are called consumers. Consumers rely on plants and other animals as a food source. Primary consumers only eat plants and are referred to as herbivores. Secondary consumers are referred to as carnivores and feed on herbivores. Tertiary consumers are carnivores that feed on other carnivores. Omnivores eat both plant and animal matter.

➤ *Decomposers:*

Dead plants and animals are decomposed by worms, microbes, fungi, ants, and other bugs. Decomposers break these items down into their smallest primary elements to be used again. Decomposers are important in that they sustain the nutrient cycle of ecosystems.

Aquatic Eco system:

An aquatic ecosystem is a community of organisms that live together, interact, and to an extent depend on each other in a water based environment.

There are different types of aquatic ecosystem as follows.

Marine ecosystems:-

A marine ecosystem is any ecosystem that exists within the sea. Our seas and oceans are vast bodies of salt water. A whole host of different organisms live in marine ecosystems. There exist seaweeds and marine algae. Invertebrates that live in the marine ecosystem include jellyfish and crustaceans. There are fish such as sharks and mammals such as whales and seals. There are also various sea birds in all parts of the sea. Humans may also form part of the marine ecosystem if they fish in the sea for food.

Freshwater ecosystems:

Freshwater ecosystem has little or no salt. The major types of freshwater ecosystem include pond ecosystem, Lake Ecosystem and river ecosystem.

➤ *Pond ecosystems:*

Many different plants, fish and animals can live in these types of ecosystems. Ponds can be natural or human made ecosystems. A pond ecosystem refers to the freshwater ecosystem where there are communities of organism dependent on each other with the prevailing water environment for their nutrients and survival. Ponds are shallow water bodies with a depth of 12-15 feet in which the sun rays can penetrate to the bottom permitting the growth of plants there.

On the basis of the depth of water, penetration of light and the types of plants and animals in the pond, the pond is divided into different zones. They are: Littoral, Limnetic and Profundal.

➤ *Lake ecosystems:*

Because they tend to be physically enclosed by the earth, rock or mountains around them, freshwater lakes are also act as a distinct habitat of a distinct community of organisms. In this ecosystem, we can find all kinds of organisms including crustaceans (such as shrimp and crayfish), fish (like carp, trout and pike) and many birds, reptiles and amphibians. Freshwater lakes can be home to some beautiful plant life the flora and fauna that abound within them may also change with the seasons. Some animals may only use lakes for looking after their offspring in, such as frogs that may leave frogspawn in a lake before leaving to inhabit other ecosystems.

➤ River ecosystems:

In River ecosystems river water is always flowing. These river ecosystems are the homes of animals and plants that are best adapted to living in flowing water. Salmon are a key example, as they use the flowing motion of a river to help them with their annual migration. And, in general, organisms that prefer to migrate – whether to seek food or to seek a partner – are often to be found in freshwater river ecosystems because the motion of the river suits their style of life. Rivers tend to flow into the sea, and in this way river ecosystems and marine ecosystems meet each other.

➤ Ocean :

All the oceans of earth are connected; each of them has unique species and features. Oceans are home to different species of life. The waters of the Arctic and Southern Oceans are very cold, yet filled with life.

➤ Estuaries:

Estuaries are places where rivers meet the sea and may be defined as areas where salt water is diluted with fresh water. River mouths, coastal bays, tidal marshes and water bodies behind barrier beaches are some examples of estuaries. In estuaries, water level and salinity rise and fall with the tides. These features also rise and fall with the seasons. During the rainy season, rivers may flood the estuary with freshwater. During the dry season, the outflow from rivers may slow to a trickle. During a storm season, storm surges and other ocean waves may flood the estuary with saltwater.

There are four different kinds of estuaries, each created a different way: 1) coastal plain estuaries; 2) tectonic estuaries; 3) bar-built estuaries; and 4) Coastal plain estuaries.

➤ Stream Ecosystem:

The plants, the animals, and the stream itself are all part of a small ecosystem, a community of living and nonliving things. Fish, insects, birds, and other living things that are part of this community depend on the stream and one another to survive.

Biodiversity and it's Conservation

Biodiversity or Biological diversity is a term that describes the variety of living beings on earth. It is the degree of variation of life. Biological diversity encompasses microorganism, plants, animals and ecosystems such as coral reefs, forests, rainforests, deserts etc.

Biodiversity is classified into three types: (1) Genetic diversity, (2) Species diversity and (3) Community or Ecosystem diversity.

➤ Genetic diversity:

A species with different genetic characteristics is known genetic diversity. Within individual species, there are varieties that are slightly different from one other. These differences are due to differences in the combination of genes. Genes are the basic units of hereditary information transmitted from one generation to the other.

Ex: (i) Rice varieties -There are thousands of rice varieties that show variation at the genetic level in the form of different size, shape and colour.

(ii) Teak wood varieties: The various teak wood varieties available are - Indian teak, Burma teak, Malaysian teak etc.

➤ Species diversity:

A discrete group of organisms of the same kind is known as species. Species diversity is the diversity between different species. The sum of varieties of all living organisms at the species level is known as species diversity. The biotic component is composed of a large number of species of plants, animals and microorganisms which interact with each other and with the abiotic component of the environment.

Ex: (i) Plant species like Apple, mango, grapes.

(ii) Animal species like Tiger, Lion and Elephant.

➤ Community or Ecosystem diversity:

Ecosystem diversity is the variation in the ecosystems found in a region or the variation in ecosystems over the whole planet. Ecological diversity includes the variation in both terrestrial and aquatic ecosystems. It can also take into account the variation in the complexity of a biological community, including the number of different niches, the number of trophic levels and other ecological processes.

Ex:- Variation in ecosystems, such as deserts, forests, grasslands, wetlands and oceans.

Biogeographically classification of India:

India has different climate and topography in different parts and hence is termed as a mega diversity country. Bio geographers have classified India into ten bio geographic zones with each zone having characteristic climate, soil and biodiversity. These zones are described below.

- **Trans-Himalayas**:- The trans-Himalayas is an extension to the Tibetan plateau. This region harbors the high-altitude cold desert in Ladakh (Jammu and Kashmir) and Lahaul Spiti (Himachal Pradesh). It accounts for 5.7% of the country's landmass.
- **Himalayas**: - The Himalayas are the northern boundaries of India. The entire mountain chain is running from Kashmir in the North-west to Assam in the north-east. The Himalayas comprise of a diverse range of biotic provinces and biomes. The Himalayas cover 7.2% of the country's landmass.
- **Desert** :- The extremely dry area west of the Aravalli hill range, is comprising both the salty desert of Gujarat and the sandy desert of Rajasthan. Deserts occupy around 6.9% of the country's land mass. The kinds of deserts found in India are:
 - The desert of western Rajasthan
 - The desert of Gujarat
 - The high-altitude cold desert of Jammu & Kashmir and Himachal Pradesh.The Indian deserts have more diversified fauna.
- **Semi-arid** :- This zone lies between the desert and the Deccan plateau. It includes the Aravalli hill range. It covers approximately 15.6% of the country's landmass.
- **Western Ghats** :- The western ghats are a mountain range that runs along the western coast of India. They are a range extending north-south from southern tip of Gujarat in the north to Kanyakumari in the south. The mountains cover an area of about 160,000 sq. km. This ghat section covers an extremely diverse range of biotic provinces and biomes. It covers about 5.8% of the country's landmass.
- **Deccan plateau** :- It is a large triangular plateau south of the Narmada valley. Three sides of the plateau are covered by mountains slopes towards east. Satpura mountains cover the north while western ghats cover the west side and eastern ghats cover the eastern side of the plateau. It is the one of largest zones covering the southern and south-central plateau with mostly deciduous trees. It covers 4.3% of the country's land mass.
- **Gangetic plains**:- This plane covers the area between the south Himalayas to the tropic of cancer. These plains were formed by the Ganges river system and are relatively homogeneous. This region experience 600 mm rainfall annually. *Sunderbans* forests are located in this region and it covers 11% of the country's land mass.

