

LEARNING MATERIAL

SEMESTER : 3RD SEMESTER
BRANCH : MINING ENGINEERING
THEORY SUBJECT : ENVIRONMENTAL STUDIES (TH – 5)

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MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

The word environment is derived from the French word '**environner**' which means to '**encircle or surround**'.

☐ Thus our environment can be defined **as “the Social, Cultural and Physical conditions that surround, affect and influence the survival, growth and development of people, animals and plants”**

☐ This broad definition includes the natural world and the technological environment as well as the cultural and social contexts that shape human lives.

☐ It includes all factors (living and nonliving) that affect an individual organism or population at any point in the life cycle; set of circumstances surrounding a particular occurrence and all the things that surrounds us.

SCOPE OF ENVIRONMENTAL STUDIES

Environmental studies as a subject has a wide scope. It includes a large number of areas and aspects, which may be summarized as follows:

☐ **Natural resources**- their conservation and management

☐ **Ecology and Biodiversity**

☐ **Environmental pollution and control**

☐ **Human population** and environment

☐ **Social issues** in relation to development and environment

IMPORTANCE OF ENVIRONMENTAL STUDIES

☐ The importance of environmental studies is that, the current trend of environmental degradation can be reversed if people of educated communities are organized, empowered and experts are involved in sustainable development.

☐ Environmental factors greatly influence every organism and their activities.

At present a great number of environmental issues, have grown in size and complexity day by day, threatening the survival of mankind on earth. These issues are studied besides giving effective suggestions in the environment studies.

☐ The environment studies enlighten us, about the importance of protection and conservation of our natural resources, indiscriminate release of pollution into the environment etc.

Environment studies have become significant for the following reasons:

NEED FOR PUBLIC AWARENESS

1. Growing Population: A population of over thousands of millions is growing at 2.11 per cent every year. Over 17 million people are added each year. It puts considerable pressure on its natural resources and reduces the gains of development. Hence, the greatest challenge before us is to limit the population growth. Although population control does not automatically lead to development, yet the development leads to a decrease in population growth rates.

2. Poverty: India has often been described a rich land with poor people. The poverty and environmental degradation are mixed with one another. The vast majority of our people are directly dependent on the nature resources of the country for their basic needs of food, fuel shelter and fodder. About 40% of our people are still below the poverty line.

3. Environment degradation has adversely affected the poor who depend upon the resources of their immediate surroundings. Thus, the challenge of poverty and the challenge of environment degradation are two facets of the same challenge.

4. Agricultural Growth: The people must be made familiar with the methods to sustain and increase agricultural growth without damaging the environment. High yielding varieties have caused soil salinity and damage to physical structure of soil.

5. Need to Increase Ground water: It is essential of rationalizing the use of groundwater. Factors like community wastes, industrial effluents, chemical

6. Air and water Pollution: Majority of our industrial plants are using outdated and pollution causing technologies and makeshift facilities devoid of any provision of treating their wastes. A great number of cities and industrial areas have been identified as the worst in terms of air and water pollution. Acts are enforced in the country, but their implement is not so easy. The reason is their implementation needs great resources, technical expertise, political and social will. Again the people are to be made aware of these rules. Their support is indispensable to implement these rules.

NATURAL RESOURCES

Natural resources can be defined as 'variety of goods and services provided by nature which are necessary for our day-to-day lives'.

□ Eg: Plants, animals and microbes (living or biotic part), Air, water, soil, minerals,

climate and solar energy (non- living or abiotic part).

☐ They are essential for the fulfillment of physiological, social, economical and cultural needs at the individual and community levels.

TYPES OF NATURAL RESOURCES

They are of two types of resources namely Renewable and Non-Renewable Resources.

1. Renewable resources: The resources that can be replenished through rapid natural cycles are known as renewable resource. These resources are able to increase their abundance through reproduction and utilization of simple substances.

Ex: Plants, (crops and forests) and animals.

☐ Some examples of renewable resources though they do not have life cycle but can be recycled.

Ex: Wood and wood-products, pulp products, natural rubber, fibers (e.g. Cotton, jute, animal wool, silk and synthetic fibers) and leather.

☐ In addition to these resources, water and soil are also classified as renewable resources.

☐ Solar energy although having a finite life, as a special case, is considered as a renewable resource in as much as solar stocks is inexhaustible on the human scale.

2. Non renewable resources: The resources that cannot be replenished through natural processes are known as non-renewable resources. These are available in limited amounts, which cannot be increased. These resources include fossil fuels (petrol, coal etc.), metals (iron, copper, gold, silver, lead, zinc etc.), minerals and salts (carbonates, phosphates, nitrates etc.). Once a non-renewable

NATURAL RESOURCES AND ASSOCIATED PROBLEMS:

☐ The main problem associated with natural resources is unequal consumption.

☐ A major part of natural resources are consumed in the 'developed' world. The 'developing nations' also over use many resources because of their greater human population. However, the consumption of resources per capita (per individual) of the developed countries is up to 50 times greater than in most developing countries.

- Advanced countries produce over 75% of global industrial waste and greenhouse gases.
- Energy from fossil fuels consumed in relatively much greater quantities in developed countries. Their per capita consumption of food too is much greater as well as their waste.

FOREST RESOURCES

A forest can be defined as a biotic community predominant of trees, shrubs or any other woody vegetation usually in a closed canopy. It is derived from latin word '*foris*' means '*outside*'. India's Forest Cover is 6,76,000 sq.km (20.55% of geographic area). Scientists estimate that India should ideally have 33% of its land under forests. Today we only have about 12% thus we need not only to protect our existing forests but also to increase our forest cover.

FUNCTIONS OF FOREST

1. It performs very important function both to human and to nature.
2. They are habitats to millions of plants, animals and wild life.
3. They recycle rain water.
4. They remove pollutant from air.
5. They control water quality.
6. They moderate temperature and weather.
7. They influence soil condition and prevent soil erosion.