- **North-east India** :- These are plains and non-himalayan ranges of northeastern India and have a wide variety of vegetation. It covers around 5.2% of the country's land mass.
- **Islands** :- The Andaman and Nicobar Islands in the Bay of Bengal has almost 300 big and small islands. Among these, only five islands are inhabited. Only tribes are found in the island of Nicobar. These islands have a highly diverse set of biomes and occupy 0.03% of the country's biomass.
- **Coasts** :-India has a large coastline distributed both to the east and west with distinct differences between the two. The Lakshwadeep islands are included in this but the area of these islands is negligible.

Value of Biodiversity:

The role of biodiversity in providing ecosystem services is twofold. Firstly, biodiversity is directly used as a source for food, fibre, fuel and other extractable resources. Secondly, biodiversity plays an important role in ecosystem processes providing the regulation, cultural and supporting services.

As all the organisms in an ecosystem are interlinked and interdependent, the value of biodiversity in the life of all the organisms including humans is enormous.

Some of the major values of biodiversity are as follows: (1) Environmental Value (2) Consumptive use value (3) Productive Use Value (4) Social Value (5) Ethical and Moral Value (6) Aesthetic Value and (7) Economic Value

➤ **Environmental Value:**

The environmental value of biodiversity can be found by examining each ecosystem process and identifying the ecosystem services that result.

➤ **Consumptive use value:**

This is related to natural products that are used directly for food, fodder, timber, fuel wood etc. Humans use at least 40,000 species of plants and animals on a daily basis. Many people around the world still depend on wild species for most of their needs like food, shelter and clothing. The tribal people are completely dependent on the forests for their daily needs.

➤ **Productive Use Value:**

This is assigned to products that are commercially harvested and marketed. Almost all the present date agricultural crops have originated from wild varieties. The biotechnologists continuously use the wild species of plants for developing new, better yielding and disease resistant varieties. Biodiversity represents the original stock from which new varieties are being developed.

➤ *Social Value:*

The social value of biodiversity includes aesthetic, recreational, cultural and spiritual values. To this can be added health benefits resulting from recreational and other activities. The indigenous people always protect the forests for their own benefit. The biodiversity in different parts of the world has been largely preserved by the traditional societies.

➤ *Ethical and Moral Value:*

It is based on the principle of 'live and let others live'. Ethical values related to biodiversity conservation are based on the importance of protecting all forms of life. All forms of life have the right to exist on earth. Man is only a small part of the Earth's great family of species. Morality and ethics teach us to preserve all forms of life and not to harm any organism unnecessarily.

➤ *Aesthetic Value:*

The beauty of our planet is because of biodiversity, which otherwise would have resembled other barren planets dotted around the universe. Biological diversity adds to the quality of life and provides some of the most beautiful aspects of our existence. Biodiversity is responsible for the beauty of a landscape.

➤ *Economic Value:*

The economic potential of biodiversity is immense in terms of food, fodder, medicinal, ethical and social values. Biodiversity forms the major resource for different industries, which govern the world economy.

Biodiversity at Global, National and Local Levels:

➤ *Global Level:-*

Conservative estimates of the existing biodiversity is ten million species, but if estimates for insects are correct then it could be around 30 million species, we have till now enlisted about 1.4 million species. It includes among others about 98% birds, 95% reptiles and amphibians, 90% fish and about 85% higher plants known to exist on this Earth.

➤ *National and Local Level:-*

India has over 108,276 species of bacteria, fungi, plants and animals already identified and described. Out of these, 84 percent species constitute fungi (21.2 percent), flowering plants (13.9 percent), and insect (49.3 percent). In terms of the number of species, the insects alone constitute nearly half of the biodiversity in India. India is 10th among the plant rich countries of the world, fourth among the Asian countries, eleventh according to the number of endemic species of higher vertebrates (amphibia, birds and mammals), and tenth in the world as far as richness in mammals is concerned.

Threats of Biodiversity:

➤ *Habitat Loss:*

- Habitat destruction is damage to an area that certain species live in, to the extent that the species can no longer survive in that area.
- The causes of habitat destruction can be either man-made or natural in origin.
- Man-made causes of habitat destruction include construction of both previously undeveloped areas as well as new construction on the fringe of developed areas.
- Agriculture is another man-made cause of habitat destruction. E
- Efforts to irrigate farmland and provide water for farm animals can impact habitat, either by taking water from an area, or adding water to an area that was previously dry.
- Global warming is a process that human activity has contributed to.
- Fire is another culprit that can fall under man-made or natural causes of habitat destruction.
- Natural disasters can be causes of habitat destruction. Examples of natural disasters that can be devastating include earthquakes, floods, and tornadoes.

➤ *Poaching Of Wild Life:*

Poaching is the illegal hunting, killing or capturing of animals. People poach because animal products, such as hide, ivory, horn, teeth and bone, are sold to dealers who make clothes, jewellery and other materials from them. The poaching causes various effects; its most direct impact is extinction, either globally or within a given locality.

Human-wildlife conflict:

It refers to the interaction between wild animals and people and the resultant negative impact on people or their resources, or wild animals or their habitat. It occurs when growing human populations overlap with established wildlife territory, creating reduction of resources or life to some people and/or wild animals. The conflict takes many forms ranging from loss of life or injury to humans, and animals both wild and domesticated, to competition for scarce resources to loss and degradation of habitat.

Effects of conflict are:

- Injury and loss of life of humans and wildlife
- Crop damage, livestock depredation, predation of managed wildlife stock
- Damage to human property
- Destruction of habitat
- Collapse of wildlife populations and reduction of geographic ranges

Types of Conservation:

Conservation can broadly be divided into two types:

➤ ***In-situ conservation:-***

In-situ conservation is on site conservation or the conservation of genetic resources in natural populations of plant or animal species, such as forest genetic resources in natural populations of tree species. It is the process of protecting an endangered plant or animal species in its natural habitat, either by protecting or cleaning up the habitat itself, or by defending the species from predators. It is applied to conservation of agricultural biodiversity in agro forestry by farmers, especially those using unconventional farming practices. In-situ conservation is being done by declaring area as protected area.

➤ ***Ex-Situ Conservation:***

Ex-situ conservation is the preservation of components of biological diversity outside their natural habitats. This involves conservation of genetic resources, as well as wild and cultivated or species, and draws on a diverse body of techniques and facilities. Such strategies include establishment of botanical gardens, zoos, conservation strands and gene, pollen seed, seedling, tissue culture and DNA banks.