OVER EXPLOITATION OF FOREST: Due to over population, there is an increased demand for medicine, shelter, wood and fuel. Hence exploitation of forest materials is going on increasing.

Cause of over exploitation:

1. Increasing agricultural production.
2. Increasing agricultural activities.
3. Increase in demand of wood resources.

DEFORESTATION: It is process of removal of forest resources due to natural or manmade activities (i.e.) destruction of forests.

Causes of deforestation:

1. Developmental projects: Developmental projects causes deforestation through two ways.

- ☐ Through submergence of forest area.
- ☐ Destruction of forest area.

Ex: big dams, hydro electric projects, road construction etc.

2. Mining operations: It reduces forest areas. Ex: Mica, coal, Manganese and lime stone.

3. Raw materials for industries: Wood is an important raw material for various purposes.

Ex: Making boxes, furniture and paper etc.

4. Fuel requirement: Wood is the important fuel for rural and tribal population.

Consequences of deforestation

1. Economic loss
2. Loss of biodiversity
3. Destructs the habitats of various species
4. Reduction in stream flow
5. Increases the rate of global warming
6. Disruption of weather patterns and global climate
7. Degradation of soil and acceleration of the rate of soil erosion.
8. Induces and accelerates mass movement / land slides.
9. Increases flood frequency, magnitude / severity.
10. Breaks the water cycle
11. Breaks the nutrient cycle

PREVENTIVE MEASURES (OR) AVOID OF DEFORESTATION (OR) METHODS OF CONSERVATION OF FORESTS

1. New plants of more or less of the same variety should be planted to replace the trees cut down for timber
2. Use of wood for fuel should be discouraged.
3. Forest pests can be controlled by spraying pesticides by using aero planes
4. Forest fire must be controlled by modern techniques.
5. Over grazing by cattle must be controlled.
6. Steps should be taken by the government to discourage the migration of people into the islands from mainland.
7. Education and awareness programmes must be conducted.
8. Strict implementation of law of Forest conservation Act.

TIMBER EXTRACTION

Wood used for engineering purposes like building houses, making furniture is called timber. The products derived from timber have been important to many civilizations, and thus it has acquired value within these civilizations. Timber extraction results in deforestation and in the fragmentation of the last remaining forests. It harms valuable species of trees, birds and wild animals. In spite of this, it is sometimes necessary to extract timber, so as to meet the needs of a developing country. During the extraction of timber, cutting, felling and handling should be done selectively, carefully and in a planned manner, in order to save the remaining forests and biodiversity.

Effects of Timber Extraction

The major effects of timber extraction on forest and tribal people include:

1. Poor logging results in a degraded forest.
2. Floods may be intensified by cutting of trees or upstream watersheds.
3. Loss of biodiversity.
4. Climatic changes such as less rains.

5. New logging roads permit shifting cultivators to gain access to logged areas and cut the remaining trees.

6. It results in forest fragmentation which promotes loss of biodiversity because

DAMS

Today there are more than 45,000 large dams around the world, which play an important role in communities and economies that harness these water resources for their economic development. Current estimates suggest some 30-40% of irrigated land worldwide relies on dams. Hydropower, another important use of stored water, currently supplies 19% of the world's total electric power supply and is used in over 150 countries. The world's two most populous countries – China and India – have built around 57% of the world's large dams.

Dams problems

Dams are the massive artificial structures built across the rivers to store water for much beneficial purpose.

Dams are considered a "Temples of modern India". Dams destruct vast area of forest area. India has more than 1600 large dams.

Effects of dams on forest:

1. Thousands of hectares of forest will be cleared.
2. Killing of wild animals and destruction of aquatic life.
3. Spreading of water borne diseases.
4. Water logging increases the salinity of the soil.

Effects of dam on tribal people

1. Construction of big dams lead to the displacement of tribal people.
2. Displacement and cultural change affects the tribal people both mentally and physically.
3. They do not accommodate the modern food habits and life style.
4. Tribal people are ill treated by the modern society.

MINING

The process of extracting mineral resources and fossil fuels like coal from the earth is called as mining.

Types of mining

1. Surface mining: Mining of minerals from shallow deposits
2. Underground mining: Mining of minerals from deep deposits

Steps involved in mining

1. Exploration
2. Development
3. Exploitation
4. Ore processing
5. Extraction and purification of minerals

The extent of damage by underground mining is more than that of surface mining, which needs enormous amount of land area for its operation and management.

Effects of mining

1. Pollute soil, water and air.
2. Destruction of natural habitat.
3. Continuous removal of minerals leads to the formation of trench where water is logged which contaminates the ground water.
4. Vibrations cause earth quakes.
5. Produces noise pollution
6. Reduces shape and size of the forest

WATER RESOURCES

Water claims to be an important resource. An important use of water in our country is for irrigation. Besides, water is also required in large amounts for industrial and domestic consumption.

UNDERGROUND WATER

Aquifer: Layers of highly permeable rock that can store water is called an aquifer. Layer of sand and gravels are good aquifers. Clay and crystalline rocks are not good aquifers.

Effects of over utilization of water

1. Decrease of ground water:

- i. Increased usage decreases the ground water.
- ii. Insufficient rain fall
- iii. Building construction activities sealing the permeability of the soil.

2. Ground subsidence: If ground water withdrawal is greater than it's recharge rate, then the sediments in the aquifers get compacted. As a result shrinkage of land surface takes place.

Problems: a. Structural damages to the buildings
b. Fracture in pipes.
c. Reversing the flow of canals.

3. Lowering of water table: Over utilization of ground water in arid and semi arid regions for agriculture disturbs the state of equilibrium of the hydrological cycle.