Difference between *In-situ* and *Ex-situ* conservation:

- *In-situ* conservation is done in the natural habitats of the biodiversity components while *ex-situ* conservation is done outside of their natural habitats.
- *In-situ* conservation is more dynamic, whereas *ex-situ* conservation is more static.
- *In-situ* conservation involves designation, management, and monitoring of target taxa in their natural habitats, whereas *ex-situ* conservation involves sampling, transfer, and storage of target taxa from their natural habitats.
- In *In-situ* conservation, populations remain within the ecosystem involving the process of evolution whereas, in *ex-situ* conservation, they are not involving the natural evolution process.
- *In-situ* conservation is time consuming but more sustainable while *ex-situ* conservation methods are aimed to use in conserving genetic components, in immediate occasions.

Environmental Pollution

Air Pollution:

- W.H.O defines air pollution as the contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. It causes undesirable effects on the ecosystem.

Sources of Air Pollution (Causes):

The sources of air pollution are natural and man-made.

Man-made causes include:

- *Burning-fossil-fuels:-* Burning of wood, charcoal and other fossil fuels causes air pollution by the release of carbon dioxide (CO₂), carbon sulphur dioxide etc.
- *Emissions-from-automobiles:-* The major pollutants released from automobiles, locomotives, aircraft etc., include CO, unburnt hydrocarbons and nitrogen oxide.
- *Industries:-* Factories pollute the air through fossil fuel emissions. These emissions include carbon dioxide, methane, and nitrous oxide.
- *Agricultural-activities:-* Spraying of insecticides and pesticides also cause air pollution. These, when inhaled create severe problems to both animals and man.
- *Wars:-* Various forms of explosives used in war pollute the air by releasing poisonous gases. Nuclear explosions pollute air by radioactive rays.

Natural causes include:

- Volcanic eruption
- Forest fires
- Marsh gas emission
- Deflation of sand and dust
- Micro-organisms such as algae, fungi, bacteria, yeast, moulds, spores are transported by wind to distant places causing air pollution.

Effects of air pollution:

Air pollution has adverse effects on living organisms and materials.

Effect on plants

- Oxides of nitrogen and fluorides reduce crop yield.
- Ozone damages cereals, fruits, and cotton crop.
- Smoke and dust cover the leaf surface and reduce photosynthetic capacity of plants.
- SO₂ causes chlorosis and also results in the death of cells and tissues.

Effect on Human health

- SO₃, CO and NO₂ diffuse into blood stream and reduce oxygen transport. CO damages cardiovascular system. Hydrocarbons and other pollutants act, as carcinogens and lead to different cancers.
- Ozone has been reported to produce chromosomal aberrations.
- Cotton dust leads to respiratory disorders e.g. bronchitis and asthma.

Effects on Aquatic life

- Air pollutants mixing up with rain can cause high acidity (lower pH) in fresh water lakes. This affects aquatic life especially fish.

Change in Climate

- Concentration of various Green House Gases into the atmosphere leads to increase in temperature.
- Thinning of ozone layer would permit more of the harmful ultraviolet rays to reach the earth.

Aesthetic loss

- Dust and smoke spoils the beauty of nature. Especially the mountain environments, which serve as a great attraction for tourists.
- Foul odours emitted by industries, automobiles, dirty drains and garbage heaps in cities are a great nuisance.

Control of Air pollution

Air pollution can be minimized by the following methods:

- Some gases, which are more soluble in a particular liquid than air, for example, ammonia in water, can be separated by dissolving in it.
- Particles larger than 50 mm are separated in gravity settling tanks. Using cyclone collectors or electrostatic precipitators separates fine particles.
- The height of chimneys should be increased to the highest possible level to reduce pollution at the ground level.
- SO₂ pollution can be controlled by extracting sulphur from the fuel before use.
- Pollution control laws should be enforced strictly.
- Trees should be planted on the roadside, riverbanks, parks and open places as they keep the environment fresh.
- Population growth, which is the main cause of pollution, should be checked.
- Nuclear explosions should be restricted.

Water Pollution – Causes, effects and Control measures

Water pollution can be defined as alteration in physical, chemical or biological characteristics of water making it unsuitable for use in its natural state.

Sources of Water Pollution: (Causes)

- Domestic sewage:- This includes household's wastes like food wastes, synthetic detergents used for washing clothes and cleaning bathrooms and latrines and water based paints.
- Industrial effluents:- Industrial wastes containing toxic chemicals, acids, alkalis, metallic salts, phenols, cyanides, ammonia, radioactive substances, etc. are discharged in the adjoining rivers and streams through flush lines of factories.
- Agricultural source:- Agrochemicals like fertilizers (containing nitrates and phosphates) and pesticides (insecticides, fungicides, herbicides etc.) washed by rain-water and surface run-off pollute water.

- **Thermal pollution**:- Waste heat from industrial discharges increases the temperature of water bodies and affects distribution and survival of sensitive species.
- **Pathogenic organisms**:- Sewage and domestic waste from houses introduces pathogenic organisms viz., protozoa, worms-eggs and bacteria into water. This contaminated water if consumed causes jaundice, typhoid, dysentery, cholera, tuberculosis etc.
- **Mineral oils**:- Oil from oil spills and washing of automobiles finds way into river water through sewers.

Effect of water pollution:

- Pesticides in drinking water ultimately reach humans and are known to cause various health problems.
- Industrial effluents containing iron, free chlorine, phenol, manganese, oils, hydrocarbons, ammonia, algae and microorganisms impair the taste and odour of water.
- The nitrates and phosphates dissolved in water accelerate the growth of microorganisms, which consume much of the dissolved oxygen depriving fish and other aquatic life.
- Nitrate when present in excess in drinking water causes blue baby syndrome.
- Excess of fluoride in drinking water causes defects in teeth and bones called fluorosis.
- Some heavy metals like lead, mercury and cadmium cause various types of diseases.
- Soap, detergents and alkalis result in foam formation, which in turn affects aquatic life.

Control of Water Pollution:

- Domestic sewage and industrial wastes should be treated before discharging them into drains. In towns where sewage facilities are not available, septic tanks should be made in the houses.
- Use of pesticides, insecticides and fertilizers should be done judiciously. Rapid biodegradable substitutes for pesticides should be employed.
- Separate ponds and tanks to be used for cattle and animals.
- Prevent run-off of manure. Divert such run-off to basin for settlement. The nutrient rich water can be used as fertilizer in the fields.

Soil Pollution – Causes, effects and control measures

Soil pollution is defined as the presence of toxic chemicals (pollutants or contaminants) in soil, in high enough concentrations to cause a risk to human health and the ecosystem.

Sources of soil pollution: (Causes)

- Pesticides are used to kill pests that damage crops. These pesticides ultimately reach the soil and persist there for a long time. Residues of these pesticides in the soils have long term effects especially under the temperate conditions.
- Industrial wastes also contain some organic and inorganic compounds that are refractory and non-biodegradable.
- Soil also receives excreta from animals and humans. The sewage sludge contains many pathogenic organisms, bacteria, viruses and intestinal worms which cause pollution in the soil.

- Thermal power plants generate a large quantity of 'Fly ash'. Huge quantities of these wastes are dumped on soils, thus contaminating them.
- Many radioactive substances like Uranium, radium, caesium etc. are discharged from industries as wastes. These elements reach the soil and persist there for a long time and keep on emitting radiations.

Effects of Soil Pollution:

- Chemicals and pesticides affect the structure and fertility of soil by killing the soil microorganisms.
- Pesticides are absorbed by the plants and then transferred to other organism. Hence, they affected food chains and food webs.
- Pathogens present in the wastes and excreta contaminate the soil and vegetable crops causing diseases in man and domesticated animals.
- Radioisotopes which attach with the clay become a source of radiations in the environment.

Control of Soil Pollution:

- Effluents should be properly treated before discharging them on the soil.
- Solid wastes should be properly collected and disposed off by appropriate method.
- Metals should be recovered from scrap and disposed materials.
- Materials like paper, glass and plastics can be recycled.
- Use of pesticides can be reduced by adopting biological control of pests.
- Use of cattle dung and agricultural wastes in biogas plants should be encouraged.

Marine Pollution – Causes, effects and control measures

Marine pollution can be defined as the introduction of substances to the marine environment directly or indirectly by man resulting in adverse effects such as hazards to human health, obstruction of marine activities and lowering the quality of sea water.

Sources of marine pollution: (Causes)

The main sources of marine pollution are:

- Rivers, which bring pollutants from their drainage basins
- Catchment area i.e. coastline where human settlements in the form of hotels, industry, agricultural practices have been established
- Oil drilling and shipment.

Effects of marine pollution:

- The pollutants in sea may become dispersed by turbulence and ocean currents and finally becomes a part of food chain.
- Hydrocarbons and benzpyrene gets accumulated in food chain and consumption of such fish by man may cause cancer.
- Bioaccumulation in food chain also result in loss of species diversity.
- Oil pollution causes damage to marine fauna and flora including algae, fish, birds, and invertebrates.
- Detergents used to clean up the spill are also harmful to marine life.

Control of marine pollution:

- Toxic pollutants from industries and sewage treatment plants should not be discharged in coastal waters.
- Run off from non-point sources should be prevented to reach coastal areas.
- Sewer overflows should be prevented by having separate sewer and rain water pipes.
- Dumping of toxic, hazardous wastes and sewage sludge should be banned.
- Developmental activities on coastal areas should be minimized.
- Oil and grease from service stations should be processed for reuse.
- Oil ballast should not be dumped into sea.
- Ecologically sensitive coastal areas should be protected by not allowing drilling.

Noise Pollution – Causes, effects and control measures

Noise pollution or *noise disturbance* is the disturbing or excessive noise that may harm the activity or balance of human or animal life. A decibel value greater than 80 decibels causes noise pollution. Noise becomes troublesome above 140 decibels.

Sources of noise pollution:

The major sources of noise are :

- various modes of transportation (like air, road, rail-transportation)
- industrial operations
- construction activities
- celebrations (social/religious functions, elections etc)
- Electric home appliances.

Effects of noise pollution:

Noise causes the following effects:

- *Interferes with man's communication:-* In a noisy area communication is severely affected.
- *Hearing damage:-* Noise can cause temporary or permanent hearing loss. It depends on intensity and duration of sound level. Auditory sensitivity is reduced with noise level of over 90 dB in the mid high frequency for more than a few minutes.
- *Physiological and Psychological changes:-* Continuous exposure to noise affects the functioning of various systems of the body. It may result in hypertension, insomnia (sleeplessness), gastro-intestinal and digestive disorders, blood pressure changes, behavioural changes, emotional changes etc.

Control of Noise pollution

Following methods can control noise pollution:

- Limited use of loudspeakers and amplifiers.
- Excurising control over noise producing vehicles.
- Industrial workers should be provided with ear plugs.
- Delocalisation of noisy industries far away from dwelling units
- Plants and trees having broad leaves should be planted all around the hospitals, libraries and schools and colleges.
- Unnecessary horn blowing should be restricted especially in vehicle-congested areas.

Thermal Pollution – Causes, effects and control measures

Thermal pollution is defined as the degradation of water quality by any process that changes ambient water temperature.

Causes of Thermal pollution:-

- Water used as coolant & ejected back into water bodies – Thermal power plants use water to cool down their machines and eject back the hot water into water bodies. Thus, the natural water goes through a sudden rise in temperature and cause thermal pollution.
- Release of cold water – Many industries liberate very cool water from their reservoirs. This water when mixed up with warm water rivers, lakes or ponds creates an unbalance in the flora and fauna of affected water bodies.
- Growing industrial activities – Thermal pollutants are increasing day by day because of the growing industrial activities.
- Chemical pollutants discharged into water – Some factories discharge their chemical waste directly into natural water bodies. This does not only causes thermal pollution but also makes the water poisonous.
- Livestock waste mixed into water – This is another major cause of thermal pollution. Many industries dispose their livestock waste into water without analyzing upon the hazardous consequences of this act.
- Water discharged from urban areas – Many urban areas like parking places, roads, etc., deposit rain water and discharge the heated water back into water bodies. The heated water disturbs the normal temperature of natural water bodies.
- Human waste, household & personal care products – These products go into sewage water which pollutes the water in ponds, seas and other water bodies.
- Deforestation & soil erosion – Soil erosion makes natural water bodies to rise beyond their normal level. Thus, they get more exposed to sunlight. Hence, the temperature of water rises. Deforestation disturbs the natural cycle and increase temperature of water.
- Natural Geo-thermal activities – Natural geothermal activities can stimulate lava and can cause a rise in water temperature, making way for thermal pollution.
- Unawareness among people – Growing thermal pollution is also the result of unawareness among people. Even after knowing the hazardous effects of thermal pollution on environment, there are abundant industries which are continuously using ways that encourage this pollution.

Effects of Thermal pollution:-

- Thermal shock resulting in rise in temperature of water bodies – When industries and factories dispose the used hot water into water bodies the temperature suddenly raises to an abnormal level. It acts as a thermal shock for aquatic life.
- Depleted level of oxygen in natural water – The used warm water of industries when mixed with water bodies causes an unusual growth of plants and expansion of algae. The algae expansion in water reduces the level of oxygen in water.
- Contamination of water – Thermal pollution also results in contamination of water of rivers, ponds, lakes, etc by the mixing of various chemicals and other wastes released by factories. This contamination of water may cause shortage of fresh water.
- Adverse effect on water plants – More and more aquatic plants are depleting each day because of thermal pollution caused by variation in temperature.

- Adverse effects on water animals –The contaminated water makes the natural water poisonous and has an adverse effect on animals living in it. Also, the reduced level of oxygen makes it difficult for water animals to survive.
- Effect on population of water animals – When the temperature in natural water bodies gets disturbed due to thermal pollution, the cycle of animal population gets disturbed.
- Unexpected Migration of Water Animals – When water animals find it difficult to survive in the changed water because of thermal pollution, they start for an unexpected migration, making way for a disturbed ecosystem.