FLOOD

It is an over flow of water. It happens when the magnitude of flow of water exceeds the carrying capacity of the channel within its bank.

CAUSES OF FLOOD

- 1. Heavy rainfall, melting of snow and sudden release of water from dams. (Flash floods)
- 2. Reduction in the carrying capacity of the channel.
- 3. Deforestation, mining and over grazing increase the runoff from rains and the level of flood raises.

EFFECT OF FLOOD

1. Water spreads in the surrounding area and submerges them.
2. Cultivated land gets affected.
3. Extinction of civilization

DROUGHT

Drought is nothing but scarcity of water, which occurs due to

1. Inadequate rain fall
2. Late arrival of rain fall
3. Excessive withdrawal of ground water.

CAUSES OF DROUGHT

1. When annual rain fall is below normal and less than evaporation, drought is created.
2. High population.
3. Intensive cropping pattern

Ex: Maharashtra - There has been no recovery from drought for the last 30 years due to over exploitation of water by sugarcane crop

EFFECTS OF DROUGHT

1. Drought causes hunger, malnutrition and scarcity of drinking water and also changes the quality of water.
2. Drought causes widespread crop failure leading to acute shortage of food and adversely affects human and live stock population.
3. Worst situation of drought causes desertification.
4. Raw materials of agro based industries are critically affected during drought time, hence industrial and commercial growth decreases.
5. Drought increases the degradation of natural resources.

DAMS

Dams made significant contributions to human development and the benefits derived from them have been considerable. Large dams are designed to control floods and to help the drought prone areas, with supply of water. But large dams have proved to cause severe environmental damage. Hence an attempt has been made to construct small dams. Multiple small dams have less impact on the environment.

Benefits: Dams ensure a year round supply of water for domestic use and provide extra water for agriculture, industries and hydropower generation.

Problems: They alter river flows, change nature's flood control mechanisms such as wetlands and flood plains, and destroy the lives of local people and the habitats of wild plant and animal species, particularly is the case with mega dams.

Some of the problems are mentioned below.

- ☐ Dam construction and submersion leads to significant loss of farmland and forest and land submergence
- ☐ Siltation of reservoirs, water logging and salination in surrounding lands reduces agricultural productivity
- ☐ Serious impacts on ecosystems - significant and irreversible loss of species and ecosystems, deforestation and loss of biodiversity, affects aquaculture.
- ☐ Socio economic problems for example, displacement, rehabilitation and resettlement of tribal people.
- ☐ Fragmentation and physical transformation of rivers

MINERAL RESOURCES

Naturally occurring inorganic crystalline solids with uniform chemical composition are called as minerals.

USES AND EXPLOITATION OF MINERALS

1. Development of industrial plants and machinery. - Fe, Al & Cu
2. Construction work – Fe, Al & Ni
3. Generation of energy - coal, lignite, uranium
4. Designing defense equipments like weapons and ornaments
5. Agricultural purposes – fertilizers and fungicides – Zn & Mn
6. Jewellery – Au, Ag & Pt

7. Making alloys for various purposes
8. Communication purposes – telephone, wires, cables and electronic devices

ENVIRONMENTAL DAMAGES CAUSED BY MINING ACTIVITIES

1. Devegetation:

- ☐ Topsoil and vegetation get removed
- ☐ Deforestation leads to several ecological losses
- ☐ Land scape gets badly affected

2. Ground water contamination: Mining pollutes ground water; sulphur is converted into sulphuric acid which enters into the soil.

3. Surface water pollution: Radioactive wastes and other acidic impurities affect the surface water, which kills many aquatic animals.

4. Air pollution: Smelting and roasting are done to purify the metal which emits air pollutants and damage the nearby vegetation. It causes many health problems.

5. Subsidence of land: Mainly underground mining results in cracks in houses, tilting of buildings and bending of rail tracks.

FOOD RESOURCES

Food is an essential requirement for survival of life. Main components are carbohydrates, fats, proteins, minerals and vitamins

TYPES OF FOOD SUPPLY

1. Crop plants: Grains mostly constitute about 76% of the world's food.

Ex: Rice, Wheat and Maize

2. Range lands: Produces 17% of world's food from trees and grazing animals.

Ex: Fruits, milk and meat

3. Ocean: Fisheries – 7% of world's food

OVER GRAZING

It is a process of eating the forest vegetation without giving a chance to regenerate.

EFFECTS OF OVER GRAZING

1. Land degradation

- ☐ Over grazing removing the cover of vegetation
- ☐ Exposed soil gets compacted

- ☐ Soil moisture reduces.
- ☐ Desertification - OG leads to poor, dry and compacted soil.
- ☐ Land cannot be used for further cultivation.

2. Soil erosion: When the grasses are removed the soil becomes loose and gets eroded by the action of wind and rain fall.

3. Loss of useful species: OG affects the plant population and their regenerating capacity. OG replace the plant of high nutritive value with plant of low nutritive value.

AGRICULTURE

Agriculture is an art, science and industry of managing the growth of plants animals for human use. It includes cultivation of the soil, growing and harvesting crops, breeding and raising livestock, dairying and forestry

TYPES OF AGRICULTURE

1. Traditional agriculture
2. Modern (or) industrialised agriculture

1. Traditional agriculture

Small plot, simple tools, surface water, organic fertilizer and a mixture of crops constitute traditional agriculture. They produce enough food to feed their family and to sell it for their income.

2. Modern agriculture

Hybrid seeds of single crop variety, high tech equipments, lot of fertilisers, pesticides and water to produce large amount of single crops.

ENERGY RESOURCES

ENERGY DISTRIBUTION IN THE WORLD

- ☐ Developed countries like USA and Canada constitute only 5% of the world's population but consume 25% of the world's available energy.
- ☐ Energy consumed by a person in a developed country for a single day is equal to energy consumed by a single person in a poor country for one year.
- ☐ Developed country GNP increases and energy consumption increases. In the poor country GNP and energy consumption are less.