Control of Thermal pollution:

The following methods can be employed to control the thermal pollution:

- Use less electricity – The use of less electricity will lead to less workload on power plants and these plants will not have to use their machines too much and there will be controlled use of water as coolant.
- Use of Better Technologies – Use of better technologies is strongly recommended for solving the problem of thermal pollution.
- Holding back the water for good – After using the water as coolant, factories should store that water somewhere else for a temporary period instead of discharging back the heated water into water bodies. This water can be used for various other purposes.
- Plantation of more trees upon the banks of rivers, seas & other water bodies – Plantation around sources of water help in absorbing the sun rays and prevent them from falling directly upon the water. This helps in prevention of heating of water bodies. Planting more trees also helps in controlling the problem of soil erosion.
- Recycling used water – If people start working upon the ideas of recycling the used water in plants and factories, the problem of thermal pollution will definitely be lessened to a significant extent.
- Spreading awareness among people – Making more and more people aware about the problem of thermal pollution will be very beneficial in the long run. Groups of people can initiate a discussion with different industries to reduce the thermal pollution.

Nuclear Hazards – Causes, effects and control measures

Nuclear hazard can be defined as the Risk or danger to human health or the environment posed by radiation generating from the atomic nuclei of a given substance, or the possibility of an uncontrolled explosion originating from a fusion or fission reaction of atomic nuclei.

Sources of Nuclear Hazards:

The sources of radioactivity are both natural and man-made.

The natural sources include:-

- Cosmic rays from outer space.
- Emissions from radioactive materials from the Earth's crust.

Man-made sources include:

- Mining and processing of radioactive ores.
- Use of radioactive material in nuclear power plants.
- Use of radioactive isotopes in medical, industrial and research applications.
- Use of radioactive materials in nuclear weapons.

Effects of Nuclear Hazards:-

Ionization radiations can affect living organisms by causing harmful changes in the body cells and also changes at genetic level.

- *Genetic damage* is caused by radiations, which induce mutations in the DNA, thereby affecting genes and chromosomes. The damage is often seen in the offspring and may be transmitted up to several generations.
- *Somatic damage* includes burns, miscarriages, eye cataract and cancer of bone, thyroid, breast, lungs and skin.

Control of Nuclear Hazards:

Following measures can help in controlling the radioactive pollution:

- Workers in nuclear plants should be provided with nuclear gadgets and safety measures against accidents.
- Leakage of radioactive elements from nuclear reactors, laboratories, transport, careless handling and use of radioactive fuels should be checked.
- There should be regular monitoring and quantitative analysis through frequent sampling in the risk areas.
- Preventive measures should be followed so that background radiation levels do not exceed the permissible limits.
- Waste disposal must be careful, efficient and effective.

Solid Waste Management:

Rapid population growth and urbanization in developing countries has led to people generating enormous quantities of solid waste. The waste is normally disposed in open dumps. This causes a major risk to public health and the environment. Management of solid wastes is important in order to minimize the adverse effects posed by its disposal.

Types of solid wastes:

Depending on the nature of origin, solid wastes are classified into

- Urban or Municipal Wastes
- Industrial Wastes
- Hazardous Wastes

Sources of Solid Waste:

Urban or Municipal Wastes such as:

- *Domestic wastes* containing a variety of materials thrown out from homes. Ex: Food waste, Cloth, Waste paper, Glass bottles, Polythene bags, Waste metals, etc.
- *Commercial wastes:* It includes wastes coming out from shops, markets, hotels, offices, institutions etc. Ex: Waste paper, packaging material, cans, bottle, polythene bags, etc.
- *Construction wastes:* It includes wastes of construction materials. Ex: Wood, Concrete, Debris, etc.
- *Biomedical wastes:* It includes mostly waste organic materials. Ex: Anatomical wastes, Infectious wastes, etc.

Industrial Wastes such as:

- Radioactive wastes from Nuclear plants
- Fly ash from Thermal power plants
- Hazardous and toxic materials of chemical industries
- Packing materials, rubbish, organic wastes, acid, alkali, scrap metals, rubber, plastic, paper, glass, wood, oils, paints, dyes, etc.

Bio-degradable wastes:

Those wastes that can be degraded by micro organisms are called bio-degradable wastes.

Ex: Food, vegetables, tea leaves, dry leaves, etc.

Non-biodegradable wastes:

Urban solid waste materials that cannot be degraded by micro organisms are called non-biodegradable wastes.

Ex: Polythene bags, scrap materials, glass bottles, etc.

Effect of Improper Solid Waste Management:

- Due to improper disposal of municipal solid waste on the roads and immediate surroundings, biodegradable materials undergo decomposition producing foul smell and become a breeding ground for disease vectors.
- Industrial solid wastes are the source for toxic metals and hazardous wastes that affect soil characteristics and productivity of soils when they are dumped on the soil.
- Toxic substances may percolate into the ground and contaminate the groundwater.
- Burning of industrial or domestic wastes produce furans, dioxins and polychlorinated biphenyls that are harmful to human beings.
- Contaminates water and air, resulting into diseases and dysentery in Human beings.
- Mosquitoes breed in the stagnant water, blocked due to waste choked in the drains.
- Decomposition of solid waste spreads bad odour in the air, thus polluting it.
- Garbage dumps and decomposed waste helps many harmful species to breed in them.

Steps Involved In Solid Waste Management:

Two important steps involved in solid waste management are:

- Reduce, Reuse and Recycle of Raw Materials
- Discarding wastes

Reduce: If usage of raw materials is reduced, the generation of waste also gets reduced.

Reuse: Refillable containers that are discarded after use can be reused.

Recycle: Recycling is the reprocessing of discarded materials into new useful products.

Discarding Wastes: The following methods are adopted for discarding wastes:

- Landfill :-
Solid wastes are placed in a sanitary landfill in which alternate layers of 80 cm thick refuse is covered with selected earth-fill of 20 cm thickness. After 2-3 years solid waste volume shrinks by 25-30% and land is used for parks, roads and small buildings. This is the most common and cheapest method of waste disposal.

- Incineration :-
It is a hygienic way of disposing solid waste. It is suitable if waste contains more hazardous material and organic content. It is a thermal process. In this method municipal solid wastes are burnt in a furnace called incinerator. Combustible substances such as rubbish, garbage, dead organisms and non-combustible matter such as glass, porcelain and metals are separated before feeding to incinerators. The non-combustible materials can be left out for recycling and reuse.
- Composting :-
In this method, bulk organic waste is converted into fertilizer by biological action. Separated compostable waste is dumped in underground trenches in layers of 1.5 m and finally covered with earth of 20 cm and left for decomposition. Within 2-3 days, biological action starts. Organic matter is destroyed by actinomycetes and lot of heat is liberated to increase the temperature of compost by 75⁰C and the refuse is finally converted into powdery brown coloured odourless mass called humus that has a fertilizing value and can be used in agriculture.

Role of individual in prevention of pollution:

- Individuals should minimize wastage of resources such as electricity.
- Individuals should prefer walking or use cycles for small distances.
- Individuals can use mass transport (buses, trains, etc) instead of using personal vehicles.
- Vehicle owners must do pollution checks at authorized centres.
- Individuals should reuse items whenever possible.
- Products that are made of recycled material should be given preference.
- Don't use plastic bags.
- Take part in plantation.
- Use water resources efficiently.
- Use renewable resources by installing equipment such as solar heaters and using solar cookers.
- Dispose potentially harmful products such as cells, batteries, pesticide etc. properly.
- Use of air-conditioners should be minimised.
- Follow and promote family planning, as more population means more resources utilized and more resources utilized imply more pollution.
- Avoid making noise producing activities such as listening to loud music.
- Organize drives to clean streets and clean drains with help of other people of locality.
- Spread awareness and inspire other people to prevent pollution.

Disaster Management:

Disaster management is a collective term comprising of all aspects of planning and responses to emergencies of disasters including both pre- and post-event activities.

Disasters are mainly of 2 types:

- Natural disasters. Example – earthquakes, floods, landslides, Floods etc.
- Manmade disasters. Example – war, bomb blasts, chemical leaks, etc.

Earthquake Management:

There is no effective warning system for earthquakes, which makes preliminary precautions even more critical. Still we can manage the earthquakes by following the methods described below.

Before an Earthquake:

- Install latches on cupboard doors to prevent them from opening during a quake.
- Store heavy items or glassware in lower cabinets so they do not become dangerous projectiles.
- Update home insurance policies to adequately cover building costs, possession replacement, and injury deductibles and Take clear photos of valuables as a record for insurance purposes.
- Secure large appliances such as refrigerators, water heaters, air conditioners and other bulky items with straps, bolts, and other stabilizing methods.
- Be sure both old and new buildings meet earthquake construction requirements.
- Do not put heavy artwork, mirrors, or shelves over beds.
- Firmly secure bookcases, artwork, mounted televisions and other objects to withstand as much shaking as possible.
- Keep cell phones charged and emergency kit ready with non-perishable food, bottled water, copies of important documents, flashlights, first aid materials, blankets, spare glasses, and other essential items.
- Plan alternative commuting routes in case an earthquake damages roads.
- All family members must learn about basic first aid; how to behave during a quake and what to do after a quake.

During an Earthquake:

- Immediately seek a safe location during the earthquake.
- Cover the back of your head and your eyes to minimize injury from flying debris.
- Do not take elevators during an earthquake.
- If cooking, turn off heating elements immediately.
- If outdoors, stay in open areas away from buildings, power lines, trees, and other potential hazards.
- If driving, stop quickly but safely and stay in the vehicle. Do not stop near power lines, bridges, overpasses, or other potentially dangerous locations.
- Stay calm and brace yourself to keep your balance, sitting if possible.

After an Earthquake:

- Be prepared for aftershocks.
- Tend injuries immediately and take emergency assistance if necessary.
- Check for structural damage, but do not enter a building that shows damage.
- Wear shoes at all times to avoid stepping on broken glass.

- Turn off gas, electricity, and water if damage is suspected or if advised to do so by authorities.
- Be cautious opening cabinets, cupboards, and closets in case items may be poised to fall.
- Keep phone lines clear for emergency use.
- Be patient. It may take hours or days to restore all services depending on the severity of the quake.

Flood Management:

Before a Flood:

- Avoid building in a floodplain.
- Construct barriers (levees, beams, floodwalls) to stop floodwater from entering your home.
- Seal walls in basements with waterproofing compounds to avoid seepage.
- If a flood is likely in your area, listen to the radio or television for information.
- Be prepared! Pack a bag with important items in case you need to evacuate.
- If advised to evacuate your home, do so immediately.
- If there is any possibility of a flash flood, move immediately to higher ground.
- Turn off utilities at the main switches or valves if instructed to do so. Disconnect electrical appliances.

During and after a Flood:

- Do not walk through moving water.
- If you have to walk in water, walk where the water is not moving. Use a stick to check the firmness of the ground in front of you.
- Do not drive into flooded areas.
- Do not touch electrical equipment if you are wet or standing in water.
- Listen for news reports to learn whether the community's water supply is safe to drink.
- Avoid floodwaters; water may be contaminated by oil, gasoline, or raw sewage. Water may also be electrically charged.
- Be aware of areas where floodwaters have receded.
- Stay away from downed power lines, and report them to the power company.
- Return home only when authorities indicate it is safe.
- Stay out of any building if it is surrounded by floodwaters.
- Service damaged septic tanks, cesspools, pits, and leaching systems as soon as possible.
- Clean and disinfect everything that got wet.

Cyclone Management:

Safety Precautions and Timely Actions to Reduce Damage:

Before Cyclone:

- Fill water buckets and cover them for use.
- Top up your car's fuel tank.
- Ensure you have fresh batteries for your usage.
- Make sure you have adequate supplies of prescribed medicines.
- Stock up on non perishable food items if required.
- Make awareness among friends, relatives and neighbours.
- Ensure your family members are in home.
- Gather tools that will be needed for emergency repairs, e.g. hammer, nails, rope etc.
- Shift to a safe place if you find any danger in your residency.
- If advised to evacuate your home, do so immediately.
- Turn off utilities at the main switches or valves if instructed to do so. Disconnect electrical appliances.

During Cyclone:

- Listen to the media for regular updates.
- Do not make unnecessary demands on the emergency services.
- Do not touch wet switches, and beware of fallen power lines.
- Stay at home.
- Service damaged septic tanks, cesspools, pits, and leaching systems as soon as possible.
- Clean and disinfect everything that got wet.

Social Issues and the Environment

Sustainable Development:

It is defined as “meeting the needs of the present without compromising the ability of the future generation to meet their own needs”.

Urban Problems related to energy:

Energy requirement of urban population are much higher than that of rural ones because urban people have a higher standard life and there life style demand more energy inputs in every sphere of life. These include:

- Residential and commercial lighting.
- Usage of auto mobiles and public transport for moving from one place to other.
- Modern lifestyle using large number of electrical gadgets in everyday life.
- Industrial plans using a big proportion of energy.
- Waste disposal using energy based techniques.
- Control and prevention of air and water pollution with energy dependent technologies.

Water Conservation:

Now a day’s water is a major factor for the society. So, water conservation is necessary for the future use. So it is the responsibility of each and every human being to store the water. The following are control measure for water conservation which is very necessary.

- Turn off the Water tap after each activity.
- Reduce over water usage in home.
- Don’t waste water anyway. Reuse Wastewater Where Possible.
- Check Faucets and Pipes for Leaks.
- Use Your Water Meter to Check for Hidden Water Leaks.

Rainwater harvesting:

It is the process of collecting rainwater and putting it to good use. Rainwater harvesting refers to the trapping and storing of rainwater so that it can be used at a later time when the need arises.

Methods of Rainwater Harvesting:

- *Surface Water Collection Systems:-* Surface water collection systems enable the collection of ground surface rainwater before it flows to other locations. Examples of such systems include rivers, ponds, and wells.
- *Rooftop system:-* Rooftops can be used to direct rainwater that falls on the roof of a building into containers or tanks.