TYPES OF ENERGY RESOURCES:

1. Renewable energy resource (or) Non conventional energy resources
2. Non renewable energy resources (or) Conventional energy resources

RENEWABLE ENERGY SOURCES: Energy which can be regenerated.

Merits of renewable energy resources

1. Unlimited supply
2. Provides energy security.
3. Fits into sustainable development concept.
4. Reliable and the devices are modular in size.
5. Decentralized energy production.

Types of renewable energy resources

1. **Solar energy:** Nuclear fusion reaction of sun produces enormous amount of energy. Several techniques are available for collecting, storing and using solar energy.

a. Solar cell (or) Photovoltaic cell (or) PV cell:

- ☐ Solar cell consists of p- type semi conductor (Si doped with B) and n-type semi conductor (Si doped with P). P-type forms top layer and n-type forms bottom layer.
- ☐ Solar rays fall on the top layer, the electrons from valence band promoted to the conduction band which crosses the p-n junction into n-type semi

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NON RENEWABLE ENERGY SOURCES:

Energy which cannot be regenerated is called as non-renewable.

1. **Coal:** It is a solid fossil fuel.

Disadvantages:

1. When coal is burnt large amount of CO₂ is released which causes global warming.

2. S, N produces toxic gases during burning.

2. **Petroleum:** Crude oil is a liquid consists of more than hundreds of hydrocarbons and small amount of impurities. The petroleum can be refined by fractional distillation. In the world level 25% of oil reserves are in Saudi Arabia. At present rate of usage, the world crude oil reserves are expected to get exhausted in just 40 years

3. **Liquefied petroleum gas (LPG):** Petroleum gases obtained during FD and cracking can be easily converted into liquid under high pressure as LPG. It is colorless and odorless gas, but during cylindering mercaptans are added to detect leakage.

4. **Natural gas:** These are found above oil in oil wells. It is a mixture of methane and other hydrocarbons. Calorific value is high. There are two types. Dry gas and wet gas.

5. **Nuclear energy:** Dr.H.Bhabha is a father of nuclear power development in India. 10 nuclear reactors are present in India. It produces 2% of India's electricity.

Nuclear energy can be produced by two types of reactions. Nuclear fission and nuclear fusion.

Nuclear fission; It is a nuclear change in which heavier nucleus split into lighter nuclei on bombardment of fast moving neutrons. Large amount of energy is released through chain reaction.

ECOSYSTEMS

- The term was first coined by Hons Reiter and Haekel in 1869.

. The term ecology (Okekologie) is originated from two Greek words Oikos (eco) – means “house” (or) place of living and “ology” means “the science of (or) the study of. Hence, ecology is the branch of science that deals with the study of the pattern of relations between the organism and their environment.

FUNDAMENTAL CHARACTERISTICS OF ECOLOGY

STRUCTURE:

- ☐ Living /Biotic
- ☐ Non-Living /Abiotic

PROCESS:

- ☐ Energy flow
- ☐ Cycling of matter

CHANGE:

- ☐ Dynamic (Not static)
- ☐ Succession etc.

FUNCTION:

- ☐ Food chain
- ☐ Food web
- ☐ Ecological pyramids
- ☐ Energy Flow
- ☐ Cycling of matter

CHARACTERISTICS OF ECOSYSTEM

- ☐ Eco system is the basic functional unit of ecology.
- ☐ It contains both biotic and abiotic components.
 - ☐ The function of ecosystem is related to the cycling of matter (materials) and flow of energy.
- ☐ The amount of energy needed to maintain an ecosystem depends on its structure.
- ☐ Ecosystem passes from a less complex state to more complex state, which is called as “**ecological succession**”.

CLASSIFICATION OF ECOSYSTEM:

- ☐ The ecosystem can be generally classified into two types:

1. Natural Ecosystem
2. Artificial Eco system

1. NATURAL ECOSYSTEM:

- ☐ A natural ecosystem is developed and governed by nature.
- ☐ These are capable of operating and maintaining themselves without any major interference by man.
- ☐ The following are the two types of natural ecosystem based on their habitat.
 1. Terrestrial Ecosystem.
 2. Aquatic Ecosystem.

1) Terrestrial Ecosystem:

- ☐ This ecosystem is related to land.

Examples: Grassland ecosystem.

Forest ecosystem, and

Desert ecosystem etc.

2) Aquatic Ecosystem:

- ☐ This ecosystem is related to water, it is further sub divided into two types based on salt content.

i. Fresh Water Ecosystem:

a. Running Water Ecosystems

Examples: Rivers, streams (small narrow rivers)

b. Standing Water Ecosystems

Examples: Pond, lake & well, etc

ii. Marine Ecosystem:

Examples: seas and sea shores <land along the edges of sea>

2. MAN MADE (OR) ARTIFICIAL ECOSYSTEM:

An artificial ecosystem is created and maintained by man for his different needs.

Examples: Reservoirs, Artificial lakes and gardens, etc.

FUNCTION OF AN ECOSYSTEM:

☐ The function of an ecosystem is related to the cycling of materials (matter) and flow of energy.

Types of functions:

☐ Functions of an ecosystem are of three types:

1. Primary Function: The producers (plants) can make their food themselves through photosynthesis. This process is called primary function of eco system.

Examples: All green plants and trees.

2. Secondary Function: The consumers (animals and humans) cannot make their own food. They are always depending upon the producers for their energy. This is called secondary function of eco system.

3. Tertiary Function: Decomposers attack the dead bodies of consumers and producers and decompose them into simpler compounds. During the decomposition inorganic nutrients are released.

A. Food chains

B. Food webs

C. Food pyramids (or) Energy pyramids

D. Energy and material flow.

A. Food Chain:

- ☐ Anything which we eat to live is called food.
- ☐ Food contains energy.
- ☐ Food can be transferred from one organism to the other.
- ☐ The process of transfer of food (energy) from one organism to a series of organisms is called as "**food chain**".
- ☐ A food chain always starts with a plant life and end with animal life. Thus, a food chain is a picture (or) model that shows the flow of energy from autotrophs (producers) to series of organisms in an environment, as shown in the following figure.

Types of food chain:

Three basic types of food **chains** are found in a typical eco system. They are:

1. Grazing food chains.
2. Detritus food chains.
3. Parasitic food chains.

1. Grazing food chains:

☐ Grazing food chain starts with green plants (producers) and goes to decomposer food chain (or) detritus food chain through herbivores and carnivores.

☐ It has two types :

a. Terrestrial food chain and

b. Aquatic food chain

a. **Terrestrial food chain:** Food chain on land is called terrestrial food chain.

Example: Grassland food chain

Forest land food chain

Desert land food chain

Grass land food chain

Grasses > Grasshoppers> Frog >Snake Eagles

Forest food chain

Food Web:

- ☐ Web means “network” such as spider’s web, World Wide Web (WWW) etc.
- ☐ So, food web is a network of food chains.
- ☐ In a food web many food chains are inter connected, where different types of organisms are connected at different trophic levels, so that there are a number of options of eating and being eaten at each trophic level. Thus, there is an inter connecting of various food chains are called food webs and as shown in following figure.

This food web shows many linear food chains <as shown in figure>. These linear food chains are inter connected with other food chains operating in the eco system to form a food web. The grazing food chains are as follows:

- ☐ Grains< Mouse <Cat
- ☐ Grains< Mouse <Hawk
- ☐ Grains <Mouse<Snake< Hawk
- ☐ Grains <Insect <Sparrow <,Hawk
- ☐ Grass<Insect< Lizard <Snake< Hawk
- ☐ Grass< Insect< Sparrow <Snake < HAWK

C. Ecological Pyramids:

- ☐ The concept of ecological pyramids was first developed by British ecologist Charles Elton in 1927.
- ☐ Ecological pyramids are the diagrammatic representation of trophic structures in which the trophic levels (i.e., tiers) are depicted in successive stages.
- ☐ An ecological pyramid is shown in the following figure.

Hawk

The above food web is a simple one. Much more complex food webs do exist in nature.

In ecological pyramids, trophic levels are shown in the following manner:

- i. The producers represent first trophic level in the ecological pyramid.
- ii. The herbivores (or) primary consumers represent second trophic level in the

ecological pyramid.

iii. The carnivores (or) secondary consumers represent third trophic level in the ecological pyramid.

iv. The omnivores (or) tertiary consumers represent fourth trophic level in the ecological pyramid.

• On the basis of the number of organisms, the biomass of organisms and energy flow in organism population. Three types of ecological pyramids are:

1. Pyramid of numbers.
2. Pyramid of biomass
3. Pyramid of energy.

1. Pyramid of numbers:

- ☐ It shows the number of individual organisms present in each trophic level.
- ☐ It is expressed in numbers per unit area.
- ☐ Depending upon the type of ecosystem, we have three types of pyramid of numbers.
 - a. Upright pyramid of numbers.
 - b. Partially upright pyramid of numbers.
 - c. Inverted pyramid of numbers.

2. Partially Upright Pyramid Of Numbers:

- ☐ A forest ecosystem is an example of partially upright pyramid.
- ☐ In a forest ecosystem, big trees are the producers, which are less in number. So, these producers occupy the lower trophic level which is narrow base.
- ☐ The primary consumers (herbivores) are birds, insects, which occupy the II trophic level. Since the number of birds, insects and other species are higher when compared to the trees, the size of which is broader.
- ☐ The secondary consumers (Carnivores) are fox, snakes, lizards, which occupy the third trophic level. Since the number of fox, snakes are lower when compared to the birds, insects the size of which is lower.

□ The tertiary consumers (omnivores) are lion, tiger, which occupy the IV trophic level. Since the number of lion, tiger are lower when compared to the fox and snakes the size of which is very (or) narrow lower. So the pyramid is narrow on both sides and broader in the middle and hence it is called partially upright of number as shown in figure.

MAJOR TYPES OF ECOSYSTEMS

FOREST ECOSYSTEM

Definition: It is a natural ecosystem consisting of dense growth of trees and wild animals

Types:

1. Tropical – deciduous, evergreen, wet green
2. Littoral and swamps
3. Sub tropical

Characteristics:

Abiotic: soil, sun light, temperature etc

Biotic : forest trees, shrubs and animals

AQUATIC ECOSYSTEM

Definition:

Deals with water bodies and biotic communities present in them-Classified as fresh water and marine ecosystems. Fresh water systems are classified as lentic and lotic ecosystems.

A. Pond ecosystem: Small fresh water ecosystem – seasonal in nature – organisms: algae, aquatic plants, insects, fishes etc. Ponds are very often exposed to anthropogenic pressure like cloth washing, bathing, cattle bathing, swimming etc.

B. Lake ecosystem: Big fresh water ecosystem – Zonation or stratification, especially during summer is a common one.

Top layer – shallow, warm, prone to anthropogenic activities – Littoral zone

Second layer – enough sunlight, high primary productivity – Limnetic zone

Third layer – very poor or no sunlight – Profundal zone

Eg. Dal lake in Srinagar, Naini lake in Nainital

Streams: fresh water ecosystem where water current plays a major role. Oxygen and nutrient content are uniform. Stream organisms have to face extreme difference in climatic conditions but they do not suffer from oxygen deficiency as pond and lake organisms. This is because large surface area of running water provides more oxygen supply. The animals have very narrow

>range of tolerance towards oxygen deficiency. Thus stream are worst victims of industrial pollution.