- **3. Dams:-** These are barriers that are designed to trap water. Rainwater can accumulate directly in them or drainage systems can be created to direct water into them. Water collected in dams is mostly used for irrigation purposes or for domestic use.
- **Underground Tanks:-** These are constructed by digging into the ground and creating a space which is then cemented to reduce water infiltration. The top is also sealed and water is obtained through pipes directed into the tank. To get water out, pumps are used.
- **Reservoirs:-** Water collected through this method is not really clean and may be contaminated. However, it can still be used for crop irrigation.
- **Barrage:** A barrage is a dam that has several openings which can be closed or opened to control the quantity of water that passes through it. It is usually large and can be used to collect a lot of water.

Advantages of Rainwater Harvesting:

Rainwater harvesting is beneficial because it provides a source of water for domestic use, industrial use, building and construction works, irrigation etc.

Water shed management:

Watershed is defined as a geo-hydrological unit draining to a common point by a system of drains. It is an area of land and water bounded by a drainage divide within which the surface runoff collects and flows out of the watershed through a single outlet into a larger river or lake.

Objectives of watershed management

The different objectives of watershed management programmes are:

- To control damaging runoff and degradation and thereby conservation of soil and water.
- To manage and utilize the runoff water for useful purpose.
- To protect, conserve and improve the land of watershed for more efficient and sustained production.
- To protect and enhance the water resource originating in the watershed.
- To moderate the floods peaks at downstream areas.
- To increase infiltration of rainwater.

Environmental ethics: issue and possible solutions:

- **Resource consumption patterns and the need for equitable utilization:**
It deals with how we utilize and distribute resources. There is a difference between the individuals, communities and countries in usage of resources. An equitable sharing of resources forms the basis of sustainable development for urban and rural communities.
- **Urban-rural equity issues:**
The common property of rural communities has increasingly been used to supply the needs of the urban and industrial sectors. As the rural sector supplies food and a part of the energy needs (mainly fuel wood) to most towns and cities in India, the common lands of the rural sector are being depleted of their resources.

- *The need for gender equity:*
All over India, especially in the rural sector, women work longer hours than men. Unfortunately, women have not been given an equal opportunity to develop and improve their status which is due to a lower access to education and health care than that of men. It has deep implications for the rate of utilization and conservation of natural resources.
- *Preserving resources for future generations:*
This ethical issue must be considered when we use resources unsustainably. If we will overuse and misuse the resources and energy from fossil fuels then our future generations will find survival very difficult.
- *The rights of animals:*
The plants and animals that share the Earth with us too have a right to live and share the Earth's resources and living space. We have no right to push a species that has taken millions of years to evolve towards extinction. Cruelty to animals is a crime that must be regarded seriously and action must be taken against offenders.
- *The ethical basis of environment education and awareness:*
The Supreme Court of our country has ordered that every young individual at school and college level be exposed to a course on environment.

Climate Change:

The United Nations Framework Convention on Climate Change (UNFCCC) defines it as a change of climate that is attributed directly or indirectly to human activity, altering the composition of the global atmosphere.

Human activity includes the pollution that arises from industrial activity and other sources that produce greenhouse gases. These gases, such as carbon dioxide, have the ability to absorb the spectrum of infrared light and contribute to the warming of our atmosphere. Once produced, these gases can remain trapped in the atmosphere for tens or hundreds of years. It is hugely responsible for climate changes.

Global warming:

Global warming is defined as the increase in the temperature on earth's surface due to various reasons. The reasons include both by human and natural but the major contribution towards the global warming is from human and his activities. The natural causes include volcanic eruptions and other natural hazards. Due to volcanic eruption there is a production large amount of heat and this heat will transmitted to the atmosphere and there will be a increase in the atmospheric temperature. The other reasons are the activities of human that lead to the global warming.

They are listed below:

- Exhaust from vehicles, industries, jet plane and other commercial planes etc.
- Exhaust from various power plants mainly non conventional
- Green house gasses
- Gases released from mines
- Exhaust form domestic usage

Effects of global warming

- Rise in sea level world wide
- Severe storms
- Massive crop failures due to climate change.
- Widespread extinction of species
- Disappearance of coral reefs

Acid Rain:

Acid rain means the presence of excessive acids in rain water. Thermal power plants, industries and vehicles release nitrous oxide and sulphur dioxide into the atmosphere by burning of coal and oil. When these gases react with water vapour in the atmosphere, they form acids and descend on Earth as "acid rain" through rain water.

Causes of Acid Rain

Both natural and man-made sources are known to play a role in the formation of acid rain. But, it is mainly caused by combustion of fossil fuels which results in emissions of sulfur dioxide (SO₂) and nitrogen oxides (NO_x).

- *Natural Sources:-* The major natural agent for acid rain is volcanic emissions. Volcanoes emit acid producing gases to create higher than normal amounts of acid rain.
- *Man-made sources:-* Human activities leading to chemical gas emissions such as sulphur and nitrogen are the primary contributors to acid rain.

Effects of Acid Rain:

Acid rain has significant effects on the world environment and public health.

- Effect on Aquatic Environment, Forests, Soil, Vegetation Cover and Plantations, Architecture and Building, Public Health etc.

Ozone Layer Depletion:

Ozone layer is a deep layer in earth's atmosphere that contains ozone which is a naturally occurring molecule containing three oxygen atoms. These ozone molecules form a gaseous layer in the Earth's upper atmosphere called stratosphere. This lower region of stratosphere containing relatively higher concentration of ozone is called Ozonosphere. The Ozonosphere is found 15-35 km (9 to 22 miles) above the surface of the earth.

Causes of Ozone Layer Depletion:

- *Natural causes of depletion of ozone layer:-* Ozone layer has been found to be affected by certain natural phenomena such as Sun-spots and stratospheric winds. But this has been found to cause not more than 1-2% depletion of the ozone layer. It is also believed that the major volcanic eruptions have also contributed towards ozone depletion.

- *Man-made causes of depletion of ozone layer:-* The main cause for the depletion of ozone is determined as excessive release of chlorine and bromine from man-made compounds such as chlorofluorocarbons halons, Methyl chloroform, Carbon tetrachloride), hydrochlorofluorocarbons, hydro-bromofluorocarbons and methyl bromide are found to have direct impact on the depletion of the ozone layer.

Effects of Ozone Depletion:

- Damage to human health
- Devastation to environment
- Threat to marine life
- Effect on animals
- Impacts certain materials

Air Prevention and Control of Pollution Act (1981):

- The Government passed this Act in 1981 to clean up our air by controlling pollution.
- It states that sources of air pollution such as industry, vehicles, power plants, etc., are not permitted to release particulate matter, lead, carbon monoxide, sulfur dioxide, nitrogen oxide, volatile organic compounds (VOCs) or other toxic substances beyond a prescribed level.
- To ensure this, Pollution Control Boards (PCBs) have been set up by Government to measure pollution levels in the atmosphere and at certain sources by testing the air. The particulate matter and gases that are released by industry and by cars, buses and two wheelers is measured by using air-sampling equipment.
- This Act is created to take appropriate steps for the preservation of the natural resources of the Earth which among other things includes the preservation of high quality air and ensures controlling the level of air pollution.