D. River ecosystem: large streams flowing from mountain highlands are rivers.

□ Three phases:

1. Mountain highlands – rushing down water fall of water – large quantity of dissolved oxygen – plants attached to rocks and fishes that require more oxygen are found.

2. Second phase – gentle slopes of hills – warmer – supports the growth of plants and fishes that require less oxygen are seen.

3. Third phase: river shapes the land – lots of silts, nutrients are brought – deposited in plains and delta – very rich in biodiversity.

E. Oceans: Gigantic reservoirs of water covering >70% of earth surface – 2,50,000 species – huge variety of sea products, drugs etc. – provide Fe, Mg, oils, natural gas, sand etc. – major sinks of carbon di oxide – regulate biochemical cycles.

F. Estuary: coastal area where river meet ocean – strongly affected by tidal actions – very rich in nutrients – very rich in biodiversity also – organisms are highly tolerant – many species are endemic – high food productivity – however to be protected from pollution.

GRASSLAND ECOSYSTEM:

Dominated by grass – few shrubs and trees are also found – rainfall average but erratic – overgrazing leads to desertification.

Three types – depending on the climate

- a. **Tropical grass lands** – found near the borders of tropical rain forests. Eg. Savannas in Africa. Animals – Zebra, giraffes etc. – fires are common in dry seasons – termite mounds produce methane – leads to fire – high in photosynthesis – deliberate burning leads to release of high CO₂ – global warming.
- b. **Temperate grasslands** – flat and gentle slopes of hills. Very cold winter and very hot summer - dry summer fires do not allow shrubs and trees to grow – soil is quite fertile – cleaned for agriculture.
- c. **Polar grasslands** – found in arctic polar region – organism – arctic wolf, fox, etc. – A thick layer of ice remains frozen under the soil surface throughout the year – known as permafrost – summer insects and birds appear.

ENDANGERED AND ENDEMIC SPECIES OF INDIA

ENDANGERED SPECIES OF INDIA: A plant, animal or microorganism that is in immediate risk of biological extinction is called endangered species or threatened species. In India, 450 plant species have been identified as endangered species. 100 mammals and 150 birds are estimated to be endangered. India's biodiversity is threatened primarily due to:

1. Habitat destruction
2. Degradation and
3. Over exploitation of resources

Factors affecting endangered species

1. Human beings dispose wastes indiscriminately in nature thereby polluting the air, land and water. These pollutants enter the food chain and accumulate in living creatures resulting in death.
2. Over-exploitation of natural resources and poaching of wild animals also lead to their extinction.
3. Climate change brought about by accumulation of green house gases in the atmosphere. Climate change threatens organisms and ecosystems and they cannot adjust to the changing environmental conditions leading to their death and extinction.

THREATS TO BIODIVERSITY

Due to

1. **Habitat loss** Deforestation activities (cutting trees for timber, removal of medicinal plants)
2. Production of hybrid seeds requires wild plants as raw material, farmers prefer hybrid seeds, many plant species become extinct.
3. Increase in the production of pharmaceutical companies made several number of medicinal plants and species on the verge of extinction.
4. Removal of forest-cover for road laying and also due to soil erosion.
5. Illegal trade of wild life.
6. Population explosion, construction of dam, discharge of industrial effluents use of pesticides.

ENVIRONMENTAL POLLUTION

Definition – Causes, Effects and Control Measures of:- (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Solid Waste Management:- Causes, Effects and Control Measures of Urban and Industrial Wastes – Role of an Individual in Prevention of Pollution – Pollution Case Studies – disaster Management:- Floods, Earthquake, Cyclone and Landslides

• **Pollution** may be defined as an undesirable change in the physical, chemical or biological characteristics of air, water and land that may be harmful to human life and other animals, living conditions, industrial processes and cultural assets. Pollution can be natural or manmade.

□ The agents that pollute are called pollutants.

POLLUTANTS

Pollutants are by-products of man's action. The important pollutants are summarized below:

- **Deposited matter**—Soot, smoke, tar or dust and domestic wastes.
- **Gases**—CO, nitrogen oxides, sulphur oxides, halogens

- **Metals**—Lead, zinc, iron and chromium.
- **Industrial pollutants**—Benzene, ether, acetic acid etc., and cyanide compounds.
- **Agriculture pollutants**—Pesticides, herbicides, fungicides and fertilizers.
- **Photochemical pollutants**—Ozone, oxides of nitrogen, aldehydes, ethylene, photochemical smog and proxy acetyl nitrate.
- **Radiation pollutants**—Radioactive substances and radioactive fall-outs of the nuclear test.

TYPES OF POLLUTION

AIR POLLUTION

Air pollution is one such form that refers to the contamination of the air, irrespective of indoors or outside. A physical, biological or chemical alteration to the air in the atmosphere can be termed as pollution. It occurs when any harmful gases, dust, smoke enters into the atmosphere and makes it difficult for plants, animals and humans to survive as the air becomes dirty.

The WHO defines **air pollution** as the presence of materials in the air in such concentration which are harmful to man and his environment. A number of ingredients find their way in the air and these are mostly gases, which rapidly spread over wide areas.

Types of Air Pollutants

☐ **Primarily air pollutants** can be caused by primary sources or secondary sources. The pollutants that are a direct result of the process can be called primary pollutants. A classic example of a primary pollutant would be the sulfur-dioxide emitted from factories

☐ **Secondary pollutants** are the ones that are caused by the inter mingling and reactions of primary pollutants. Smog created by the interactions of several primary pollutants is known to be as secondary pollutant.

Equipment used to control air pollution

Air pollution can be reduced by adopting the following approaches.

1. Ensuring sufficient supply of oxygen to the combustion chamber and adequate temperature so that the combustion is complete thereby eliminating much of the smoke consisting of partly burnt ashes and dust.

2. To use mechanical devices such as scrubbers, cyclones, bag houses and electrostatic precipitators in manufacturing processes. The equipment used to remove particulates from the exhaust gases of electric power and industrial plants are shown below. All methods retain hazardous materials that must be disposed safely. Wet scrubber can additionally reduce sulphur dioxide emissions.
3. The air pollutants collected must be carefully disposed. The factory fumes are dealt with chemical treatment.

WATER POLLUTION

Water pollution may be defined as "the alteration in physical, chemical and biological characteristics of water which may cause harmful effects on humans and aquatic life."

Sources of water pollution

1. **Point sources:** These are pollutants that are discharged at specific locations through pipes, ditches or sewers into bodies of surface waters.

Ex: Factories, sewage treatment plants, abandoned underground mines and oil tankers.

2. **Non point sources:** These pollutants cannot be traced to a single point of discharge. They are large land areas or air-sheds that pollute water by runoff, subsurface flow or deposition from the atmosphere.

Ex: Acid deposition, runoff of chemicals into surface water from croplands, livestock feedlots, logged forests, urban streets, lawns, golf courses and parking lots.

Control measures of water pollution

1. Administration of water pollution control should be in the hands of state or central government
2. Scientific techniques should be adopted for environmental control of catchment areas of rivers, ponds or streams
3. Industrial plants should be based on recycling operations as it helps prevent disposal of wastes into natural waters but also extraction of products from waste.
4. Plants, trees and forests control pollution as they act as natural air conditioners.
5. Trees are capable of reducing sulphur dioxide and nitric oxide pollutants and

hence more trees should be planted.

6. No type of waste (treated, partially treated or untreated) should be discharged into any natural water body. Industries should develop closed loop water supply schemes and domestic sewage must be used for irrigation.

7. Qualified and experienced people must be consulted from time to time for effective control of water pollution.

8. Public awareness must be initiated regarding adverse effects of water pollution using the media.

9. Laws, standards and practices should be established to prevent water pollution and these laws should be modified from time to time based on current requirements and technological advancements.

Effects of Thermal pollution

1. Reduction in dissolved oxygen: Concentration of Dissolved Oxygen (DO) decreases with increase in temperature.

2. Increase in toxicity: The rising temperature increases the toxicity of the poison present in water. A 10°C increase in temperature of water doubles the toxicity effect of potassium cyanide, while 80°C rise in temperature triples the toxic effects of o-xylene causing massive mortality to fish.

3. Interference in biological activity: Temperature is considered to be of vital significance to physiology, metabolism and biochemical processes that control respiratory rates, digestion, excretion, and overall development of aquatic organisms. Temperature changes cause total disruption to the entire ecosystem.

4. Interference in reproduction: In fishes, several activities like nest building, spawning, hatching, migration and reproduction depend on optimum temperature.

5. Direct mortality: Thermal pollution is directly responsible for mortality of aquatic organisms. Increase in temperature of water leads to exhaustion of microorganisms thereby shortening the life span of fish. Above a certain temperature, fish die due to failure of respiratory system and nervous system failure.

6. Food storage for fish: Abrupt changes in temperature alter the seasonal variation in the type and abundance of lower organisms leading to shortage of right

food for fish at the right time.

Control measures for thermal pollution The following methods can be adapted to control high temperature caused by thermal discharges: 87 Environmental Science AITT & H&S

1. Cooling towers: Use of water from water systems for cooling systems for cooling purposes, with subsequent return to the water way after passage through a condenser, is called cooling process. Cooling towers transfer heat from hot water to the atmosphere by evaporation. Cooling towers are of two types:

- (i) **Wet cooling tower:** Hot water coming out from the condenser (reactor) is allowed to spray over baffles. Cool air, with high velocity, is passed from sides, which takes away the heat and cools the water.
- (ii) **(ii) Dry cooling tower:** Here, hot water is allowed to flow in long spiral. Cool air with the help of a fan is passed over these hot pipes, which cools down hot water. This cool water can be recycled

2. Cooling ponds: Cooling ponds are the best way to cool thermal discharges. Heated effluents on the surface of the water in cooling ponds maximize dissipation of heat to the atmosphere and minimize the water area and volume. The warm water wedge acts like a cooling pond.

3. Spray ponds: The water coming out from condensers is allowed to pass into the ponds through sprayers. Here water is sprayed through nozzles as fine droplets. Heat from the fine droplets gets dissipated to the atmosphere.

4. Artificial lakes: Artificial lakes are manmade water bodies that offer once-through cooling. The heated effluents can be discharged into the lake at one end and water for cooling purposes may be withdrawn from the other end. The heat is eventually dissipated through evaporation

NOISE POLLUTION

Noise is defined as, "the unwanted, unpleasant or disagreeable sound that causes discomfort to all living beings". Sound intensity is measured in decibels (dB), that is the tenth part of the longest unit Bel. One dB is the faintest sound that a human

ear can hear.

Types of noise: Environmental noise has been doubling every ten years. Noise is classified as:

1. Industrial Noise
2. Transport Noise
3. Domestic Noise

Effects of Noise pollution

☐ Noise pollution affects both human and animal health. It leads to:

- contraction of blood vessels
- making skin pale
- Excessive adrenalin in the blood stream which is responsible for high blood pressure.
- Blaring sounds are known to cause mental distress
- Heart attacks, neurological problems, birth defects and abortion
- ☐ Muscle contraction leading to nervous breakdown, tension, etc

- The brain is adversely affected by loud and sudden noise by jets and airplanes. People are subjected to psychiatric illness.

☐ Recent reports suggest that blood is thickened by excessive noise.