The main objectives of the Act are as follows:

- To provide for the prevention, control and abatement of air pollution.
- To provide for the establishment of central and State Boards with a view to implement the Act.
- To confer on the Boards the powers to implement the provisions of the Act and assign to the Boards functions relating to pollution.
- The main function of the Central Board is to implement legislation created to improve the quality of air and to prevent and control air pollution in the country.
- The State Boards have the power to advise the State Government on any matter concerning the prevention and control of air pollution. They have the right to inspect at all reasonable times any control equipment, industrial plant, or manufacturing process and give orders to take the necessary steps to control pollution.

Water Prevention and Control of Pollution Act,1974:

- This act aims to prevent and control water pollution and to maintain/restore of water by establishing central and state pollution control board to monitor and enforce the regulations.
- The Central Pollution Control Board and State Pollution Control Boards composition, terms and conditions of service of members are defined in Sections 3-12 of water (prevention and control of pollution) act, 1974.
- The Board advises the government on any matter concerning the prevention and control of water pollution. It coordinates the activities and provides technical assistance and guidance. This policy sets the standards and penalties for non-compliance for polluting bodies.

The main objectives of the Act are as follows:

- Advise the Central Government on any matter concerning the prevention and control of water pollution.
- Coordination between the activities of the State Boards and central boards in the prevention and control of water pollution.
- Plan and organise the training of persons engaged or to be engaged in programmes for the prevention, control or abatement of water pollution.
- Organise through mass media a comprehensive programme regarding the prevention and control of water pollution.
- Collect, compile and publish technical and statistical data relating to water pollution and the measures devised for its effective prevention and control and prepare manuals, codes or guides relating to treatment.

Public Awareness:

- Government should organize Environmental Education campaign programmes for children, youth, men and women. The state government should establish appropriate funding mechanisms for raising public awareness of environmental education.
- Government officials can make significant contributions to improve public awareness of environmental education.
- NGOs (at national and community levels) should initiate and help by awareness campaigns to save environment.
- Ban the littering of polythene cannot be successful until the public understands the environmental implications of the same.

- Proper methods of disposal and its treatment should be applied otherwise they can be the causes of chronic diseases. When sewage is applied continuously on a part of land, the pores or voids of the soil are clogged and free circulation of air is prevented.
- Humans are responsible for depletion of the natural resources; degradation of the vital life-supporting systems (like air, water, soil, etc.); ecological imbalance; deteriorated environment, etc. By exercising following actions, humans can protect global environment for sustainable development:
 - Preserve forest cover: Humans should minimize cutting of trees and using timber for aesthetic pleasure such as decoration of drawing rooms.
 - Preserve natural resources: Human should not extract unnecessarily and exhaustively the natural resources such as mineral resources, water resources, etc.
 - Conserve energy: Human should not harness too much energy from burning of fossil fuels.
 - iv. Maintain ecological balance: Human should exploit synergy between green revolution and industrial evolution by compulsory growing green belts around industrial areas, maintaining wild life sanctuaries and national parks.
- Practice green technology.

Human Population and the Environment

Population Growth:

In the past, population growth was a gradual phenomenon and the Earth's resources were capable of adjusting to this increase. In the recent past, the rapid growth of human numbers has become a major cause of our environmental problems. According to report by the United Nation Population Fund (UNPF), total population is likely to reach 10 billion by 2025 and grow to 14 billion by next century. Both death rates and birth rates have fallen, but death rates have fallen faster than birth rates.

Causes of population growth:

- Increase in food production and distribution.
- Improvement in public health
- Medical technology, along with gains in education and increase in standards of living within many developing nations.
- People were able to fight and cure deadly germs that once killed them. In addition, because of the technology people could produce more & different kinds of food gradually over a period of time these discoveries and inventions spread throughout the world lowering death rates and improving the quality of life for most people.
- Improvement in public health which lead to increased fertility rate and birth rate, decreased mortality and morbidity rates.
- Medical technology, along with gains in education and increase in standards of living.

Human rights:

Human rights are those conditions that are considered indispensable for a person's all – round development and welfare. These rights can be divided into two groups: legal rights and moral rights. Legal rights come from the law. For example, people have a legal right to vote in India once they are 18 years old. A person's wife or child has got a moral right to be taken care of by him.

Several environmental issues are closely linked to human rights. These include:

- The equitable distribution of environmental resources
- The utilization of resources and intellectual property rights (iprs)
- Conflicts between people and wildlife especially around pas
- Resettlement issues around development projects such as dams and mines
- Access to health to prevent environment-related diseases

Value education:

Values are a set of principles or standards of behaviour that are regarded desirable, important & held in high esteem by society. Value education is expected to bring about a new sustainable way life. Education, both through formal and non-formal processes, must address understanding environmental, natural and cultural values, social justice, human heritage, equitable use of resources, managing common property resources and the causes of ecological degradation.

Value education aims to focus in the following key areas:

- Environmental values
- Valuing nature
- Valuing cultures
- Human heritage
- Equitable use of resources
- Common property resources
- Ecological degradation
- Social justice

Role of Information Technology in Environmental Management:

The understanding of environmental concerns and issues related to human health has exploded during the last few years due to the sudden growth of information technology.

For bridging the gap between scientists and decision-makers for the purpose of environmental policy-making is today more important than ever. Global Resource Information Database was established by UNEP in 1985 to bridge this gap and to provide the global society with updated and reliable environment information. Strategic tools to achieve this were geographical information technology for the analysis and presentation of information and telecommunications for the dissemination and exchange of information.

Role of Information Technology in Human Health:

- *Electronic Health Information Sources:*
An enormous amount of health information is available in electronic form. World Wide Web has made it possible to rapidly retrieve, arrange and display on web pages the contents of files on health information.
- *Bringing Health care online:*
Health care contains information about Medicare and Medicaid and various related web sites guide consumers to a wide variety of health information.
Many institutions maintain web sites with information about communicable diseases, epidemics, population-based health care and on international health issues.
- *Medical Images:*
Documentation and display of human anatomy in a series of photographic and computerized images of cross-sections of a human body are now possible through Internet.
- *Internet & websites:*
Health information technologies help patients to know more information about their health status which lightens the burden of physician or surgeon who treat them.
- *Telemedicine:*
It is being used for consultations between rural and urban practitioners. Though private hospitals and institutions are quick in adoption, it is interesting & appreciable to note that the government has also made major efforts in this direction. NRHM & PHCS, HMRI are using this technology.

Population Explosion:

Population explosion is defined as the condition of having more people than can live on the earth in comfort, happiness and health and still live the world a fit place for future generation.

World population is expected to increase to 8 billion by the year 2025. At present China has the highest population and India is the second most populated country.

Problems related to Population Explosion:

- Famine in areas where growth is more and food production is less.
- Political unrest due to great disparities in availability of resources (jobs, goods, food).
- Environmental degradation by poor agricultural practices.
- Increase in pollution of air, water, land etc.
- Extinctions due to the conversion of natural ecosystem to managed agricultural ecosystems.
- Destructive effects of exploitation of natural resources (strip mining, oil spills, ground water mining).

Family welfare programmes:

In response to our phenomenal population growth, India seriously took up an effective family planning program, which was renamed the “family welfare program”. Slogans such as “hum do hamare do” indicated that each family should not have more than two children. However, it has taken several decades to become really effective.