☐ The optical system of human beings is also affected by noise pollution. Severe noise pollution causes:

- Popularly dilation
- Impairment of night vision and
- Decrease in rate of color perception

Effects of Nuclear Pollution

Studies have shown that the health effects due to radiation are dependent on the level of dose, kind of radiation, duration of exposure and types of cells irradiated. Radiation effects can be somatic or genetic

1. Somatic effects: Somatic affects the function of cells and organs. It causes damages to cell membranes, mitochondria and cell nuclei resulting in abnormal cell

functions, cell division, growth and death.

2. Genetic effects: Genetic effects the future generations. Radiations can cause mutations, which are changes in genetic makeup of cells. These effects are mainly due to the damages to DNA molecules. People suffer from blood cancer and bone

3. SOLID WASTE MANAGEMENT

Rapid population growth and urbanization in developing countries has led to people generating enormous quantities of solid waste and consequent environmental degradation. The waste is normally disposed in open dumps creating nuisance and environmental degradation. Solid wastes cause a major risk to public health and the environment. Management of solid wastes is important in order to minimize the adverse effects posed by their indiscriminate disposal

Types of solid wastes

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

1. Urban or municipal wastes
2. Industrial wastes
3. Hazardous wastes

☐ **Sources of urban wastes:** 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.

LANDSLIDES

☐ Landslides occur when mass of earth material move downward. It is also called mass wasting or mass movement.

☐ sudden landslide occurs when unconsolidated sediments of a hillside are saturated by rainfall or water logging.

☐ Many landslides take place in coincidence with earthquakes. The most common form of landslides is earthquake induced landslides or more specifically rock falls and slides of rock fragments that form on steep slopes.

☐ The size of area affected by earthquake induced landslides depends on the magnitude of the earthquake, its focal depth, the topography and geologic conditions near the causative fault, the amplitude, frequency, composition and duration of ground shaking.

Control measures for landslides

☐ Avoid construction activity in landslide occurring areas.

☐ Reducing slope of hilly side

☐ Stabilizing the slope portion

☐ Increasing plantation of deep rooted vegetation on the slope.

EARTHQUAKES

☐ An earthquake occurs when rocks break and slip along a fault in the earth. Earthquakes occur due to deformation of crust and upper mantle of the earth.

☐ Due to heating and cooling of the rock below these plates, movement of adjacently overlying plates and great stresses, deformation occurs.

☐ Tremendous energy cans build-up between neighboring plates.

☐ If accumulated stress exceeds the strength of the rocks, the rocks break suddenly releasing the stored energy as an earthquake.

☐ The earthquake releases energy in the form of waves that radiate from the epicenter in all directions.

☐ The 'p' wave or primary wave alternately compresses and expands material in the same direction it is travelling.

☐ This wave can move through solid rocks and fluids.

Rainwater harvesting. It is a technique of collecting and storing rain water for use in non-monsoon periods. In the present age, concrete houses, well-built roads, footpaths and well –concreted courtyards have left few open grounds. With the decrease in natural forest cover, increase in concrete jungles and the decrease in exposed earth; very little open ground is left for water to soak in and thereby increase the ground water table. So, artificial recharging of the ground water is extremely essential. It is done through rain water harvesting. For the purpose, rain water is collected at the roof top or in an open well and then carried down for immediate use or it is directed into the aquifer.

OZONE LAYER DEPLETION

Ozone gas is present in the atmosphere. It is highly concentrated at the stratosphere Between 10 to 50 Km above the sea level and is called as ozone layer.

Importance: O_3 protects us from damaging UV radiation of the sun. It filters UV- B radiation. Now days certain parts of O_3 layer is becoming thinner and O_3 holes are formed. Because of this more UV–B radiation reaches the earth's surface. UV –B radiation affects DNA molecules, causes damages to the outer cell of plants and animals.

AIR PREVENTION ACT 1981

This act was enacted in the conference held at Stock Holm. It envisages the establishments Of central and State control boards to monitor air quality and pollution control.

Important features:

1. The central board may lay down the standards for quality of air.
2. The central board co-ordinates and settle the disputes between state boards.
3. The central board provides technical assistance and guidance to state boards.
4. The state boards are empowered to lay down the standards for emission of air pollutants from industries or other resources.
5. The state boards are to examine the manufacturing processes and control equipment for for the prescribed standards.
6. The direction of central board is mandatory on state boards.

FOREST (CONSERVATION) ACT 1980

This act is enacted in 1980. It aims to arrest deforestation. This act covers all types of Forests including reserved forests, protected forests and any forest land.

IMPORTANT Features of the act :

- 1.The reserved forests shall not be diverted or dereserved without the permission Of central govt.
- 2.The forest land may not be used nonforest purposes.
- 3.This act stops illegal activities within forest area.

WILD LIFE ACT 1972.

This act was amended in 1983, 1986, and 1991. This act is aimed to protect and preserve all animals and plants that are not Domesticated. India has 350 species of mammals, 1200 species of birds and about 20000 Known species of insects. Some of them are listed as endangered species in wild life protection act. Wild life is declining due to human action. Wild life products like skins, furs, feathers, Ivory etc. have decimated the population of many species. Wild life population monitored regularly and management strategies formulated to protect .

Important Features

- 1The act covers the rights and non- rights of forest dwellers.
- 2It allows restricted grazing in sanctuaries but prohibits in national parks.

ENVIRONMENT (PROTECTION) ACT 1986

This act empowers the central govt. to fix the standards for quality of air, water, soil, and noise. The central govt. formulates procedures and safe guards for handling of hazard substances.

Important features: 1. this act empowers the govt. to lay down procedures and safe guards for the prevention of accidents which cause pollution and remedial measures if accidents occur.

2 The govt.has the authority to close or prohibit or regulate any industry or its operation if

The violation of provisions of the act occurs